# Summary revision to begin in 6 States, U.T.s

ECI conducts SSR annually to enrol eligible voters, especially first-timers; it says furnishing Aadhaar details in Forms 6 and 8 will remain voluntary

The Hindu Bureau
NEW DELHI



**Making it count:** Youth throng a special voter enrolment camp at a college in New Delhi in September. SUSHIL KUMAR VERMA

The Election Commission of India (ECI) on Thursday announced the annual special summary revision (SSR) of electoral rolls for six States and Union Territories – Arunachal Pradesh, Mizoram, Odisha, Sikkim, Chandigarh and Dadra and Nagar Haveli and Daman and Diu – where the special intensive revision (SIR) has been completed and the final rolls published.

Earlier on October 15, the SSR was announced for 17 States and Union Territories, including poll-bound Uttarakhand, Uttar Pradesh, Punjab, Manipur, and Goa. The SSR, an annual exercise, has not been carried out amid the launch of the now controversial SIR of electoral rolls last year. Election Commissioners S.S. Sandhu and Vivek Joshi are understood to have raised this as an anomaly as well among other issues.

The annual SSR seeks to enrol eligible voters, particularly young and first-time electors, and facilitate advance applications from those who will become eligible on April 1, July 1, and October 1, 2027.

The draft electoral rolls will be published on November 30 this year and the final ones on January 21, 2027.

Furnishing Aadhaar details in Forms 6 and 8 will remain voluntary.

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ORDER FOR IT OVERSIGHT
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## Summary revision to begin in 6 States, U.T.s

No application for enrolment can be rejected, nor can an existing entry be deleted, for failure to provide Aadhaar, according to the SSR order issued by the ECI.

Unlike the contentious SIR process, when enrolling through the SSR, voters do no need to give any documentation proving citizenship or be mapped with earlier electoral rolls.

Among the firsts, in this year's SSR, the ECI has directed that, at the time of polls, "readable PDF" of the alphabetically arranged electoral rolls in pen drive or any other electronic storage device can be provided to the contesting candidates.

This is crucial as Opposition parties have been demanding machine-readable electoral rolls rather than image-based PDFs, so that they are digitally searchable, indexable, and verifiable.

Political parties would also be provided with supplementary voter lists, which were earlier kept only for record and future use.

The SSR process this time would also not include house-to-house visits by booth-level officers (BLOs). Instead, both draft as well as final lists would be put up at polling booths.

GS II – Polity & Governance

**Key Pointers**

- What is Special Summary Revision (SSR) of electoral rolls?
- How is SSR different from Special Intensive Revision (SIR)?
- What is the role of the Election Commission of India (ECI) in preparing and updating electoral rolls?
- What are Forms 6 and 8 used for in the voter registration process?

# Arrest occurs at the moment of detention, says SC

**Krishnadas Rajagopal**
NEW DELHI

**Ambiguity in definition of arrest has let agencies detain a person for days before recording formal arrest, said the SC**

The Supreme Court on Thursday ruled that an arrest occurs the moment an official "touches" an individual to restrain their liberty, immediately triggering the 24-hour countdown to produce them before a Judicial Magistrate.

A Bench headed by Justice Ujjal Bhuyan said the word 'arrest' is not defined in penal statutes, from the colonial Indian Penal Code to the Code of Criminal Procedure to the Bharatiya Nagarik Suraksha Sanhita.

It said the ambiguity has allowed law enforcement agencies to detain a person for days on end before the formal arrest is recorded.

The Bench pointed out that such detentions allowed the agencies to employ third-degree measures, including torture, to squeeze out confessions.

Once formal arrest is recorded, Article 22(2) requires the arrested person to be produced before a Judicial Magistrate, giving the person an opportunity of a hearing. So far, law enforcement officers and police have calculated the 24-hour rule from the time of formal arrest after search and seizure.

The hours and days of prior detention were not taken into account. Changing the script, Justice Bhuyan said the perceived dichotomy between detention and arrest has led to grave human rights violations.

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## Arrest starts at moment of detention, says SC

"The tendency to detain suspects for questioning and manipulating the record to show a later time of arrest is a reprehensible practice... What the investigating officers do, in such cases, is to procure statements by assault, illegal detention and fear of continued detention... The worst violations of human rights take place during the course of investigation," the court observed. The 24-hour period was a constitutional safeguard intended to act as a safety barrier to check such Executive excess.

