

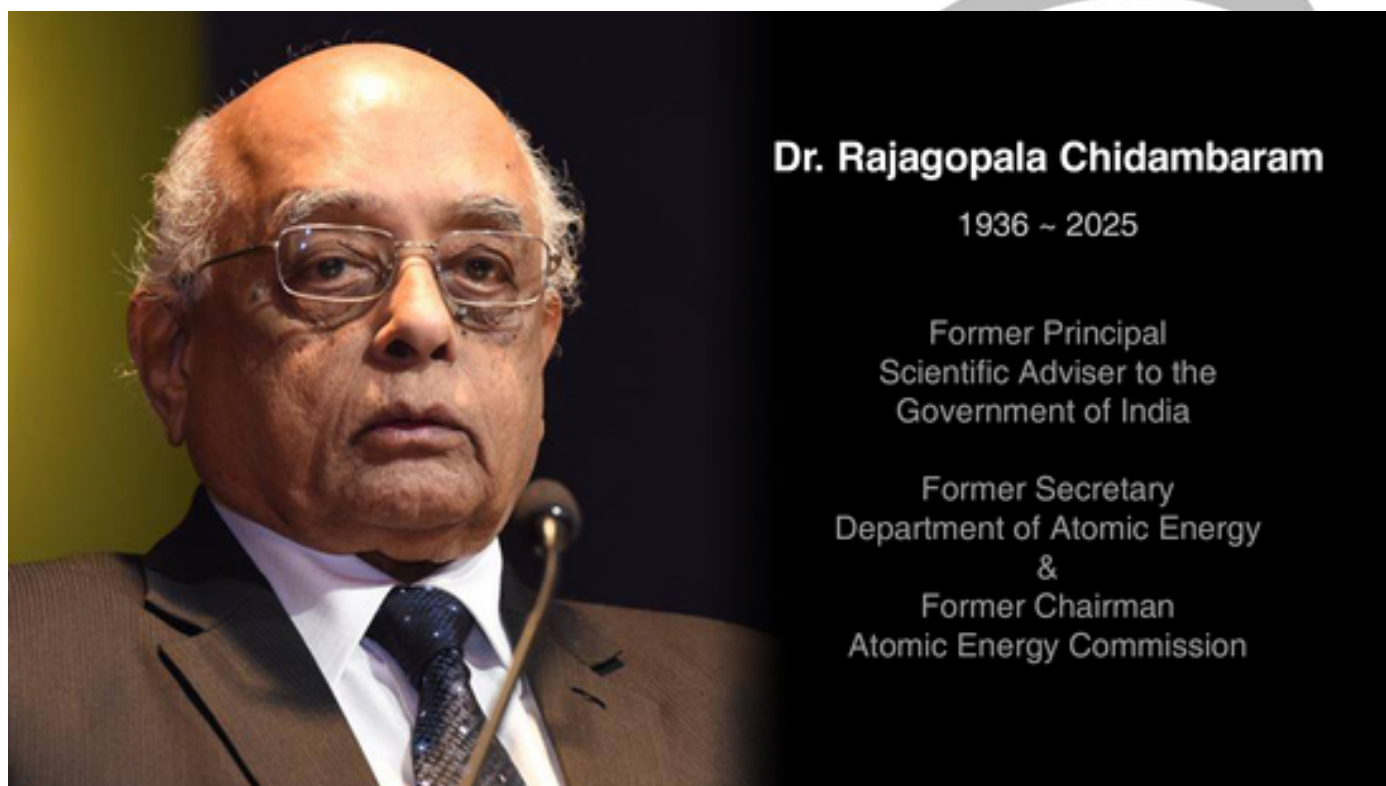


India's Nuclear Programme

[Source: IE](#)

Why in News?

Eminent physicist, scientist, former Chairman of the [Atomic Energy Commission \(AEC\)](#) and a **key architect of India's nuclear programme** **Dr. Rajagopala Chidambaram** recently passed away.



Key Contributions of Dr. Rajagopala Chidambaram

- **Scientific Achievements:** Solved the "equation of state" for plutonium (1967), advancing nuclear fission and [materials science](#).
 - Led India's indigenous [supercomputer](#) development.
- **Leadership in Nuclear Tests:** [Smiling Buddha \(1974\)](#) and [Operation Shakti \(1998\)](#).
- **Key Positions:** Director of [BARC](#), Chairman of [Atomic Energy Commission \(AEC\)](#), Chairman of [IAEA](#) Board of Governors.
 - Principal Scientific Advisor (2002-2018), overseeing initiatives like [RuTAG](#) and [National Knowledge Network \(NKN\)](#).
- **Awards:** [Padma Shri \(1975\)](#) and [Padma Vibhushan \(1999\)](#) for contributions to science.

What is India's 3-Stage Nuclear Power Programme?

- **About:** India's **3-Stage Nuclear Power Programme** is designed to harness the nation's nuclear resources for sustainable energy production while **ensuring long-term energy security**. It was formulated by well-known physicist **Dr. Homi Bhabha**.
- **Objective:** It focuses on **efficiently using India's limited uranium resources** while **maximizing the potential of thorium**, which is more abundant in the country.
- **3 Stages:**

Stage	Aim	Fuel/Coolant/ Moderator	Nuclear Reactor	Current Status
Stage 1	<p>It aims to generate electricity while producing plutonium-239 (Pu-239) as a byproduct.</p> <ul style="list-style-type: none">▪ Plutonium is key for the next stages of the	<p>Fuel: Uranium (U-238)</p> <p>Moderator: Heavy water (deuterium oxide)</p>	Pressurized Heavy Water Reactors (PHWRs)	India has already constructed 18 PHWRs, as the foundation of India's nuclear power infrastructure.
Stage 2	<p>It focuses on Fast Breeder Reactors (FBRs), which utilize Pu-239 from the first stage to generate more fissile material than they consume.</p> <ul style="list-style-type: none">▪ These reactors convert fertile uranium-238 into Pu-239, enhancing the nuclear fuel cycle efficiency and providing a sustainable fuel source.	Mixed Oxide of Plutonium-239 and Uranium-238	Fast Breeder Reactors (FBRs)	The Prototype FBR at Kalpakkam, Tamil Nadu , is a key development in this stage.
Stage 3	It focuses on Thorium Reactors , which use Thorium-232 to produce	Thorium-232 (converted into Uranium-233)	Thorium-Based Reactors (Thorium Cycle)	Research into thorium-based reactors is ongoing, with the Advanced Heavy Water Reactor

	<p>uranium-233, a fissile material.</p> <ul style="list-style-type: none"> ▪ Leveraging India's abundant thorium reserves, this stage offers a long-term solution for nuclear fuel needs, ensuring sustainable energy security. 			<p>(AHWR) being developed as part of this stage.</p>
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India Nuclear Weapon Programme

- **Smiling Buddha (1974):** [Smiling Buddha](#) was the codename of India's **first successful nuclear test**, conducted at **Pokhran** in Rajasthan, marking India as the **sixth nuclear-capable nation** after the **US, Soviet Union, United Kingdom, France, and China**.
- **Operation Shakti (1998):** [Operation Shakti](#) (Pokhran-II) was a series of **five nuclear tests** under **Operation Shakti**, including a **thermonuclear bomb**.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. In India, why are some nuclear reactors kept under “IAEA safeguards” while others are not? (2020)

- (a) Some use uranium and others use thorium
- (b) Some use imported uranium and others use domestic supplies
- (c) Some are operated by foreign enterprises and others are operated by domestic enterprises
- (d) Some are State-owned and others are privately owned

Ans: (b)