The legislative framework for nuclear energy in India

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The complexity of the nuclear regime

- The global nuclear regime is complex, comprising international treaties, UN resolutions, guidelines of the International Atomic Energy Agency, standards of the International Commission on Radiation Protection, and informal understandings.
- India is engaged in harnessing nuclear science and technology for the welfare of the nation, and while doing so, has honoured its legal obligations and informal understandings.
- Also, India has demonstrated a commitment to safety following a science-based approach to regulation. This must continue when India expands the role of nuclear power.
- The regime's influence on nuclear power arises because of the intertwining of the nuclear fuel cycle for generating electricity and nuclear weapon technologies. This influences the growth of nuclear power.

Non-Power Applications

- Non-power applications of nuclear science and technology are important, but the regime does not influence their use. Applications are in the areas of health care (diagnosis, therapy, and sterilisation), industry (scanning, gauging, cross-linking within polymer molecules, etc.), agriculture (mutation of seeds, fertiliser uptake studies, food preservation, etc.) and research. You can see the Annual Report of AERB to see the latest numbers.

The evolution of the nuclear regime: early developments

- Trinity tests on 16 July 1945; Use of weapons on 6 and 9 August 1945 in Japan.
- Acheson-Lilienthal report, 1946

"The development of atomic energy for peaceful purposes and the development of atomic energy for bombs are in much of their course interchangeable and interdependent."

"A system of inspection superimposed on an otherwise uncontrolled exploitation of atomic energy by national governments will not be adequate safeguard."

- The UN Charter does not mention nuclear weapons, as it was concluded about three weeks before the Trinity test.
- **Atoms for Peace**: speech to UNGA by US President Eisenhower – 1953 – proposed an IAEA. IAEA Statute (1956): Article III.B.2 and Article XII.A.5 provide for the Agency's control over excess special fissionable material. The "Atoms for Peace" evolved into "**Control over atoms even when used for peace**".
- The Eighteen-Nation Committee on Disarmament (ENCD) was sponsored by the United Nations in 1961. ENCD negotiated NPT. By 1964, there were five nuclear powers in the world.
- **The treaty on the non-proliferation of nuclear weapons** was drafted and opened for signature on 1 July 1968. It entered into force on 5 March 1970. It was extended indefinitely on 11 May 1995.
- These dates are important. India enacted the Atomic Energy Act in 1962.

Nuclear regime that resulted from the treaty

- Five states recognized as Nuclear Weapon States. For this Treaty, an NWS is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device before 1 January 1967.
- Nuclear programmes of NNWS only under safeguards by IAEA. Safeguards obligations are met by signing comprehensive safeguards agreements.
- Facility-specific safeguards agreements for countries that are not a Party to NPT. Safeguards agreements are intended to prevent the diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices.
- The Zangger Committee was set up in 1971 to implement export controls. Zangger's understandings establish lists of material and equipment and three conditions for the supply: a non-explosive-use assurance, an IAEA safeguards requirement, and a re-transfer provision that requires the receiving State to apply the same conditions when re-exporting these items.
- The Nuclear Suppliers Group was set up in 1975; it adopted guidelines for international trade in nuclear technology. It was inactive during the period 1975 – 1992. It established a framework for dual-use items in 1992. NSG guidelines require the application of full-scope safeguards as a condition for nuclear supplies. It thus goes beyond NPT.

Problems with the treaty

- Absence of an explicit prohibition on deploying nuclear weapons in territories of third states, sharing of nuclear forces, and providing guarantees to allies.
- Lack of provisions to curb vertical proliferation, both qualitative and quantitative, by NWS.
- NWS didn’t agree to give a strong commitment to disarmament in response to the renunciation of nuclear weapons by NNWS.
- 1995 Review and Extension Conference extended NPT indefinitely. Over the years, NPT has been supplemented by strengthened safeguards by IAEA, guidelines of the Nuclear Suppliers Group, and national export control legislation, but there has been no progress toward disarmament.