"The 24-hour timeline as mandated under clause (2) of Article 22 of the Constitution would commence from the date and time of detention of the person and when his liberty stands curtailed, and not from the time of his formal arrest," Justice Bhuyan held. Justice Bhuyan reasoned that the Constitution did not recognise detention dehors (outside) arrest.

"Even if a person is touched with a view to detaining, it would amount to an arrest... Thus, the prescription of 24-hour time period would commence the moment a person is detained by the arresting authority suspecting him to have committed an offence, when his liberty is effectively curtailed," Justice Bhuyan said. The court held that the fundamental rights to life and liberty as enshrined in Article 21 were at the core of Constitutional jurisprudence, and "cannot be tinkered with so lightly, not even under the special statutes".

"Article 22(2) does not sanction the creation of any buffer zone where the liberty of an individual is curtailed for investigating purposes, but not formally shown as arrested. Creation or contemplation of such a buffer zone is unconstitutional," the court held.

In a series of directions, the court ordered that any person found to have been detained beyond 24 hours by a Magistrate on his or her production, must be released immediately. The Bench directed that no other time period, except the time necessary for the journey from the place of arrest to the court of the Magistrate, must be excluded from the 24-hour timeline. The Magistrate concerned was duty-bound to record the actual date and time of detention of the person produced before the court.

GS II – Polity & Governance | Fundamental Rights

**Key Pointers**

- What is the difference between arrest and detention?
- When does an arrest legally take place, according to the Supreme Court?
- What does Article 22 of the Constitution say about protection against arrest and detention?
- How does Article 21 protect the right to life and personal liberty?

AMRITA IAS
An Amrita Group Institution

# SIR petitioners in top court seek FIRs over Form 7 'forgery'

**The Hindu Bureau**
NEW DELHI

Activists Anjali Bhardwaj and Amrita Johri, petitioners in the Supreme Court case pertaining to the special intensive revision (SIR) drive in Delhi, on Thursday wrote to the Chief Election Commissioner Gyanesh Kumar, Election Commissioners Sukhbir Singh Sandhu and Vivek Joshi, and Delhi Chief Electoral Officer (CEO) Ashok Kumar, seeking an immediate investigation and legal action over alleged forgery and identity fraud in the filing of Form 7 applications in Mustafabad.

In their letter, Ms. Bhardwaj and Ms. Johri cited a report published in *The Hindu* on Thursday about 16 of the 20 booth-level agents (BLAs) of the Bharatiya Janata Party denying any association with the filing of Form 7s, used to seek deletion of existing names from the electoral roll or to object to the inclusion of names.



A re-verification drive for the nearly 47.56 lakh voters whose names were dropped from Delhi's draft roll is under way. FILE PHOTO

The names of the 20 BLAs were listed as 'objectors' in 787, or 77%, of the total 1,021 deletion applications filed so far in north-east Delhi's Mustafabad Assembly constituency.

All the Form 7 applications were filed against Muslim electors.

**'Serious concerns'**

The findings, the petitioners stated, raise "serious concerns about possible systematic and fraudulent attempt to disenfranchise legitimate electors through the deliberate misuse of statutory procedures".

They urged the Election Commission of India (ECI) to direct the registration of First Information Reports (FIRs) under the relevant provisions of the Bharatiya Nyaya Sanhita for forgery, criminal impersonation, identity fraud and submission of false declarations.

They also sought a comprehensive audit of all Form 7 applications filed across the national capital during the ongoing SIR exercise to establish whether the named objectors had authorised and signed the froms. The petitioners also called for deletion proceedings arising from third-party applications to be stayed until independent verification with the affected electors and the listed objectors is completed. They also sought action under Section 31 of the Representation of the People Act, 1950, against those found to have knowingly submitted false declarations, besides publication of verification reports and all Form 7 applications on the Delhi CEO website.

**'Grave threat'**

"Given the grave threat to voter rights, an immediate and transparent response is imperative," said the petitioners.

Around 47.56 lakh names were dropped from Delhi's draft roll published on August 31.

A re-verification drive for these voters is currently under way. Last week, the ECI pushed the deadline for publishing Delhi's final electoral roll to December 22, marking the fourth such revision.

