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EDITORIAL SUMMARY

Fast Breeder Reactor (FBR) and Energy Security

Background

- A Fast Breeder Reactor (FBR) is a nuclear reactor that uses fast neutron to generate more nuclear fuels than they consume while generating power, dramatically enhancing the efficiency of the use of resources. Nuclear fission by fast neutron causes the increase in neutrons generated.
- The International Energy Agency (IEA) defines energy security as the uninterrupted availability of energy sources at an affordable price.
- Energy security has many aspects: long-term energy security mainly deals with timely investments to supply energy in line with economic developments and environmental needs.
- On the other hand, short-term energy security focuses on the ability of the energy system to react promptly to sudden changes in the supply-demand balance.

Key Points of the Article/Lead

India's FBR Programme

- The Bharatiya Nabhikiya Vidyut Nigam Ltd or BHAVINI was incorporated to build and operate India's most advanced nuclear reactor, the Prototype Fast Breeder Reactor (PFBR) in 2003.
- Though the project was expected to be completed by September 2010, but was delayed due to technological challenges. The last set of approvals had revised the completion target to October 2022.
- After its commissioning, India will be the second country after Russia to have a commercial operating FBR. China has a small programme on fast breeders; programmes in countries such as Japan, France, and the United States were shut down amid safety concerns.

India's Three Phase Nuclear Power Programme

- India owes the vision of the three-phase programme of nuclear power to ensure energy security to Dr Homi J Bhabha, the father of India's nuclear programme, and Dr Vikram Sarabhai, who recognised the need for developing FBRs, as these reactors generate more nuclear fuel than they consume due to the gainful conversion of fertile isotopes into fissile material.
- The Department of Atomic Energy's (DAE's) envisages a pathway to utilizing India's abundant Thorium reserves - found in coastal and inland placer sands on the beaches of Kerala, Tamil Nadu, Odisha, Andhra Pradesh, Maharashtra, and Gujarat, and in the inland riverine sands of Jharkhand and West Bengal - to generate electricity.
- The three stages involve the conversion of 'fertile material', which is not fissionable by thermal neutrons but can be converted into fissile material

India's Three Stage Nuclear Power Programme

Stage-I: Natural uranium fuelled Pressurized Heavy Water Reactors (PHWRs).
Stage-II: Fast Breeder Reactors (FBRs) utilizing plutonium based fuel.
Stage-III: Advanced nuclear power systems for utilization of thorium.

- The first stage which is the setting up of Pressurized Heavy Water Reactors (PHWRs) and associated fuel cycle facilities - is in progress. PHWRs are reactors that use natural uranium as fuel and heavy water (deuterium oxide) as coolant and moderator.
- The second stage involves the setting up of FBRs backed by reprocessing plants and plutonium fabrication plants, primarily to multiply the inventory of fissile material. Multiplication of fissile inventory is also needed to establish a higher power base for using thorium in the third stage of the programme.
- The third stage will be based on the ThU233 cycle. For producing U233, obtained by irradiation of thorium in PHWRs and FBRs, an Advanced Heavy Water Reactor (AHWR) is proposed.
- The combination of power reactors from all the three stages is expected to ensure long-term energy security for the country. The progress on the FBR has made the passage to the third phase visible.

Way Forward

- The DAE maintains that despite the use of this advanced technology, both the capital cost and per-unit electricity cost are "comparable" to other nuclear and conventional power plants.
- While the first of the three stages is already underway with the PHWR programme, the India-US civil nuclear deal has opened the doors for India to buy uranium for its domestic reactors, thus increasing the pace of its nuclear programme.
- The DAE aims to increase the share of nuclear power in the energy mix by 2032 by producing 22,400 MWe from its nuclear power plants. It has approved the construction of 10 new PHWRs in 'fleet mode', in which a plant is expected to be built in five years from the first pouring of concrete.

Source : *Indian Express*