Republic Day Address 2026 by Director BARC

Dear Colleagues, Distinguished Invitees, Ladies and Gentlemen,

Namaste and a very happy Republic Day to all.

Today, as we assemble here to celebrate the 77th Republic Day, we do so with a deep sense of pride, reflection, and renewed responsibility. This solemn day marks the adoption of our Constitution in 1950, a visionary document that transformed a newly independent nation into a sovereign, democratic republic anchored in the timeless ideals of justice, liberty, equality, and fraternity.

On this auspicious occasion, it is fitting that we reflect not only on the journey of our nation, but also on the role that science, technology, and institutions such as ours have played in shaping India’s progress.

Our institute was built to serve the nation through scientific excellence, to translate research into societal benefit, and to contribute meaningfully to India’s march towards a secure, prosperous, and developed future. Every laboratory we establish, every technology we develop, and every young mind we nurture is, in essence, a contribution to the larger nation-building enterprise.

To reach our goal of a Viksit Bharat in 2047, we must embrace frameworks that accelerate innovation and foster unprecedented collaboration. It is with this spirit of "reform to transform" that we enter a new epoch in our nuclear journey.

SHANTI Act

In this regard, the Government of India undertook the necessary legislative reforms in the field of atomic energy. Accordingly, the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India Bill (SHANTI Bill), 2025 was passed by Parliament during winter session and was gazette notified on 21st December, 2025. It was subsequently signed into an Act by the Honourable President of India.

It is a landmark reform that modernises and unifies India's civil nuclear energy framework, securing country's energy future in a safe, responsible, and forward-looking manner by replacing earlier laws such as the Atomic Energy Act, 1962 and the Civil Liability for Nuclear Damage (CLND) Act, 2010. It opens the nuclear power sector to regulated participation of private Indian entrepreneurs, attracting investment and harnessing innovation, while retaining full strategic control with the Centre.

The act establishes a revised graded nuclear liability regime and government-backed coverage beyond operator limits.

This Act introduces a fast-track mechanisms for compensation and dispute resolution and creates dedicated Atomic Disputes Tribunal to provide specialized legal recourse.

It lays down provisions for emergency preparedness, safety audits, and waste management oversight.

The Act also facilitates private and joint-venture participation across permitted segments of the nuclear value chain, allows controlled foreign investment through Indian entities, supports deployment of advanced technologies such as small modular reactors, and retains state control over strategically sensitive fuel-cycle activities, thereby balancing

investment, safety, national security, and India's long-term energy security while reducing dependence on fossil fuels.

Several Scientists and engineers from BARC made significant contributions for drafting the SHANTI Bill and continue to work towards framing the rules and licensing requirements which shall be submitted for ratification of the parliament.

I shall now briefly reflect upon some of these important milestones and successes achieved during the past year.

Vertical 1

Let me begin with the foremost application of nuclear energy i.e., our reactor programme.

It is matter of pride that all the nuclear research reactors of BARC have continued to operated safely. The research reactor Dhruva and Apsara-U were operated with high availability factor and Critical Facility was operated as per demand. During 2025, more than 2100 Ci of radioisotopes were generated, radiochemically processed and supplied to hospitals through BRIT.

The indigenously developed silicide dispersion fuel of Apsara-U performed robustly with average burn-up of 55 GWD/Te.

Critical facility was utilised for testing of detectors, large volume samples for neutron activation analysis. Most importantly it was also used for special criticality experiments with solid LiF-BeF-LEU fuel salt in one of the fuel assemblies. This salt is identical to the one being planned for demonstration molten salt reactor under design.

Dhruva reactor continued to irradiate fission moly plates for meeting supply requirements. During the year, antimony rod assemblies were

irradiated at Dhruva which were used for start-up for TAPS1&2. It also continues to serve as national facility for neutron beam research which was utilised by more than 60 research groups across the country from various universities and institutions for neutron scattering experiments in condensed matter physics. A single crystal alignment facility has been commissioned and commissioning of neutron detector test facility is in progress at Apsara-U.

As part of the ageing management programme for Dhruva, several challenging activities were successfully accomplished, notably the replacement of ‘O’-rings in most of the shut-off rods.

Among the upcoming projects, site allocation has been granted by DAE for establishing the lead version of BSMR-200 i.e., 220 MWe Bharat Small Modular Reactor, at Tarapur.

The Isotope Production Reactor (IPR) project has received financial and administrative sanction for establishment at BARC, Visakhapatnam. The notice inviting tender (NIT) has been floated and the project will be executed through an EPC contract.