GS II – Polity & Governance

**Key Pointers**

- What is Form 7, and how is it used to object to the inclusion of a name in the electoral roll?
- Who is authorised to submit Form 7 applications under election rules?
- What is the role of Booth Level Agents (BLAs) in the electoral roll revision process?
- How can false or unauthorised Form 7 applications affect eligible voters?

# Danger in the sewer

## India must eliminate situations that lead to sewer cleaning deaths

Despite legislation, Supreme Court orders, government programmes, the availability of mechanised cleaning technologies, and exhortations from politicians, India continues to lose sanitation workers to foreseeable, and largely preventable, circumstances. In a recent incident, four workers lost their lives in Ujjain, Madhya Pradesh, cleaning a hotel's food-waste chamber. According to Parliament and the National Commission for Safai Karamcharis data, the number of workers who died on jobs involving sewer and septic tanks was 859 between 2014 and 2025, 498 from 2019 to mid-2026, 332 across 18 States and Union Territories in 2021-26, and 1,350 between 1993 and 2025. The figures have never tended towards zero even as the Safai Karamchari Andolan has repeatedly alleged severe under-reporting. Further, the government has maintained since at least 2021 that the practice of manually cleaning excreta from insanitary latrines has been eliminated, effectively signalling that it believes it has addressed the root of the problem when it has not, and freeing administrative bodies of the urgency of inspecting municipalities and private establishments. Members of historically marginalised castes are also overrepresented in these jobs. The law has distinguished hazardous cleaning of sewers and septic tanks from manual scavenging since 2013. Even so, persons entering them are still vulnerable to noxious gases. In *Dr. Balram Singh* (2023), the Court strengthened the requirements under *Safai Karamchari Andolan* (2014) to, among other measures, ensure outsourced sewer-cleaning contracts did not entail workers entering sewers and raise the compensation for deaths to ₹30 lakh per worker. In 2025, there was an order to end manual sewer cleaning in four metropolitan cities, Bengaluru, and Hyderabad followed a year later with notices to 15 Chief Secretaries for disobeying the 2023 order, including on the compensation.

Private contractors and municipal bodies are known to violate the restrictions on manual cleaning specified in the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act 2013 and Rules, and evade liability by hiring undocumented daily-wage workers. The scourge of such worker deaths thus cannot be eliminated without also formalising their employment and improving social security across caste lines. A significant gap between aims and outcomes has also persisted under the National Action for Mechanised Sanitation Ecosystem scheme. And while it is centred on urban local bodies, its difficulties speak to the state's fundamental error: to maximise administrative assistance, such as by distributing kits, rather than minimising the number of situations that could lead to worker deaths.

GS II – Social Justice | Governance

**Key Pointers**

- What is manual scavenging, and how is it different from hazardous sewer cleaning?
- What are the major health and safety risks faced by sanitation workers?
- What does the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 provide?
- What are the key provisions of the National Action for Mechanised Sanitation Ecosystem (NAMASTE) scheme?

# 'Private involvement in nuclear sector won't dilute safety'

**Tiki Rajwi**
THIRUVANANTHAPURAM

A.K. Balasubrahmanian, Chairperson, Atomic Energy Regulatory Board (AERB), has sought to allay concerns regarding the entry of private players into the country's sensitive nuclear energy sector, asserting that there will be no compromise on safety aspects. The sector, he says, is being opened up at the right time, given the emerging power requirement of the country.

As a regulator, the AERB will provide an "enabling environment" for private players, but at the same time, the board will not dilute the regulatory and safety requirements he told *The Hindu* on the sidelines of symposium on the emerging frontiers in nuclear science and technology organised here this week by the Atomic Energy Retirees' Association.

The AERB chairperson's remarks gain significance in the context of the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India Act, 2025 (SHANTI Act). He says the sector is being opened up at the right time, as India is targeting 100 GW of nuclear power capacity by 2047.

AMRITA IAS
An Amrita Group Institution

GS III – Science & Technology

**Key Pointers**

- Why is nuclear energy important for India's long-term energy security?
- What is the difference between nuclear fission and nuclear fusion?
- What is the role of the Atomic Energy Regulatory Board (AERB) in regulating nuclear safety?
- What are the major provisions of the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India (SHANTI) Act, 2025?
- Why is India encouraging private participation in the nuclear energy sector?

