

BIHAR'S FIRST NUCLEAR PLANT: GEOGRAPHY

NEWS: Bihar to get its first nuclear power plant as part of national SMR rollout

WHAT'S IN THE NEWS?

Bihar will host its first nuclear power plant under India's National Nuclear Energy Mission, which also promotes Small Modular Reactors (SMRs) and aims to boost nuclear capacity to 100 GW by 2047 as part of diversifying India's clean energy mix.

- Bihar is set to host its first nuclear power plant, joining five other states as part of the Government of India's National Nuclear Energy Mission.
- The project underscores India's push to diversify its energy mix, enhance regional energy security, and integrate advanced technologies like Small Modular Reactors (SMRs).

Key Developments in Bihar

- A 1,000 MW battery storage capacity project has also been approved in Bihar to improve grid stability and support renewable energy integration.
- The government will provide viability gap funding of ₹18 lakh per MW for this battery storage initiative, indicating a policy shift toward balanced energy infrastructure development.

About Nuclear Energy

- Nuclear energy is released during nuclear reactions—primarily through fission (splitting heavy atomic nuclei like uranium or plutonium) or fusion (merging lighter nuclei).
- In nuclear power plants, nuclear fission is harnessed to generate heat, which is then converted into electricity using turbines.

What are Small Modular Reactors (SMRs)?

- SMRs are advanced nuclear reactors with a power capacity of up to 300 MW(e) per unit, roughly one-third that of conventional nuclear plants.
- *Small:* Physically smaller than traditional nuclear reactors.
- *Modular:* Designed for prefabrication in factories, allowing for easy transport and assembly on-site.
- *Reactors:* Rely on nuclear fission to produce heat and subsequently electricity.
- SMRs come in four main types: light water, high temperature gas, liquid metal, and molten salt reactors.

Advantages of SMRs

- *Enhanced Safety Features:* Passive safety mechanisms such as natural convection and gravity-fed cooling systems reduce reliance on human intervention and external power, improving safety in emergency conditions.

- *Flexibility*: Their modular nature allows for phased addition of capacity to match incremental increases in energy demand.
- *Suitability for Remote Areas*: Compact designs make SMRs ideal for smaller grids, district heating, and even water desalination in remote or off-grid regions.
- *Cost-Effective Construction*: Factory prefabrication reduces costs, construction delays, and risks often associated with large-scale nuclear power projects.

Government Initiatives for Nuclear Capacity Enhancement

- India aims to expand its nuclear installed capacity from the current 8,180 MW to 22,480 MW by 2031–32.
- Construction and commissioning of 10 new reactors (totaling 8,000 MW) are ongoing across Gujarat, Rajasthan, Tamil Nadu, Haryana, Karnataka, and Madhya Pradesh.
- International cooperation initiatives include in-principle approval for six 1,208 MW nuclear reactors in Kovvada, Andhra Pradesh, developed in partnership with the United States.

Recent Developments in India's Nuclear Energy Sector

- *New Uranium Discovery*: A significant uranium deposit has been identified near India's oldest uranium mine in Jaduguda, Jharkhand.
- *Rajasthan Atomic Power Project (RAPP-7)*: On September 19, 2024, Unit-7 of RAPP achieved criticality, marking the start of a self-sustained nuclear chain reaction—this is the third indigenous reactor to achieve this milestone.
- *Kakrapar Units 3 & 4*: Two 700 MWe units began commercial operation in FY 2023–24. These are among India's first large-scale indigenously designed Pressurized Heavy Water Reactors (PHWRs).
- *Kalpakkam PFBR*: India's first 500 MWe Prototype Fast Breeder Reactor (PFBR) at Kalpakkam completed key milestones in 2024, including sodium filling, commissioning of sodium pumps, and core loading.

National Nuclear Energy Mission Highlights

- *Capacity Target*: 100 GW of installed nuclear power by 2047 (up from the current 8 GW).
- *SMR Development*: Allocation of ₹20,000 crore for research, development, and domestic manufacturing of SMRs, with a goal of operationalizing five SMRs by 2033.
- *Private Sector Participation*: Proposals to amend the Atomic Energy Act, 1962 and Civil Liability for Nuclear Damage Act, 2010 to enable private sector involvement and strengthen nuclear compensation mechanisms.
- *Capacity Expansion*: 10 new reactors totaling 8 GW currently under construction in multiple states.
- *International Partnerships*: Approval of a 6×1,208 MW nuclear project in Andhra Pradesh in collaboration with the USA.

- *Future Plans:* The government plans to collaborate with the private sector on Bharat Small Reactors (BSRs) and Bharat Small Modular Reactors (BSMRs) to accelerate India's nuclear power expansion.

Significance of Nuclear Energy Push

- Nuclear energy expansion will diversify India's energy portfolio, helping reduce dependence on fossil fuels.
- It is crucial for achieving India's energy security goals, reducing carbon emissions, and meeting climate commitments.
- By integrating SMRs and battery storage, India aims to build a resilient, flexible, and sustainable future energy system.

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