

14 March, 2024

## 'Core-loading' in India's first indigenous FBR

**Context:** The crucial second phase of India's three-stage nuclear program received a significant boost as the country's first indigenous Fast Breeder Reactor (FBR) in Kalpakkam, Tamil Nadu, commenced "core loading."

**Core Loading Initiation:** This marks the first step towards achieving "criticality," initiating a self-sustaining nuclear fission reaction crucial for generating power in the 500 MWe FBR.

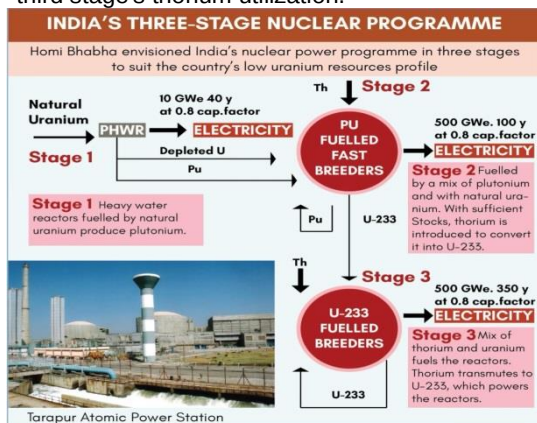
### India's FBR Program:

- India's efforts to develop an FBR began two decades ago, aiming to establish comprehensive nuclear fuel cycle capabilities.
- The Bharatiya Nabhikiya Vidyut Nigam Ltd (BHAVINI) was established in 2003 under Prime Minister Atal Bihari Vajpayee to build and operate the Prototype Fast Breeder Reactor (PFBR).
- Delays in the project, attributed to technological challenges, pushed the completion target to October 2022.

**Global FBR Landscape:** India's FBR program positions it as the second country, after Russia, to operate a commercial FBR, distinguishing it from countries like Japan, France, and the United States, where such programs were discontinued due to safety concerns.

### Three-Stage Nuclear Power Programme:

- The Department of Atomic Energy's (DAE) three-stage power program aims to utilize India's abundant thorium reserves for electricity generation.
- The first stage involves setting up Pressurised Heavy Water Reactors (PHWRs), supplemented by Light Water Reactors (LWRs).
- The second stage focuses on establishing FBRs to multiply fissile material inventory, essential for the third stage's thorium utilization.



### Way Forward:

- Initially, the FBR will use Uranium-Plutonium Mixed Oxide (MOX) fuel, with uranium transmutation in the U238 "blanket" to produce more fuel.
- Transmutation of thorium (Th232) into fissile U233 is envisioned for the third stage, where thorium will serve as a fuel source.
- Despite advanced technology usage, the DAE asserts that both capital and per-unit electricity costs of FBRs

are comparable to other nuclear and conventional power plants.

### Expansion Plans:

- The India-US civil nuclear deal facilitates uranium procurement for domestic reactors, accelerating India's nuclear program.
- The DAE aims to increase nuclear power's share in the energy mix by producing 22,400 MWe from nuclear power plants by 2032, including the construction of 10 new PHWRs in "fleet mode".

| Aspect              | Nuclear Fission                          | Nuclear Fusion                         |
|---------------------|------------------------------------------|----------------------------------------|
| Definition          | Splitting of heavy atomic nuclei         | Combining of light atomic nuclei       |
| Fuel                | Uranium-235, Plutonium-239               | Hydrogen isotopes (Deuterium, Tritium) |
| Energy Release      | Releases energy                          | Releases more energy than fission      |
| Reaction Type       | Chain reaction                           | Requires extremely high temperatures   |
| Reaction Initiation | Neutron bombardment                      | High temperature and pressure          |
| Reactor Type        | Used in current nuclear reactors         | Not yet commercially viable            |
| Fuel Availability   | Finite, limited fuel supply              | Abundant, readily available            |
| Waste Produced      | Produces radioactive waste               | Minimal radioactive waste              |
| Environmental       | Risk of meltdown, radioactive pollution  | Minimal environmental impact           |
| Safety Concerns     | Risk of accidents, nuclear proliferation | No risk of meltdown or proliferation   |
| Reactor Size        | Requires large facilities                | Potentially smaller reactors           |
| Maturity            | Established technology                   | Still in experimental stage            |

## Report on Child Mortality Estimation

**Context:** A UN report discovered that nearly 5 million children passed away before reaching their fifth birthday in 2022.

### Global Child Mortality Trends:

- In 2022, global child deaths reached a historic low, according to the latest estimates by the United Nations Inter-agency Group for Child Mortality Estimation.
- The annual number of global under-five deaths in 2022 declined by more than half from the 2000 estimate, dropping from 9.9 million to 4.9 million.