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# The ecological fallout of Israel's war in Gaza



**Abdullah Nasir**

Associate Professor at the Centre for International Legal Studies, Jawaharlal Nehru University

On November 5, 2001, the United Nations General Assembly (UNGA) designated November 6 each year as the International Day for Preventing the Exploitation of the Environment in War and Armed Conflict. This recognition underscores the far-reaching impacts of environmental damage caused by armed conflict, including degradation of ecosystems and resource depletion well after the conflict period. This impact often extends beyond the limits of national territories and affects future generations.

Considering the importance of the issue, the International Law Commission (ILC), in its report titled 'Protection of the Environment in Relation to Armed Conflicts' (PERAC), adopted 27 draft principles in 2022, which were formally noted by the UNGA on December 7, 2022. The overarching purpose of these principles is to enhance the protection of the environment in relation to armed conflicts. The first principle of the PERAC provides that the principles apply to the protection of the environment before, during and after an armed conflict, including in situations of occupation. In this context, Israel's responsibility for internationally wrongful acts causing environmental harm arises not only from its ongoing genocide in Gaza but also from its continuing role as an occupying power.

**The devastation in Gaza**

In its report released on September 23, 2025, titled the 'Environmental Impact of the Conflict in the Gaza Strip', the United Nations Environment Programme (UNEP) documented that two years of escalating hostilities have resulted in unprecedented environmental devastation in Gaza, severely affecting its soils, freshwater resources, and coastline. It says that since 2023, Gaza has lost 97% of its tree crops, 95% of its shrubland, and 82% of its annual crops, leaving its population on the brink of famine.

Freshwater resources are critically scarce, and much of the remaining supply is contaminated.

The destruction of Gaza's ecosystems underscores the need for accountability under international law

The destruction of sewage treatment facilities, piped water systems, and the increasing reliance on cesspits have likely worsened pollution of the aquifer that provides most of Gaza's water. The UNEP further notes that marine and coastal environments are also likely contaminated.

Approximately 78% of Gaza's estimated 2,50,000 buildings have been damaged or destroyed, resulting in around 61 million tonnes of debris. The loss of vegetation cover and soil compaction from military activity have further degraded soil quality, reducing its capacity to absorb water, heightening flood risks, and limiting groundwater recharge. The UNEP report does not capture the full extent of the environmental devastation in Gaza, as the situation continues to deteriorate and statistics are rapidly rendered obsolete amid Israel's ongoing genocidal assault.

**Violations of environmental obligations**

As an occupying power, Israel is obligated under the PERAC principles to administer and use the natural resources in an Occupied Palestinian Territory (OTP), for the benefit of the protected population of the occupied territory, while ensuring respect for and protection of the environment. It must integrate environmental considerations into the administration of the OTP.

Nevertheless, Israel has engaged in the systematic extraction of natural resources from the OPT and transferred them to itself, resulting in significant environmental degradation; this has been acknowledged by the International Court of Justice in its advisory opinion of July 19, 2024, 'Legal Consequences Arising from the Policies And Practices of Israel in the Occupied Palestinian Territory, Including East Jerusalem'.

Such practices not only contravene environmental protection obligations but also infringe upon the Palestinian people's collective rights, including their permanent sovereignty over natural resources and their right to self-determination. International law affirms that all peoples, including those under occupation, have permanent sovereignty over natural resources, imposing strict limitations on the actions of occupying powers regarding these natural resources. Yet, Israel's prolonged occupation – characterised by territorial expansion, settlement construction, and systematic resource appropriation – has consistently undermined these foundational principles of international law.

Principle 9 of the PERAC stipulates that a state that commits an internationally wrongful act in relation to an armed conflict, resulting in environmental damage, bears international responsibility and is obligated to provide full reparation for such damage, including damage to the environment itself. Accordingly, Israel bears an obligation under international law to provide full reparation for the environmental destruction it has caused in Gaza – an obligation reaffirmed by the International Court of Justice in its advisory opinion of July 19, 2024, 'Legal Consequences Arising from the Policies And Practices of Israel in the Occupied Palestinian Territory, Including East Jerusalem'.

**The overall picture of occupation**

On this International Day for Preventing the Exploitation of the Environment in War and Armed Conflict, it is critical to acknowledge that the devastation inflicted on Palestine, beginning with the formation of the state of Israel and its ongoing settler-colonial project, constitutes a serious breach of international law. This has become more pronounced since October 7, 2023 when Hamas-led attacks on Israel were followed by Israel's genocidal attack on Gaza.