India and the NPT

- India was a member of the Eighteen Nation Committee on Disarmament and took active part in drafting the treaty.
- China detonated first nuclear weapons on October 16, 1964 at the Lop Nur test site. It was a uranium-235 implosion fission device made from weapons-grade uranium (U-235) enriched in a gaseous diffusion plant in Lanzhou. The bomb had a yield of 22 kilotons.
- India looked for security guarantees and they were not forthcoming. Therefore, India decided not to sign the NPT. Calls on India to join NPT are being made even now. (Jayita Sarkar, Ploughshares and Swords, Cornell University Press, 2022)
- Atal Bihari Vajpayee in Lok Sabha on 27 May 1998, “India is now a nuclear weapon state. This is a reality that cannot be denied. It is not a conferment that we seek; nor is it a status for others to grant. It is an endowment to the nation by our scientists and engineers.”
- In response to a question from Fareed Zakaria on GPS show on 29 November 2009, Manmohan Singh stated that India was prepared to join NPT as a sixth NWS.

Three important terms

- In nuclear parlance, we use three terms: safeguards, security and safety.
- Safeguards refer to nuclear material accounting.
- Security refers to the physical protection of nuclear material and facilities.
- Nuclear safety refers to achieving proper operating conditions, preventing accidents and mitigating their consequences to protect workers, the public and the environment from undue radiation risk.
- The safety and physical security of nuclear facilities and material are important.
- Issues influencing the increased exploitation of nuclear power are safeguards and export controls. Both are linked to NPT. (However, they predate NPT)

Evolution of the nuclear regime

- NPT
- CTBT negotiated and signed. Has not entered into force. It can be considered as dead.
- FMCT negotiations have been deadlocked. Even definitions have not been agreed.
- No progress toward disarmament. No (qualitative and quantitative) checks on vertical proliferation.
- However, instruments that are restrictive for NNWS are thriving.
- Nuclear Suppliers Group. Export controls: extensive reporting obligations
- Safeguards (Comprehensive, facility-specific), Strengthened safeguards (Additional Protocol).
- Guidelines of the International Atomic Energy Agency, standards of the International Commission on Radiation Protection.
- Nuclear summit process. Strengthened security regime. Convention on the Physical Protection of Nuclear Materials and its 2005 amendment.

Where do we stand today?

- India conducted nuclear tests in 1998.
- An intense diplomatic activity followed to ensure a growing acceptance of India as a responsible nuclear power. These efforts led to NSG revising its guidelines in 2008 to facilitate international civil nuclear trade with India.
- This was a reversal of its 1995 decision and resulted in the restoration of facility-specific safeguards.
- This removed a major constraint for the expansion of the nuclear power programme. In parallel, NPCIL has developed the 700 MW PHWR. Its supply chain is in India.
- Having overcome the uranium availability constraint and met the challenge of developing indigenous technology, India is ready for an ambitious nuclear power programme.

Implications of safety, security and safeguards

- There is no issue with the implementation of provisions related to safety and security. With the implementation of safety measures, plant safety and plant capacity factors have improved.
- Security is a necessity due to the prevailing geopolitical scenario.
- Compliance with safeguards provisions is burdensome.
- One needs to recall fundamentals: the fission reaction and the concept of a critical mass.

Uncontrolled chain reaction

- By the appropriate design of an assembly and having enough quantity of fissile material in the assembly, one can have a self-sustaining chain reaction. Such a mass of fissile material is referred to as a critical mass.
- In an atomic bomb, a mass of fissile material greater than the critical mass must be assembled instantaneously and held together for about a millionth of a second to permit the chain reaction to propagate before the bomb explodes
- The amount of a fissionable material's critical mass depends on several factors: the shape of the material, its composition and density, and the level of purity.
- A sphere has the minimum possible surface area for a given mass, and hence minimizes the leakage of neutrons. By surrounding the fissionable material with a suitable neutron "reflector", the loss of neutrons can be reduced, and the critical mass can be reduced.
- By using a neutron reflector, only about 5 kilograms of nearly pure or weapon-grade plutonium-239 or about 15 kilograms of uranium-235 is needed to achieve critical mass.

