



US to Build Small Modular Reactors in India

For Prelims: [Small Modular Reactor \(SMR\) technology](#), [International Atomic Energy Agency](#), [2008 India-US Civil Nuclear Deal or 123 Agreement](#), [Civil Liability for Nuclear Damage Act, 2010](#), [Atomic Energy Act, 1962](#), [Union Budget 2025-26](#).

For Mains: SMR and India, Advancements of Indian in Nuclear Technology

[Source: IE](#)

Why in News?

The US has granted approval to **Holtec International** under its regulation **10CFR810**, to transfer **unclassified [Small Modular Reactor \(SMR\) technology](#)** to 3 Indian private entities.

What are the Key Highlights of India-US SMR Technology Nuclear Deal?

- **Validity:**
 - The authorization, **valid for 10 years** and subject to **review every 5 years**, allows Holtec to design and construct nuclear reactors in India.
- **Regulatory Safeguards:**
 - Under the approval, **SMR technology can only be used for peaceful civilian purposes**, must follow [International Atomic Energy Agency \(IAEA\)](#) safeguards, and **cannot be used for military activities**, ensuring compliance with global non-proliferation norms.
- **Significance:**
 - **Operationalises the 123 Agreement:** Revives the [2008 India-US Civil Nuclear Deal or 123 Agreement](#) by overcoming legal and commercial barriers.
 - **Encouraging Private Sector:** Marks the **first direct US tech transfer to Indian private firms**, shifting from **state-only control to a [public-private \(PPP\) model](#)**.
 - **Boosting Indigenous Capability:** Facilitates local manufacturing of **SMR** and positions India as a **future hub for nuclear innovation** and exports, especially for the Global South.
- **Legal and Policy Challenges:**
 - **Civil Liability for Nuclear Damage Act, 2010:** [Civil Liability for Nuclear Damage Act, 2010](#) holds **suppliers liable for nuclear accidents**, discouraging foreign investment and tech transfer.
 - **Atomic Energy Act, 1962:** [Atomic Energy Act, 1962](#) restricts nuclear power generation to government entities, **barring private firms from owning or operating plants**.
 - The government has formed **inter-ministerial committees** to amend the **Atomic Energy Act, 1962** and the **Civil Liability for Nuclear Damage Act, 2010**, aiming to enable **private sector participation** in nuclear energy.

What are Small Modular Reactors (SMRs)?

▪ About:

- **SMRs** are advanced nuclear reactors with a **capacity of up to 300 MW(e)**, about **one-third of traditional reactors**.
- They are **compact, factory-assembled, and transported for installation**, making them suitable for **remote or space-constrained areas**.
 - **Eg: NuScale (USA), CAREM (Argentina)**

▪ Key Features:

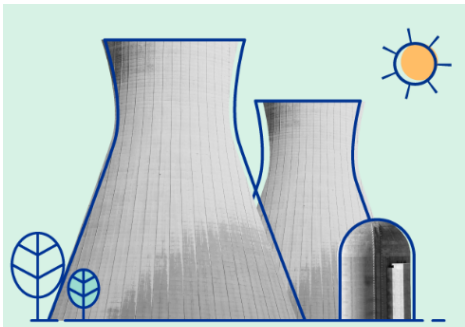
- **SMRs** are compact nuclear reactors that generate low-carbon electricity. They are:
 - **Small:** Much smaller in size compared to conventional nuclear reactors.
 - **Modular:** Factory-built components can be transported and assembled on-site.
 - **Reactors:** Use nuclear fission to produce heat, which is converted into energy.

▪ Key Advantages:

- **Fuel Efficiency:** Require refueling every **3-7 years** (as compared to **1-2 years in conventional plants**).
- **Scalability & Flexibility:** Easily integrated into diverse power systems and can be scaled for remote areas or urban grids.
 - Reduce reliance on **rare reactor-grade fuels** or advanced enrichment processes.
- **Passive Safety:** Incorporate **inherent safety systems** for enhanced accident resilience.
- **Low-Carbon & Reliable:** Provide **24/7 clean energy**, complementing renewables and aiding grid stability, helping meet rising energy demand and net-zero goals by 2070).

▪ SMR and India:

- **Budgetary Allocation:** The [Union Budget 2025-26](#) announces the launch of a **Nuclear Energy Mission** with focus on **research and development of Small Modular Reactors (SMRs)** and develop **at least 5 indigenously designed and operational SMRs by 2033**.
- **Bharat Small Reactors (BSRs):** **BSR** are **220 MW Pressurized Heavy Water Reactors (PHWRs)** with a strong safety record which will be **deployed near industries** like steel, aluminium, and metals, functioning **as captive power plants to aid decarbonization**.
 - Private entities will provide land, cooling water, and capital, while NPCIL will handle design, quality assurance, and operations.
 - This initiative aligns with **India's COP26 pledge to achieve 500 GW of non-fossil fuel-based energy and 50% renewable energy by 2030**.
- **Small Modular Reactors (SMRs):** **Bhabha Atomic Research Centre (BARC)** is working on SMRs for **repurposing retiring coal-based power plants** and **meeting the energy needs of remote areas**.
 - The **Department of Atomic Energy (DAE)** is also focusing on developing reactors such as **high-temperature gas-cooled reactors** for **hydrogen generation** and **molten salt reactors** to utilize India's vast **thorium resources**.