As Swedish climate activist Andreas Malm aptly observes, the destruction of Palestine is the destruction of the earth. The international community must recognise that climate justice is impossible without dismantling Israel's settler-colonial structure and ensuring the liberation of Palestine.

GS III – Environment | International Relations | International Law

**Key Pointers**

- How do wars and armed conflicts damage ecosystems and natural resources?
- What are the Protection of the Environment in Relation to Armed Conflicts (PERAC) Principles?
- What responsibilities do occupying powers have towards the natural resources and environment of occupied territories?
- What is the role of the International Court of Justice (ICJ) in addressing environmental responsibilities under international law?

# Removing the odds between safety and freedom

Children's internet access must be protected as a fundamental right, with age-appropriate safeguards and shared responsibility to ensure online safety without imposing blanket restrictions

LETTER & SPIRIT

C.B.P. Srivastava

Access to the Internet is essential for ensuring a bright digital future for children and building an inclusive and informed society. However, striking a balance between freedom and safety is the need of the hour. In this regard, the Supreme Court recently, in *Just Rights for Children Alliance v. S. Harish* (2026), has recognised internet access as a fundamental right, emphasising that, particularly for children, the internet serves as a gateway to knowledge, creativity, and self-expression. In the digital era, access to the Internet is a human right and an essential component of the right to freedom of speech and expression guaranteed under Article 19(1)(a) of the Constitution.

The court has observed that the general perception that safety and freedom are at odds with each other is a false notion. Protecting children does not necessarily mean restricting their freedom. The court's observations reinforce democratic principles. However, it is equally important to create an environment in which people in general, and children in particular, can explore the digital world safely while protecting, respecting, and fulfilling their fundamental rights.

**'Authority-liberty coordination'**

Reasonable restrictions on the exercise of freedoms are important to strike a balance between individual and social interests. This ensures that a constitutionalist approach is followed, whereby the Constitution sets limits on the exercise of State authority as well as citizens' liberty. When the State oversteps these limits, dictatorial tendencies may emerge; when citizens seek to exercise their rights without restraint, an anarchic mindset may prevail. Therefore, it is pertinent to ensure the "authority-liberty coordination" for the smooth functioning of India's democratic governance.

**A tool for learning**

Digital technologies have been transforming almost all sectors, pushing the world to a faster growth trajectory and contributing greatly to enhancing capabilities by widening choices. While Amartya Sen propounded that capability enhancement would lead to development, Joseph Stiglitz said that transformation, in addition to capabilities, is key to development. These theoretical justifications establish that Internet access can open the golden gate of knowledge for children, provided adequate regulations are in place to govern the content available online. It also enables children to develop technological skills, express their opinions, and connect with people across geographical boundaries. It should therefore be recognised not as a privilege granted to children, but as a matter of right.

Some of the countries like Australia, Brazil, China, Indonesia, Malaysia and UAE have restricted the use of social media by children by setting screen time limits and in Brazil particularly the children require to link their social media accounts to a legal guardian. In India, States like Andhra Pradesh and Karnataka have plans to impose screen-time curbs for children. The idea behind such plans is to ensure that access to the internet is subject to responsibility. On many occasions, obscene material is posted as content that needs to be effectively restricted. In the recent ruling, the court has rightly said that we should not imitate the international approach while putting curbs; the balance should be consciously decided.

Earlier, in *Anuradha Bhasin v. Union of India* (2020), the Supreme Court held that freedom of speech and expression, and the freedom to carry on trade or business, through the internet, are protected under Articles 19(1)(a) and 19(1)(g). In another ruling, in *Pragya Prasun v. Union of India* (2025), the court held that excluding persons with disabilities from digital KYC violated Article 21 and that the right to digital access is an intrinsic component of the right to life. It also cited Cricket Association of Bengal (1995), saying that Article 19(1)(a) includes the right to know and to receive and impart information and ideas.

**Balancing freedom and safety**

Freedom cannot go unrestricted, as it would make society uncivilised. Hence, safety measures need to be blended with it.

Though Internet access offers numerous benefits to children, it also exposes them to serious risks, which *inter alia* include cyberbullying, online harassment, violations of privacy, and frauds of various kinds. Ignoring such dangers would prove detrimental to the fast-changing domestic and global social and cultural milieu. It might also lead to the widening of civilisational advancements and cultural traits. A convergent approach is therefore needed, bringing together parents, the government, educational institutions and the service providers. Age-appropriate boundaries must be set, and awareness of online risks must be raised so that children can make informed decisions without getting into an unsafe environment.