A summary of major international commitments

- For Safeguards
  - Agreement between the Government of India and the International Atomic Energy Agency for the Application of Safeguards to Civilian Nuclear Facilities. INFCIRC/754, 29 May 2009.
  - Protocol Additional to the Agreement Between the Government of India and the International Atomic Energy Agency for the Application of Safeguards to Civilian Facilities, INFCIRC/754/Add.6, 1 August 2014.
  - INFCIRC/754/Add.12, 13 January 2023. List of facilities.
- For Security
  - Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Rev. 5), 2011.
- For Safety
  - Convention on Nuclear Safety and there are several documents and guides by IAEA.

Any person engaged in atomic energy must take cognisance of safety, security and safeguards and all international commitments.

Salient features of the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India Act, 2025

The long title: A Bill

to provide for the promotion and development of nuclear energy and ionizing radiation for nuclear power generation, application in healthcare, food, water, agriculture, industry, research, environment, innovation in nuclear science and technology, for the welfare of the people of India, and for robust regulatory framework for its safe and secure utilisation and for matters connected therewith or incidental thereto.

The Act has a long preamble that,

- informs about the responsible pursuit of nuclear energy by India with an excellent record in nuclear safety and radiation safety;
- describes nuclear energy as clean and abundant;
- reiterates ongoing pursuit of a closed fuel cycle to enable sustainability of nuclear fuel resources;
- underlines India's commitment to enhance the share of nuclear energy in the energy mix;
- highlights applications of nuclear science and technology in energy, healthcare, food, water, agriculture, research, etc.
- notes the desirability to harness the potential of nuclear energy through active involvement of both private and public sectors.

The private sector participation

- Both public and private sectors to own and operate nuclear power plants under a license by DAE, and safety authorisation by the Board.
- The source material and the fissile material remain under the surveillance and control of the Central Government and prescribed safeguards.
- Spent fuel to be delivered to the Central Government.
- Heavy water used in a nuclear facility is to remain under the supervision of the Central Government.
- It permits research, development and innovation by the private sector.
- Reprocessing and heavy water production to remain under the Central Government. Enrichment up to a certain threshold may be allowed, but only after a notification has been issued.
- It allows private sector participation, but maintains strategic control over sensitive technologies in line with the responsible path India has followed in nuclear affairs.

Licensing framework to be prescribed

- Section 7 (1): …the Central Government may grant a licence in such manner and subject to such terms and conditions as may be prescribed, including compliance with the financial, technical, management and other organisational capabilities covering the aspects of design, construction, commissioning, operation, maintenance, life management, decommissioning, quality assurance, radioactive waste management, liability, security, as it may deem necessary, for the entire life time of the facility or mine.
- This calls for developing a licensing procedure. That is work in progress.

Guardrails have been built in

- Section 7(4)…no licence may be granted to—

  (a) any company, if the Central Government knows or has reason to believe that it is owned, controlled or dominated by entities who are inimical to defence and national security, or health and safety of the public;

  (b) any person in India, if in the opinion of the Central Government, the issuance of a licence to such person would be inimical to defence and national security, or health and safety of the public.

- Section 8 provides for suspension or cancellation, etc. of a license or safety authorisation.
- Private companies incorporated outside India are not permitted to operate nuclear facilities (Section 2(9) of the Act defines “company” by reference to Section 2(20) of the Companies Act, 2013, and expressly excludes companies incorporated outside India.)

Duties and liabilities have been specified in Section 10

- Every person who has been granted a licence or safety authorisation under this Act, shall
  - comply with the terms and conditions of the licence and safety authorisation and the rules, regulations, orders and regulatory documents issued under this Act in respect of safety, security and safeguards, quality assurance and control, radioactive waste management, decommissioning of the facilities, and maintaining design support throughout the life time of the facility or mine;
  - maintain sufficient financial security in the prescribed form.

