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Maharashtra Signs Nuclear MoUs Worth ₹6.5L Crore for 25,400 MW — India's Nuclear Expansion

20 May 2026 · ECONOMY · SCIENCE & TECH · ENVIRONMENT · GS3

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Maharashtra Signs Nuclear MoUs Worth ₹6.5L Crore for 25,400 MW — India's Nuclear Expansion

20 May 2026 · 11 min read · 3 tags

WHY IN NEWS:

The **Maharashtra government** signed **Memoranda of Understanding (MoUs) worth approximately ₹6.5 lakh crore** in **May 2026** for nuclear energy projects totalling **25,400 MW** of installed capacity. The agreements — covering multiple sites in the state including the long-delayed **Jaitapur Nuclear Power Project** — are the largest nuclear investment commitments by any Indian state and form a key pillar of India's national target of **100 GW of nuclear power by 2047** under **Vision 2047**.

BACKGROUND: INDIA'S NUCLEAR ENERGY TARGETS

India's civilian nuclear programme has historically been modest relative to the country's energy ambitions. As of early 2026, the country's **total installed nuclear capacity stands at approximately 7,480 MW** from **22 operational reactors** across seven sites, all operated by the **Nuclear Power Corporation of India Limited (NPCIL)**.

The government has set an ambitious roadmap:

TARGET	CAPACITY	TIMELINE
Current operational capacity	~7,480 MW	As of May 2026
Under construction / committed	~6,700 MW	2026–2031
Vision 2047 nuclear target	**100 GW**	By 2047
Share of electricity mix (2047 goal)	~25%	By 2047

Achieving 100 GW from the current ~7.5 GW base requires roughly a **13-fold expansion in 21 years** — an unprecedented pace that demands both domestic manufacturing scale-up and large foreign investment partnerships.

THE MAHARASHTRA MOUS: KEY DETAILS

The Maharashtra MoUs aggregate multiple investment agreements signed at the **Magnetic Maharashtra 2.0 / Global Investors Summit** framework and bilateral government-to-government negotiations. The total portfolio covers **25,400 MW** across new-build nuclear sites in the state.

MoU Summary Table

PROJECT / PARTNER	TECHNOLOGY	CAPACITY	ESTIMATED INVESTMENT
Jaitapur Nuclear Power Project (NPCIL + EDF/Framatome)	EPR (Evolutionary Power Reactor)	9,900 MW (6 × 1,650 MW)	~₹1.5–2 lakh crore (est.)
Additional NPCIL fleet expansion (Maharashtra sites)	PHWR / future technologies	~8,000 MW	~₹1.8 lakh crore (est.)
ASHVINI (NPCIL 51%–NTPC 49% JV)	PHWR / SMR pathway	~4,000 MW	~₹1 lakh crore (est.)
Adani / private PSU JV pipeline (subject to Atomic Energy Act amendment)	To be determined	~3,500 MW	~₹1 lakh crore (est.)
Total (all MoUs)	Mixed	**25,400 MW**	**~₹6.5 lakh crore**

> *Individual MoU investment figures are government estimates; actual costs depend on finalised reactor models, financing terms, and construction timelines. EPR cost overruns in Europe (Flamanville, Hinkley Point C) make precise estimates inherently uncertain.*

JAITAPUR NUCLEAR POWER PROJECT — DEEP DIVE

The **Jaitapur Nuclear Power Project (JNPP)** is the centrepiece of Maharashtra's nuclear ambitions and, if completed, will be the **largest nuclear power plant in the world by installed capacity**.

Key Facts

PARAMETER	DETAIL
Location	Madban village, **Ratnagiri district**, Konkan coast, Maharashtra
Reactors	6 × **EPR (Evolutionary Power Reactor)**
Capacity per reactor	1,650 MW
Total installed capacity	**9,900 MW**
Foreign partner	**EDF (Électricité de France) / Framatome** (France)
Indian partner	**NPCIL**
Site area	~968 hectares
Land acquisition status	Largely completed (2010–2012); ongoing court challenges
First reactor target	Revised multiple times; current target ~2031–2033
Nuclear safety regulator	**Atomic Energy Regulatory Board (AERB)**

EPR Reactor Technology

The **Evolutionary Power Reactor (EPR)** is a **Generation III+** pressurised water reactor (PWR) designed by **Framatome** (formerly AREVA), jointly developed with **Siemens**. It is among the most powerful commercial reactor designs in operation.