Blanket curbs will ultimately prevent children from getting information across sectors. Instead of curbing children's rights, it would be better to revisit existing systems.

All stakeholders must take steps to restrict harmful content and act more responsibly. Preventive measures are always preferable to curtailing children's right to Internet access as a corrective measure.

*(C.B.P. Srivastava is President, Centre for Applied Research in Governance)*

GS II – Polity & Governance | Fundamental Rights | Social Justice

**Key Pointers**

- Why is access to the internet important for children's education, knowledge and development?
- How is internet access linked to the freedom of speech and expression under Article 19(1)(a)?
- How does Article 21 protect the right to life and personal liberty in the digital environment?
- What are the major online risks faced by children, such as cyberbullying, online harassment and privacy violations?

# Merchant charge has been imposed to save UPI ecosystem, NPCI tells SC

'Zero Merchant Discount Rate' for all UPI transactions is no longer sustainable as functional costs would burn into the public exchequer, says payments body in affidavit; the fee will apply to only about 4% of merchant transactions, it adds

Krishnadas Rajagopal
NEW DELHI



UPI processed 24.51 billion transactions, cumulatively worth about ₹29.82 lakh crore, in the month of August 2026 alone. REUTERS

The National Payments Corporation of India (NPCI) has said in the Supreme Court that "zero Merchant Discount Rate (MDR)" for all Unified Payments Interface (UPI) transactions was no longer sustainable, as functional costs for the phenomenally expanding digital payment industry in India would burn into the public exchequer.

UPI processed as many as 24.51 billion transactions, cumulatively worth approximately ₹29.82 lakh crore, in the month of August 2026 alone, marking its highest-ever monthly volume. An average of approximately 791 million transactions were processed every single day in that month. In Financial Year 2025-26, UPI processed approximately 241.62 billion transactions worth approximately ₹314 lakh crore, the NPCI said.

"The figures illustrate not merely growth, but growth of a magnitude that places correspondingly greater demands on the security, resilience, and infrastructural capacity of the system," the NPCI, represented by Additional Solicitor-General N. Venkataraman, submitted in court.

**Legal challenge**

The NPCI was responding to a challenge in court to the government's decision to introduce an MDR of 0.4% on Person-to-Merchant (P2M) UPI transactions above ₹2,000.

Person-to-person (P2P) transactions, which account for 70% of total UPI transaction value, would remain completely free irrespective of amount, the NCPI said. There would be no transaction or platform fee or other charge permissible for individuals for sending or receiving money through UPI, it added.

It said person-to-merchant (P2M) payments up to ₹2,000 would also remain "entirely free of MDR". "This threshold is calibrated to shield the overwhelming majority of everyday, low-value merchant payments of the kind made by ordinary consumers and small merchants alike," the NPCI said.

The affidavit said that the amended MDR framework targeted only higher value commerce without disturbing low-value transactions that drive the mass adoption of UPI. The MDR charge, which did not exceed 0.4%, would apply to P2M transactions above ₹2,000. "Effectively, MDR will apply to only about 4% of merchant transactions, and approximately 96% of all P2M will remain unaffected," the NPCI said.

**'MDR is not a tax'**

The NPCI countered the petitioners' contention that an amended MDR framework should have been introduced only through a new legislation and not just through a notification in September. It argued that MDR was not a tax, cess, fee, duty or any other statutory levy imposed by or under a legislative enactment. It was plainly a 'charge' collected to recover the huge costs associated with the functioning of the payment system, and was in turn, distributed entirely amongst the participants in the UPI ecosystem. "MDR is a charge collected by the system participants to recover the costs incurred in running the payment system, and not an imposition pursuant to any delegation of legislative or fiscal power by Parliament, the Central Government or RBI," the NPCI submitted.

In a 100-page affidavit, the NPCI said that, as a system provider, it had the liberty to determine the MDR applicable to transactions processed through the payment system operated by it. The NPCI recalled how the government's efforts to cover the costs of zero MDR from 2021-2022 through incentive schemes had been a huge financial strain on the public exchequer.

Further, the UPI Steering Committee, which includes third party application providers, had endorsed the MDR framework, the NCPI said.