Overall, the Act ensures that the prime responsibility for safety, security, and safeguards lies with the licensee or the employer of the facility, etc.

General powers and functions of the Central Government

- Framing of the national nuclear energy policy consistent with the National Electricity Policy.
- Framing of national policy for **safety, security and safeguards**.
- Framing the national policy for management of spent fuel and radioactive waste.
- Framing policies for quality assurance and quality control of facilities.
- Establishing Directorates, Wings and Divisions under it as necessary (for providing services related to environmental surveillance, personnel monitoring, dosimetry and other matters related to radiological protection, etc.).
- Coordinating and supporting Government agencies to ensure nuclear and radiological emergency preparedness and response.

Safety Regulation

- The Act established the regulator, 'AERB', under section 17.
- Powers and functions of AERB are defined in section 24.
- AERB empowered for entry and inspection (Section 28), conduct of investigation (Section 29), etc.
- It provides for a separate regulation for the strategic sector (Section 25).
- It established an Atomic Energy Redressal Advisory Council (Section 47).
- The Appellate Tribunal (APTEL) for Electricity established under section 110 of the Electricity Act, 2003, has been designated as the Appellate Tribunal under the Act (Section 49).
- Beyond APTEL, an aggrieved person can go to the Supreme Court (Section 52).
- This results in a four-tier adjudication architecture.

The CLND Act has been merged into it

- The basic principles of liability remain the same as earlier. Basic principles: Liability is strict, based on the principle of no-fault, channelled only to the operator, liability is limited in amount and time during which claims have to be filed, the regulatory body is to notify an incident (parameters for such announcement have already been notified), and a single court of jurisdiction. (Chapter 3). Specifies liability amounts in the second schedule.
- Right of recourse is left to the operator and supplier to negotiate (Section 16). This can be based on specific technology under negotiation.
- Provides for a review of liability amount having regard to deployment of nuclear installations with advanced technology, enhanced safety features and other relevant criteria. Section 83 (1) (b).
- Section 14 of the Act places the liability beyond the Second Schedule on the Union Government, thereby limiting the scope of exposure for operators, but not the compensation to be paid to victims. Sub-section (2) of section 14 provides for establishing a Nuclear Liability Fund. While developing Rules, one can elaborate about the use of the Fund. That can include contributions to CSC when an accident takes place elsewhere.

Limits of Liability of the Operators for Different Categories of Nuclear Installations

Sl. No.	Categories of nuclear installation	Limit of operator's liability (INR) in crore
1.	Reactors having thermal power above 3600 MW	3000
2.	Reactors having thermal power above 1500 MW and up to 3600 MW	1500
3.	Reactors having thermal power above 750 MW and up to 1500 MW	750
4.	Reactors having thermal power above 150 MW and up to 750 MW	300
5.	Reactors having thermal power up to 150 MW, fuel cycle facilities other than spent fuel reprocessing plants and transportation of nuclear materials.	100

Supplementary information

- Fuel ownership: See Section 3.(4)(a).
- High-energy radiation generating equipment: Section 4(2)
- Tariff: See section 37(1)
- Licensing terms and conditions: See Section 7 (1).
- Provisions to deny a license: See Section 7 (4).
- Provisions to cancel a license: Section 8.
- Duties and liabilities: Section 10. 10(3)(a): Very important. Includes radioactive waste management, decommissioning, maintaining design support throughout life, etc. 10(3)(e) mandates maintaining financial security for waste management, decommissioning, etc.
- Government may establish directorates, wings and divisions as necessary to carry out various functions. Section 32.

Summary

- Single law: The Act consolidates regulation, enforcement, civil liability, and dispute resolution within a single statute. It reduces legal complexity and uncertainty in compliance.
- Clear licensing regime
- Central control on core functions
- Statutory regulator
- The Act embeds safety oversight across the entire lifecycle of nuclear facilities.
- It separates permission to establish a facility from authorisation to operate it safely, requiring both a license and safety authorisation.

Thank you