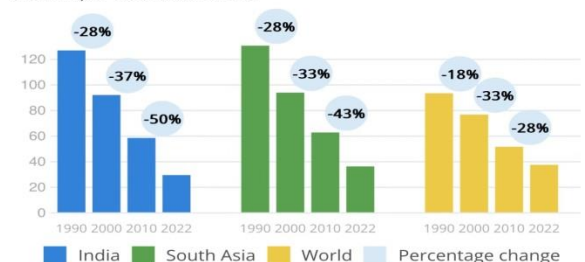
**Frequency of Child Deaths:** Despite improvements, neonatal deaths occurred globally every 14 seconds, while a child under five died every six seconds, and an adolescent died every 35 seconds in 2022.

### Decline in Child Deaths:

- The report noted a 62% decline in child deaths from the 1990 estimates.
- However, it highlighted persistent and entrenched inequities among vulnerable populations of children despite these improvements.

### PROGRESS

Under-five mortality rate (deaths per 1,000 live births)



## Face to Face Centres

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➤ **Global Child Loss:**

- Between 2000 and 2022, the world lost 221 million children, adolescents, and youth, with children under five accounting for 162 million.
- Neonatal deaths accounted for 72 million, indicating a concentration of under-five deaths in the neonatal period.

➤ **Regional Disparities:**

- Sub-Saharan Africa bears the greatest burden of under-five deaths, with annual neonatal deaths stagnating at about 1 million.
- The mortality rate for children aged 28 days in the region is more than two times higher than the global average.

**Leading Causes of Death:** Prematurity, pneumonia, trauma, malaria, and diarrhea are among the leading causes of death for newborns and children, all preventable causes.

➤ **Factors Affecting Survival:**

- Child survival is influenced by factors such as place of birth, income level of the country, and within-country inequities.
- Children living in rural areas face a higher risk of death before age 5 compared to their urban counterparts.

➤ **Future Projections:**

- The report estimates that 35 million children under the age of 5 will lose their lives before 2030, with sub-Saharan Africa bearing the brunt of the death toll.
- It warns that countries are unlikely to meet the United Nations-mandated Sustainable Development Goal (SDG) targets on time.

➤ **Impact of Achieving SDG Targets:**

- If every country realized the SDG-5 vision of ending preventable under-five deaths and met the relevant mortality targets on time, nine million more children would survive to age five.
- However, current trends suggest that 59 countries will miss the SDG under-five mortality target, with even more—64 countries—missing the neonatal mortality target.

- Pi Day has since gained global popularity as an occasion for raising awareness about mathematics among the general public.
- In 2019, UNESCO's 40th General Conference designated Pi Day as the International Day of Mathematics, highlighting its significance on a global scale.

➤ **Definition and Significance of Pi:**

- Pi, represented by the Greek letter  $\pi$ , is the ratio of a circle's circumference to its diameter.
- It is an irrational number with an infinite decimal expansion, commonly approximated as 3.14 or expressed as the fraction  $\frac{22}{7}$ .
- The constant Pi is fundamental in geometry, trigonometry, calculus, and various fields of science and engineering.

➤ **Historical Calculations and Advancements in Pi:**

- Ancient civilizations, including Babylonians and Egyptians, approximated Pi using geometric methods involving circles and polygons.
- Greek mathematician Archimedes devised a method to calculate Pi accurately using inscribed and circumscribed polygons.
- Mathematicians throughout history have continuously improved Pi's accuracy, with advancements in mathematical techniques and computational technology.

➤ **Modern Pi Calculation and Achievements:**

- With the advent of modern computing, Pi has been calculated to trillions of decimal places.
- French mathematician Thomas Fantet de Lagny achieved a calculation of Pi up to 112 decimal places by 1719.
- Today, supercomputers and advanced algorithms have pushed the limits of Pi computation, with calculations extending to trillions of decimal places.

➤ **Practical Applications and Philosophical Significance of Pi:**

- Pi is crucial in various fields such as architecture, engineering, physics, and cosmology.
- - Its value is indispensable in designing structures like bridges, satellites, and electronic devices, where precise calculations of circles and spheres are required.
- Beyond its practical applications, Pi holds philosophical significance, symbolizing the concept of infinity and the inherent order found in perfect geometric shapes.
- Mathematicians and enthusiasts are captivated by Pi not only for its practical utility but also for its intrinsic beauty, complexity, and its representation of profound mathematical concepts.

## Pi Day

**Context:** March 14, known as 3/14 in the American convention, is globally celebrated as Pi Day, commemorating the famous approximation (3.14) of the mathematical constant Pi.

➤ **Origin and Global Recognition of Pi Day:**

- Physicist Larry Shaw of the Exploratorium museum in San Francisco initiated the tradition of Pi Day in 1988 to celebrate the mathematical constant Pi ( $\pi$ ).

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## NEWS IN BETWEEN THE LINES

### PM-SURAJ Portal



Recently, the Ministry of Social Justice and Empowerment has launched the PM-SURAJ portal for credit support to entrepreneurs from disadvantaged sections of society.