AMRITA IAS
An Amrita Group Institution

GS III – Indian Economy

**Key Pointers**

- What is the Unified Payments Interface (UPI), and how does it work?
- What is the Merchant Discount Rate (MDR), and who pays this charge?
- How can MDR help recover the cost of operating digital payment systems?
- What is the role of the National Payments Corporation of India (NPCI) and the Reserve Bank of India (RBI) in digital payments?

# Navigation satellite NVS-03 is fully healthy: ISRO Chairman

**Aloysius Xavier Lopez**
CHENNAI



ISRO Chairman V. Narayanan inaugurates Yuri Gagarin's statue at Periyar Science and Technology Center, Chennai on Thursday. RAGU R.

ISRO's next-generation navigation satellite NVS-03, launched on October 30 to strengthen India's NavIC regional satellite navigation system, is "fully healthy", ISRO Chairman V. Narayanan said on Thursday.

Speaking at the inauguration of the statue of legendary astronaut Yuri Gagarin at the Periyar Science and Technology Centre, Mr. Narayanan said, "NVS-03, successfully launched on October 30 midnight, was perfectly placed in the elliptical orbit. From there, we operated the engine of the satellite for 6,400 seconds to the circular orbit. Right now, the satellite is fully healthy. We have to do a lot of in-orbit testing for the satellite payload."

**'Saved lives on Axiom-4'**

Mr. Narayanan recounted ISRO's role in ensuring the success of the Axiom-4 mission this summer, which was piloted by Group Captain Shubhanshu Shukla, the first Indian in space in the last 40 years. Indian scientists had saved the lives of all the astronauts aboard by insisting on scrubbing the initially scheduled launch due to a liquid oxygen leak.

"One day ahead of the scheduled launch on June 11, the countdown had started, and there was a news item about a minor leak. We went ahead with a discussion. I was not satisfied. We insisted on correcting it. Later, we found it was a line crack, not a minor leak," the ISRO chief explained. "We proved to the world that Indians are second to none, the Indian education system is second to none, Indian training is second to none, to ensure the safety of *Gaganyatris* [astronauts], including Shubhanshu Shukla," he added.

Mr. Narayanan stressed the need to strengthen space technology for better services for citizens. "The work on the fourth launch complex in Kulasekarapattinam in Tamil Nadu is under way," he said.

GS III – Science & Technology | Space Technology

**Key Pointers**

- What is Navigation with Indian Constellation (NavIC), and why was it developed?
- How does NavIC help in providing accurate location and timing services?
- How is NavIC different from the Global Positioning System (GPS)?
- What are the major features of the NVS series of navigation satellites?

GETTY IMAGES

# How do tokamaks work to make nuclear fusion possible?

A tokamak uses magnetic fields to confine superhot plasma to enable nuclear fusion; despite advances in research, engineering challenges remain, and no tokamak has generated net energy for commercial power

Jacob Koshy

A tokamak is a device that uses magnetic fields to trap very hot plasma inside a ring-shaped vacuum chamber. Plasma, a fourth state of matter, is a gas whose atoms have been stripped of their electrons, leaving free electrons and charged nuclei. The word comes from a Russian acronym describing a toroidal (ring-shaped) chamber with magnetic coils. The best-known fusion energy project in the world, the International Thermonuclear Experimental Reactor (ITER), uses this design.

**What problem does tokamak solve?**
Nuclear energy today comes almost entirely from fission, the controlled chain reaction of uranium atoms, but fusion has always been theoretically possible and a subject of consistent long-term investigation by scientists. When light atomic nuclei such as deuterium and tritium, two isotopes of hydrogen and the best-studied candidates, join, they form helium and a fast neutron. But even this simple merger requires temperatures hotter than the sun's core, which no earthly material can contain. In physics, this is called the problem of containment. Contact with a wall would also cool the plasma and contaminate it with impurities. Plasma, being made of charged particles, can be steered by magnetic fields, and a tokamak uses that property to hold it away from the walls long enough for fusion to occur.

**Who first conceived it?**
The concept was developed in the Soviet Union in the early 1950s, largely credited to physicists Igor Tamm and Andrei Sakharov.

Experimental work followed at the Kurchatov Institute in Moscow, where the first machines operated in the late 1950s and, once word of its potential spread, it was adopted in research programmes in several universities.

**Why is it shaped the way it is?**
Charged particles in a magnetic field spiral around the field lines. In a straight tube, they would simply travel along the lines and escape through the ends, but bending the tube into a closed ring removes the ends, making the field lines loop back on themselves.