FEATURE	SPECIFICATION
Reactor type	Pressurised Water Reactor (PWR)
Generation	Gen III+
Capacity	**1,650 MW (electric)**
Fuel	Low-enriched uranium (UO_2); MOX-capable
Design life	60 years
Core damage frequency	$< 10^{-5}$ per reactor-year
Operational EPRs globally	Taishan 1 & 2 (China); Olkiluoto 3 (Finland)
Under construction	Flamanville 3 (France), Hinkley Point C (UK)

Jaitapur: Challenges and Controversies

1. Land Acquisition and Local Opposition Local fishing and farming communities in Madban and surrounding villages have opposed the project since 2010, citing threats to coastal livelihoods, the Konkan mango belt (Alphonso GI tag), and seismic risks. The Konkan coast lies near seismically active zones.

2. Cost and Financing EPR projects in Europe have suffered severe cost overruns — Flamanville 3's cost rose from €3.3 billion (2006 estimate) to over €13 billion (2024 revised). India seeks a competitive per-unit cost through economies of scale (6 reactors at one site) and indigenisation.

3. Civil Liability for Nuclear Damage Act, 2010 (CLND) The **CLND Act's Section 17(b)** allows NPCIL to pursue the equipment supplier for damages in the event of a nuclear accident caused by supplier defect. This **supplier liability clause** has been a major sticking point for EDF/Framatome, as it diverges from the **Convention on Supplementary Compensation for Nuclear Damage (CSC)** framework, which channels all liability to the operator. India ratified the CSC in 2016, but the domestic CLND Act's wording remains unchanged — creating legal ambiguity that foreign suppliers view as a commercial risk.

4. Strategic Significance Jaitapur is a cornerstone of the **Indo-French strategic partnership**. It was a deliverable of the 2008 civil nuclear deal with France and has been referenced in every India–France summit since. The **2023 Bastille Day visit of PM Modi to France** and the **2024 Republic Day visit of President Macron** both included Jaitapur progress as an agenda item.

NUCLEAR LEGAL FRAMEWORK — SHANTI ACT, 2025 (REPLACED AEA 1962)

[UPDATE: The Atomic Energy Act, 1962 was repealed by the SHANTI Act, 2025, which received Presidential assent in December 2025.]

The **Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India (SHANTI) Act, 2025** replaced both the Atomic Energy Act, 1962 and the Civil Liability for Nuclear Damage Act, 2010, fundamentally restructuring India's nuclear legal framework.

Key Changes Under SHANTI Act, 2025

PROVISION	EFFECT
Private sector participation	Private Indian companies and JVs can now build, own, operate, and decommission nuclear power plants under a government licence — the six-decade-old state monopoly is ended
Foreign investment	FDI up to **49%** permitted in specified nuclear activities under the automatic route
Retained government control	Enrichment of nuclear material, production of heavy water, and management of spent fuel beyond on-site storage remain with the Central Government
AERB status	Atomic Energy Regulatory Board (AERB) given formal statutory independence as the sector regulator
Supplier liability	Supplier liability provisions of the erstwhile CLND Act removed; operator liability capped based on plant capacity — aligning with international conventions (CSC)
Weapons material	Controlled by Department of Atomic Energy (DAE) — unchanged

PSU Joint Ventures (Pre-SHANTI)

Under the 2022–2023 amendments to the Atomic Energy Rules, the first PSU–PSU joint venture was permitted:

- **ASHVINI (Anushakti Vidhyut Nigam Ltd.)** — a JV between NPCIL (51%) and NTPC Ltd (49%), approved by the Government on September 11, 2024. ASHVINI can build and operate nuclear plants with NPCIL as the technology and safety backstop. Under SHANTI, private companies can now also form JVs or independently develop nuclear plants.

The MoUs signed by Maharashtra at the Magnetic Maharashtra 2.0 summit, which include potential private sector investment pipelines, are now legally viable under the SHANTI Act framework.

CIVIL LIABILITY FOR NUCLEAR DAMAGE ACT, 2010 (CLND) — NOW REPEALED BY SHANTI ACT

[NOTE: The CLND Act, 2010 was repealed by the SHANTI Act, 2025 (December 2025). The SHANTI Act removes supplier liability and caps operator liability by plant capacity, aligning India with international conventions. The provisions below are historical context explaining why the CLND Act was a barrier to Jaitapur and other projects for over a decade.]