Radiological impact assessments for IPR and High Temperature-Gas Cooled Reactor (HTGCR) have been carried and siting clearances has been granted. The design of a small reactor for Boron Neutron Capture Therapy (BNCT) is in advanced stages.

Among other related activities, BSC granted twenty-three regulatory clearances for various facilities and projects

A two-dimensional axisymmetric model was developed in-house and validated for off-gas management system of molten salt reactor. A correlation was established linking xenon concentration in molten salt to reactor power, incorporating key parameters. Based on the simulation

studies, an optimized stripper configuration was designed for in-situ removal of xenon and hydrogen from FLiBe molten salt.

Post irradiation examination of garter springs and pressure tube rolled joint stubs from RAPS-3 was carried and mechanical testing on first set of irradiated reactor pressure vessel surveillance samples from KKNPP 1 VVER is currently under progress. Failure analysis of out-of-core components from RAPS 3 & 4 was also carried out.

Vertical 2

A good reactor programme must be supported by the nuclear fuel cycle.

Regular production of FBTR, Dhruva and Apsara-U reactors was continued as per requirement to ensure reactor availability at the desired power level. Fabrication of fuel pins for PFBR also continued. Fabrication of LEU target plates for Fission Molly plant was continued for production of medical grade Fission Molly radioisotope.

The reprocessing and waste management facilities at Trombay, Tarapur and Kalpakkam continued to operates safely and efficiently with sustained throughput and radiological control.

Processing requirements of both High-Level Liquid Waste (HLW) and Intermediate Level Liquid Waste (ILW) were catered fully,

Hot commissioning of Organic Liquid Waste Incineration System was completed while plasma incineration for volume reduction of low active solid wastes was continued.

In the upcoming plants, first of its kind special equipment for head end operations like spent fuel chopper, direct fuel transfer system, automated pool bridge etc were installed and successfully tested at INRP-Tarapur with dummy fuel bundles. Construction of Waste Management Plant, Core

Sub Assembly Plant have been completed at FRFCF Kalpakkam and Occupational Health Centre and Security Time Office are operational now.

Projects related to new fuel fabrication facility such as FFF for fast breeder reactor, FFP at FRFCF for Plutonium bearing fuels recycled from PFBR, technical labs 1,2& 3 for future carbide fuel are progressing with desired pace.

Projects related to fuel recycling, like INRP-1 and the fuel recycling plant at FRFCF, are also advancing at the expected pace.

The civil construction of TL-5 has been completed and construction and procurement activities for operationalisation of TL-3 ad TL-10 service buildings have been initiated.

Vertical 3

In the area of development of accelerator applications,

Infrastructure development for accelerator complex at BARC Facilities, Vizag has begun with site preparation activities. It will house Proton Linac, Electron accelerator and SUBHIR facilities.

A large custom-made cryogenic plant with 2 kW refrigeration capacity at 2 Kelvin which was delivered to Fermilab earlier as in-kind contribution under Fermilab Collaboration is in advanced stage of installation and the plant commissioning is expected to begin by end of first quarter of 2026.

The 200 TW laser system was utilized for demonstrating the acceleration of electrons of up to 4 MeV. The acceleration was quantified using an in-house developed compact electron spectrometer.

Vertical 4

Apart from the power programme, nuclear energy has tremendous application which benefits the society directly. Some of the main achievements in these areas are;

In agriculture sector, first mutant Banana variety of India, Trombay Banana Mutant-9 (TBM-9, Kavery Vaaman), developed in collaboration with National Research Centre for Banana (NRCB), Trichy, and released and Gazette notified as 72nd crop variety form BARC. It is a dwarf variety with shorter crop duration and is resistant to lodging.

Apart from this, three mustard varieties and one ground nut developed by BARC have been included in the National Mission on Edible Oilseeds (NMEO) of India.

Two Trombay groundnut varieties are being used as check varieties by Indian Council of Agricultural Research (ICAR) against new breeding lines/mutants developed by various Agricultural Universities and Institutes.

In the area of food preservations, gamma irradiation dose was optimised for shelf-life extension and safety assurance of heat sensitive ‘apple-banana composite purée’ by six months at ambient temperature storage.

Healthcare is another important field where BARC contributes significantly.

A patented nitric oxide releasing wound dressing developed by BARC was launched for its commercial distribution for the treatment of diabetic foot ulcers. It represents first of its kind approved nitric oxide-based wound dressing and promises for treatment of chronic foot ulcers, common among diabetic patients.

