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India's Indigenous Fast Breeder Reactor at Kalpakkam Attains Criticality

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Prime Minister Narendra Modi hailed a major milestone as India's first indigenous Prototype Fast Breeder Reactor (PFBR) at Kalpakkam attained criticality, marking a significant step in the country's civil nuclear programme.

Key Highlights

PFBR achieved criticality (self-sustaining nuclear chain reaction) on 6 April 2026.

It is a 500 MWe (megawatt electric) reactor developed indigenously.

Considered a "defining step" in India's nuclear journey by the Prime Minister.

Represents advancement in Atmanirbhar Bharat (self-reliance in nuclear technology).

Marks entry into the second stage of India's three-stage nuclear programme.

What is 'Criticality'?

A stage where a nuclear fission reaction becomes self-sustaining.

Each fission produces enough neutrons to continue the reaction at a steady rate.

It is a key milestone before commercial power generation.

About Fast Breeder Reactor (FBR)

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Produces more fissile fuel than it consumes.

Uses fast neutrons instead of slow neutrons.

Converts:

Uranium-238 → Plutonium

Thorium-232 → Uranium-233

Uses liquid sodium as coolant.

Significance of the Achievement

Boosts energy security and nuclear fuel self-reliance.

Enables efficient use of India's vast thorium reserves.

Places India among few countries with advanced FBR technology.

Supports clean energy transition (low carbon emissions)

Strengthens India's position in advanced nuclear technology globally

India's Three-Stage Nuclear Programme

(Conceptualised by Homi J. Bhabha)

Stage 1 → Pressurised Heavy Water Reactors (PHWRs) using natural uranium

Stage 2 → Fast Breeder Reactors (like PFBR) using plutonium

Stage 3 → Thorium-based reactors (U-233 fuel cycle)

About PFBR:

Developed by: BHAVINI (Bharatiya Nabhikiya Vidyut Nigam Ltd.)

Designed by: Indira Gandhi Centre for Atomic Research (IGCAR)

Location: Tamil Nadu

Fuel: MOX (Mixed Oxide fuel – Uranium + Plutonium)

Coolant: Liquid sodium

Expected commercial operation: 2026 (post commissioning phase)

Additional Important Points

India may become second country after Russia to operate a commercial-scale FBR.

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Thorium reserves are mainly found in:

Kerala, Tamil Nadu, Odisha, Andhra Pradesh coasts

FBR helps:

Reduce nuclear waste

Increase fuel efficiency significantly

Nuclear energy contributes to India's Net Zero target (2070)