The **Civil Liability for Nuclear Damage Act, 2010** had established the liability regime for nuclear accidents in India, implementing India's ratification of the **Convention on Supplementary Compensation for Nuclear Damage (CSC)**.

Key Provisions

SECTION	PROVISION
Section 6	Operator (NPCIL) is strictly liable for nuclear damage — no proof of negligence required
Section 7	Operator's liability capped at **₹1,500 crore per incident**
Section 8	Central Government covers damages beyond operator cap (unlimited liability in practice)
Section 17(a)	Operator right of recourse against supplier if accident caused by **wilful act or gross negligence**
Section 17(b)	Operator right of recourse against supplier if **nuclear contract includes such a clause** (controversial)
Section 46	Preserves rights under other laws — broader civil and criminal liability pathway

The Section 17(b) Controversy

Section 17(b) is unique globally — it allows NPCIL to seek indemnity from the equipment supplier not just for wilful fault but through **contractual inclusion of supplier liability clauses**. Western reactor vendors (EDF, Westinghouse, GE-Hitachi) argue this creates **open-ended financial risk** for suppliers, making nuclear project insurance and financing difficult. The International Atomic Energy Agency (IAEA) has noted India's CLND framework diverges from international norms.

Various workarounds have been proposed — **nuclear insurance pools**, **government-backed indemnity funds**, and **side letters** — but no final resolution has been reached, partly explaining the decades-long delay at Jaitapur.

INDIA'S NUCLEAR POWER PLANTS — CURRENT OPERATIONAL FLEET

STATION	STATE	OPERATOR	REACTORS	CAPACITY
Tarapur	Maharashtra	NPCIL	4 (BWR + PHWR)	1,400 MW
Rawatbhata (RAPS)	Rajasthan	NPCIL	6 (PHWR)	1,180 MW
Kudankulam (KKNPP)	Tamil Nadu	NPCIL	4 (VVER-1000; Units 3&4 in commissioning)	2,000 MW (operational)
Kalpakkam (MAPS)	Tamil Nadu	NPCIL	2 (PHWR)	440 MW
Narora (NAPS)	Uttar Pradesh	NPCIL	2 (PHWR)	440 MW
Kakrapar (KAPS)	Gujarat	NPCIL	4 (PHWR)	920 MW
Kaiga (KGS)	Karnataka	NPCIL	4 (PHWR)	880 MW
Fast Breeder Reactor (PFBR)	Tamil Nadu (Kalpakkam)	BHAVINI	1 (FBR; commissioning)	500 MW
Total (operational)	—	—	**~22**	**~7,480 MW**

INDIA'S THREE-STAGE NUCLEAR PROGRAMME

India's nuclear strategy follows the **Three-Stage Programme** conceived by **Dr. Homi J. Bhabha** to achieve **thorium fuel self-sufficiency** — India holds approximately **25% of global thorium reserves**.

STAGE	REACTOR TYPE	FUEL	GOAL
Stage 1	PHWR (Pressurised Heavy Water Reactor)	Natural uranium	Produce plutonium
Stage 2	FBR (Fast Breeder Reactor)	Plutonium + thorium	Breed U-233 from thorium
Stage 3	Advanced Heavy Water Reactor (AHWR)	U-233 / thorium	Full thorium cycle

The **Prototype Fast Breeder Reactor (PFBR)** at Kalpakkam, operated by **BHAVINI (Bharatiya Nabhikiya Vidyut Nigam Limited)**, marked India's transition from Stage 1 to Stage 2. It achieved **first criticality in September 2024** and is approaching full-power commissioning.

NUCLEAR ENERGY: ENVIRONMENT AND CLIMATE DIMENSION

Nuclear power is a **low-carbon, baseload energy source** — critical for India's climate commitments:

- India's **Nationally Determined Contribution (NDC)** under the **Paris Agreement** targets **50% non-fossil electricity capacity by 2030** and **net-zero by 2070**.
- Nuclear's **lifecycle carbon emissions** (~12 gCO_2/kWh) are comparable to wind energy and far below coal (~820 gCO_2/kWh).
- Unlike solar/wind, nuclear provides **firm, dispatchable power** — not dependent on weather.
- The **25,400 MW** proposed for Maharashtra alone would, if realised, displace approximately **130–150 million tonnes of CO_2 per year** (vs. coal at same capacity factor).