#### About PM-SURAJ Portal:

- The PM-SURAJ (Pradhan Mantri Samajik Utthan Evam Rozgar Adharit Jankalyan) Portal is a **national online platform** unveiled by Prime Minister Narendra Modi.
- The portal serves as a platform to extend credit **assistance to one lakh entrepreneurs** belonging to disadvantaged communities, aiming to promote entrepreneurship and self-reliance among them.
- With a specific focus on **Scheduled Castes, backward classes and Safai Mitras**, the PM-SURAJ portal ensures the inclusive participation of these groups in economic development initiatives.
- Apart from credit support, the portal facilitates the distribution of **Ayushman health cards** and **Personal Protective Equipment (PPE)** kits to Safai Mitras, enhancing their access to healthcare services and ensuring safety at work.
- The launch of PM-SURAJ underscores the government's unwavering commitment to **"Vanchiton Ko Variyata,"** demonstrating prioritization of historically underserved communities for targeted development efforts.

### Pobitora Wildlife Sanctuary



Recently, the Supreme Court has intervened by freezing the Assam government's decision to withdraw a notification that established the Pobitora Wildlife Sanctuary.

#### About Pobitora Wildlife Sanctuary:

- Pobitora Wildlife Sanctuary is a wildlife reserve in the Morigaon district of **Assam**, located on the **southern bank of the Brahmaputra River**.
- It is also known as **"Mini Kaziranga"** because of its similar landscape and vegetation.
- It was declared a reserve forest in **1971** and a wildlife sanctuary in **1987**.
- The sanctuary is known for its **great Indian One-horned rhinoceros** population, which is one of the largest in Assam.
- Flora:** The flora primarily comprises wet savannah dominated by **Arundo donax** and Saccharum, with the rest of the area occupied by water bodies.
- Fauna:** The fauna includes **leopards**, leopard cats, **fishing cats**, jungle cats, feral buffalo, wild pigs, **Chinese pangolins**, etc.

### PM SVANidhi Scheme



Prime Minister Narendra Modi will address PM SVANidhi Beneficiaries at Jawaharlal Nehru Stadium in Delhi today.

#### About PM SVANidhi Scheme:

- The PM Street Vendor's AtmaNirbhar Nidhi (PM SVANidhi) is a **micro-credit scheme** started by the central government that provides affordable working capital loans to street vendors.
- The **Ministry of Housing and Urban Affairs** launched the scheme on **June 1, 2020** to support marginalized street vendors during the COVID-19 pandemic.
- The scheme offers collateral-free working capital loans of up to **₹50,000** in incremental tranches.
- The first tranche is a maximum of ₹10,000, the second is a maximum of ₹20,000, and the third is a maximum of ₹50,000.
- To be eligible for the scheme, street vendors must have been operating their business for at **least one year before March 24, 2020** and have **valid ID proof**.
- The scheme is only available to beneficiaries from states and union territories that have notified rules and schemes under the **Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014**.

### PB-SHABD



Recently, the Union Information and Broadcasting Minister Anurag Singh Thakur launched 'PB-SHABD'.

#### About PB-SHABD:

- Prasar Bharti - Shared Audio Visuals for Broadcast and Dissemination (PB-SHABD) is a **Prasar Bharati's news sharing service** and the revamped **websites of DD News and Akashvani News**.
- It has been designed to provide **daily news feeds in video, audio, text** and other formats to subscribers.
- It **aims to share accurate and meaningful news** content across print and electronic media in India.
- SHABD service was being provided free of cost for the first year as an introductory offer and would provide news stories in all major Indian languages across 50 categories.

## Face to Face Centres



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## Photovoltaics



### About Photovoltaics:

- Photovoltaics refers to the **conversion of light energy into electrical energy, primarily through the use of solar cells.**
- Solar cells are devices made of **semiconducting materials**, such as silicon, that convert sunlight into electricity through the photovoltaic effect.
- When sunlight strikes a semiconductor material, it excites electrons from the valence band to the conduction band, creating electron-hole pairs.
- The efficiency of solar cells is limited by factors such as transparency loss, where some photons pass through the material without interaction and thermalization, where excess energy from photons heats the material.
- Presently, **solar cells can only convert around one-third of incident solar energy** into electric energy due to limitations imposed by the Shockley-Queisser limit.
- Photovoltaics play a crucial role in **renewable energy generation**, offering a sustainable and environmentally friendly alternative to fossil fuel-based energy sources.

## POINTS TO PONDER

- Which state/UT recently conducted an All-Women Maritime Surveillance Mission? – **Andaman & Nicobar**
- Where was the inauguration of the Khelo India Rising Talent Identification (KIRTI) programme held recently? – **Chandigarh**
- What missile system is Mission Divyastra, recently in the news, related to? – **Agni-5**
- Introduced by which ministry, was the Revamped Pharmaceuticals Technology Upgradation Assistance (RPTUAS) Scheme recently seen in the news? – **Ministry of Chemicals and Fertilizers**
- What are "Carmoisine, Tartrazine, and Rhodamine," which are sometimes seen in the news – **Food coloring agents**

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