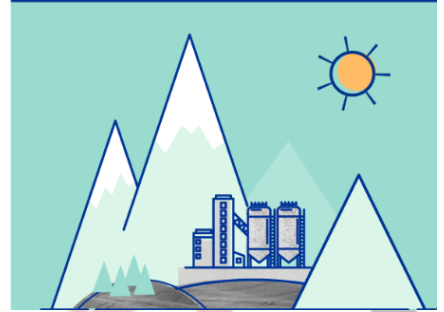
LARGE, CONVENTIONAL REACTOR
700+ MW(e)



SMALL MODULAR REACTOR
Up to 300 MW(e)



MICROREACTOR
Up to ~10 MW(e)



SMALL MODULAR REACTORS

Small modular reactors (SMRs) are one of the latest innovations in producing nuclear energy. With a simplified, compact design and relative low-cost production methods, innovators hope to deploy them more readily.

SMALL:

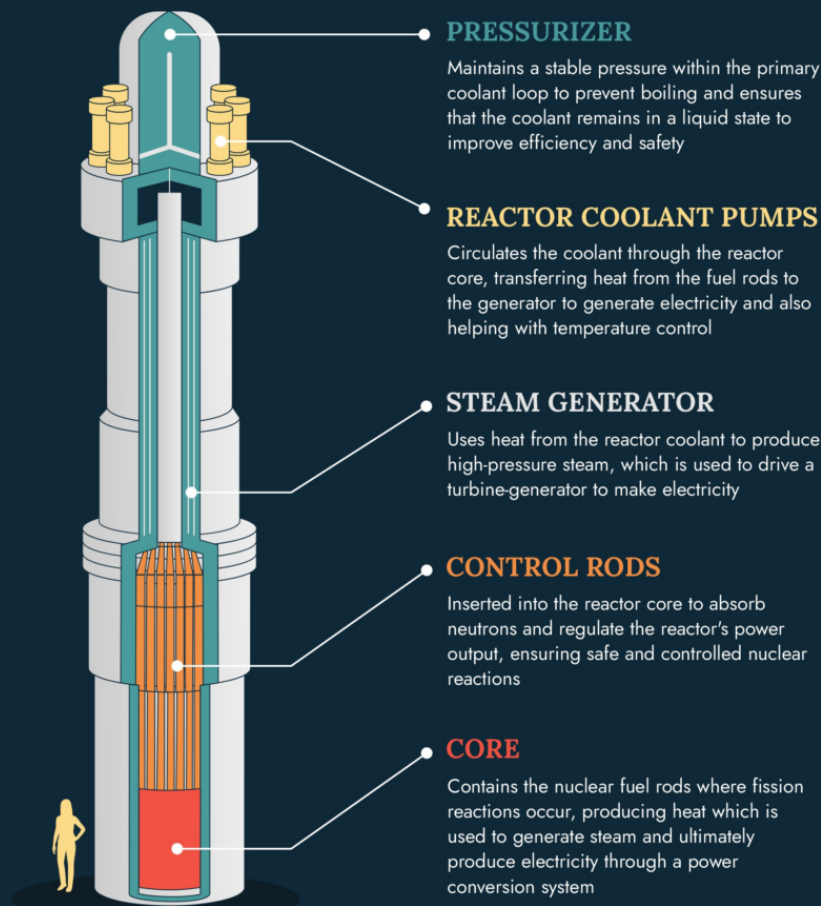
SMRs are designed to be in the range of 1 to 300 megawatts, roughly one third of the gigawatt scale of traditional nuclear reactors

MODULAR:

SMRs can be manufactured in a factory and transported to the site, making them easier to deploy and potentially reducing construction costs

REACTOR:

Like all nuclear reactors today, SMRs harness nuclear fission to generate heat to produce energy



Source: U.S. Department of Energy

The Main SMR Types



Light Water Reactors



High Temperature Gas Cooled Reactors



Molten Salt Reactors



Fast Neutron Reactors

By using smaller, mass manufactured designs, SMRs can provide additional benefits in terms of **safety**, **cost**, and **flexibility** in nuclear power generation.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. The function of heavy water in a nuclear reactor is to (2011)

- (a) Slow down the speed of neutrons
- (b) Increase the speed of neutrons
- (c) Cool down the reactor
- (d) Stop the nuclear reaction

Ans: (a)

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