A ring alone does not work, however. The field from coils around a ring is stronger on the inner side than on the outer, which makes ions and electrons drift in opposite directions, up and down. This creates an electric field that pushes the whole plasma outwards into the wall.

The tokamak gets around this by driving a large electric current through the plasma itself, typically induced by a central magnet acting like a transformer. This current produces a second magnetic field that twists the field lines into a helix around the ring. Particles following a twisted line spend time at both the top and the bottom, which cancels the drift. A tokamak therefore combines two fields: one running around the ring, from external coils, and a twisting one from the plasma current. Additional coils shape and position the plasma.

**How does all this create useful energy?**
The plasma is kept away from the walls, but the energy it releases is not. In fact, the design depends on that energy reaching them. In a deuterium-tritium reaction, about 80% of the 17.6 MeV (million electron-volts) released goes to the neutron and about 20% to the helium nucleus (alpha particle). A kilogram of this fuel would release about $3.4 \times 10^{14}$ J if fully fused, roughly 10 million times the energy in the same quantity of coal.

In a power plant design, the inner wall is backed by a thick layer called a blanket. The neutrons slow down in it and deposit their energy as heat, much as in a fission reactor's core. A coolant, such as water or helium, carries the heat out to make steam and spin a turbine, as in a conventional power plant. The blanket also contains lithium. Neutrons striking lithium produce tritium, which is rare and radioactive, so a plant would breed its own fuel this way.

**Why haven't tokamaks so far produced the energy?**
The principles are well understood, but the engineering challenges are formidable. ITER is funded and run by seven members – China, the European Union, India, Japan, South Korea, Russia and the United States – representing more than 30 countries. It has been plagued by delays over funding, and its projected costs, which were €5 billion in 2005, have increased at least fourfold.

ITER has not been switched on. It is still being assembled at Cadarache in France, so it has had no chance to succeed or fail. It is designed to produce about ten times the heating power fed into its plasma, but only once it begins deuterium-tritium operation. Deadlines are constantly shifting. In 2024, the project moved the start of research operations to 2034 and deuterium-tritium operation to 2039, adding about €5 billion in costs. Officials attributed this to the Covid-19 pandemic, supply-chain and quality problems, and "over-optimistic planning" for a first-of-a-kind machine. Even when it runs, ITER is a physics experiment and will not convert heat into electricity.

**What about China?**
China's EAST tokamak in Hefei sustained a high-confinement plasma for 1,066 seconds in January 2025, a record for duration, with electron temperatures of about 100 million degrees. In January 2026, it reported running at plasma densities well above a long-standing empirical limit. EAST is a physics machine, though, and has not generated net energy.

**How many tokamaks does India have?**
The two main machines are at the Institute for Plasma Research (IPR) in Gandhinagar. ADITYA, India's first tokamak, began operating in 1989 and was rebuilt as ADITYA-U, which resumed operations in 2017. SST-1, the Steady State Superconducting Tokamak, produced its first plasma in 2013 and uses superconducting magnets. India is also a member of ITER and manufactures components for it. Bengaluru-based Pranos Fusion has unveiled PRAGYA, which it describes as India's first privately developed compact tokamak. The experimental machine is intended to develop capabilities in plasma control and magnetic confinement, rather than generate commercial electricity.

**Are there alternatives?**
Fusion research broadly follows two approaches: magnetic confinement, which includes tokamaks, and inertial confinement.

Stellarators also use a ring, but create the twisted field entirely with complex external coils rather than a plasma current. This allows steadier operation and avoids some instabilities, but the coils are harder to design and build. Germany's Wendelstein 7-X is the best-known example.

Inertial confinement, which doesn't use tokamaks at all, compresses a tiny fuel pellet with lasers or other beams so quickly that fusion occurs before the fuel can fly apart. The U.S. National Ignition Facility used this approach in 2022 to claim the production of "net energy." Other magnetic designs include mirror machines, which use open-ended fields, and compact configurations such as field-reversed configurations that have no central hole.

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**Key Pointers**

- What is nuclear fusion, and how is it different from nuclear fission?
- How does a tokamak use magnetic fields to control extremely hot plasma?
- Why is very high temperature needed to achieve nuclear fusion?
- What are deuterium and tritium, and why are they used as fusion fuels?