UPSC RELEVANCE

GS Paper 3 — Energy, Economy, Environment, S&T

DIMENSION	RELEVANCE
Energy Security	Nuclear as baseload complement to renewables; reducing coal dependence
Science & Technology	EPR reactor design; Three-Stage Programme; PHWR/FBR/AHWR pathway
Economy	₹6.5 lakh crore investment; Make in India (reactor component localisation); NPCIL structure
Environment	Low-carbon baseload; nuclear vs. coal lifecycle emissions; site ecology concerns (Konkan coast)
Governance / Polity	SHANTI Act 2025 (replaced AEA 1962 and CLND 2010); private sector opening; AERB statutory independence; ASHVINI PSU-JV model
International Relations	Indo-French strategic partnership; Jaitapur as diplomatic deliverable; NSG membership linkage

Possible Mains Questions:

- "The SHANTI Act, 2025 fundamentally restructures India's nuclear legal framework. Analyse the key changes it introduces and evaluate their impact on India's ability to attract foreign nuclear investment and achieve its 100 GW target by 2047." (250 words, GS3)
- "Critically examine India's Three-Stage Nuclear Programme in the context of the country's 100 GW nuclear target by 2047." (250 words, GS3)

- “Nuclear energy is indispensable for India’s net-zero journey. Discuss with reference to India’s current capacity, policy framework, and challenges.” (250 words, GS3)

FACTS CORNER

INDIA'S NUCLEAR CAPACITY (MAY 2026):

Total operational: ~7,480 MW from 22 reactors across 7 sites

All operated by NPCIL (Nuclear Power Corporation of India Limited)

Target: 100 GW by 2047 (Vision 2047)

JAITAPUR NUCLEAR POWER PROJECT:

Location: Madban, Ratnagiri district, Maharashtra (Konkan coast)

Capacity: 9,900 MW (6 × 1,650 MW EPR reactors) — largest nuclear plant in world by capacity when complete

Partner: EDF / Framatome (France)

Reactor: EPR (Evolutionary Power Reactor) — Generation III+, PWR design

Operational EPRs: Taishan 1 & 2 (China), Olkiluoto 3 (Finland)

LEGAL FRAMEWORK:

SHANTI Act, 2025 — Enacted December 2025; replaced both Atomic Energy Act 1962 and CLND Act 2010; opens nuclear sector to licensed private companies; permits FDI up to 49%; removes supplier liability; gives AERB statutory independence

Atomic Energy Act, 1962 — REPEALED by SHANTI Act, 2025 (had given Central Government monopoly; private sector excluded for six decades)

CLND Act, 2010 — REPEALED by SHANTI Act, 2025 (had imposed Section 17(b) supplier liability clause that blocked foreign nuclear investment)

ASHVINI (Anushakti Vidhyut Nigam Ltd.) — NPCIL (51%) + NTPC (49%) JV, approved September 2024; continues under SHANTI Act framework

AERB (Atomic Energy Regulatory Board) — India's nuclear safety regulator; now has formal statutory independence under SHANTI Act

KEY INSTITUTIONS:

NPCIL — Nuclear Power Corporation of India Limited (operator, under DAE)

BHAVINI — Bharatiya Nabhikiya Vidyut Nigam Limited (operates PFBR; Stage 2)

DAE — Department of Atomic Energy (nodal ministry)

IAEA — International Atomic Energy Agency (global nuclear watchdog)

MAHARASHTRA MOUS (MAY 2026):

Total value: ~₹6.5 lakh crore

Total capacity: 25,400 MW

Key project: Jaitapur (9,900 MW), plus NPCIL/NTPC fleet expansions

INDIA'S THORIUM RESERVES: ~25% OF GLOBAL RESERVES — RATIONALE FOR THREE-STAGE PROGRAMME

PFBR: ACHIEVED FIRST CRITICALITY SEPTEMBER 2024 AT KALPAKKAM, TAMIL NADU; OPERATED BY BHAVINI

Sources: NPCIL , PIB , Ministry of Power

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