Further a pelvic phantom and methodology have been developed and tested for conducting nationwide comprehensive end-to-end dosimetry audit in high dose rate intracavitary brachytherapy. It will enhance the treatment accuracy of cervical cancer.

In pursuance of the philosophy of “Wealth from Waste” 30 nos. of Cs-137 pencils were delivered to BRIT for use in blood irradiators. Supply of Ruthenium (RuBy) plaques was continued to various national eye hospitals, as per demand. Yttrium-90 was selectively recovered from HLW at Trombay and supplied to RMC for use as radiopharmaceutical.

An extraction-chromatography based process was developed to meet higher demands of Yttrium-90 for treatment of neuro endocrine tumours. The new process and its product meet stringent clinical standards for radiopharmaceutical applications.

Yttria-90-Alumino-Silicate glass microspheres (BhabhaSphere) and yttrium-90 labelled skin patches were supplied to various hospitals while the supply of Iodine-125 brachytherapy sources was also continued.

In some other applications of radioisotopes, isotope hydrological studies were carried out utilising environmental stable and radioisotopes to help sustain urban aquifers in Bengaluru, Hyderabad, and Nashik.

I would like share one more technology benefitting the society. A 5.0 MLD sea water reverse osmosis desalination plant commissioned at OSCOM by BARC is now fully operational and public distribution of 1.5 MLD of desalinated water has commenced in the nearby villages.

Vertical 5

BARC has always emphasised the importance of advanced basic sciences for their role in furthering its core mandates. During last year a synthetic protocol was developed for indigenous synthesis of boron-10 doped L-Borophenylalanine (L-BPA) and the product was characterised. L-BPA is one of the clinically approved boron neutron capture therapy (BNCT) agents not available in India but required for research.

BARC formally released an indigenously developed certified reference material (CRM) named ‘Ferrocarbonatite (FC) – (BARC B1401)’ in collaboration with AMDER. This CRM will play a pivotal role in exploration, extraction and process control for rare earth elements (REEs) ore mining and allied production industries.

A new artificial protein, having potential for developing novel radiopharmaceuticals for cancer treatment, has been designed using AI-tools against a cancer target protein. This protein was synthesized and its crystal structure was determined at protein crystallography synchrotron beamline at Indus-2.

BARC beamlines at Indus synchrotrons Indore have been operating round-the-clock for the benefit of Indian scientists and other users from across the nation. During the last six months, 195 users from various universities and institutes have utilized the beamlines.

Calibration and Measurement Capabilities (CMCs) of BARC are published on 27 November 2025 in Key Comparison Database (KCDB) of Bureau International des Poids et Mesures (BIPM)

One officer of BARC participated in Winter Indian Arctic Expedition conducted by National Centre for Polar and Ocean Research (NCPOR),

GOA during the period Nov 28 to Dec 28, 2025. The member was involved in the installation of upgraded software of muon detector and data recording of muon and neutron detectors at Grubevadet Lab, Norway

Vertical 6

BARC has always been in forefront for development of new indigenous technologies for self-reliance. During last year, several technologies were either newly developed or matured to next level. I will now share few such examples.

Beginning with hydrogen technologies, the installation of pilot-scale facility of Cu-Cl thermochemical cycle of hydrogen production at FBTR site is completed. The integrated Cu-Cl facility operation with molten sodium from secondary loop of FBTR will be unique first-of-its-kind demonstration of hydrogen production using direct nuclear heat. The Iodine-Sulphur (IS) thermochemical process was innovatively redesigned in the hydroiodic acid decomposition step to lower its operating temperature from 450 °C to a more industrially feasible 250 °C. The process was modified to co-produce sulfuric acid at required concentrations alongside hydrogen.

Plug-in type laboratory scale hydrogen generator was development & demonstrated for performance. Steady performance of the system was

demonstrated without any degradation for more than 100 hours. This is the completely indigenous electrolyser cell technology, using domestically sourced components.

BARC has developed metallic and ceramic membrane reactor for enhanced, high-purity (>99.9%) hydrogen production during high temperature decomposition of NH_3 and H_2S, overcoming the equilibrium decomposition constraints. The technology has immense potential for large-scale hydrogen production from industrial waste gas streams.

First time in the country, PIXEL type particle Radiation Detector PADs have been fabricated at BEL's foundry by BARC technology using indigenously grown high purity prime grade silicon wafers.

Demonstrating a significant milestone, BARC has commissioned a pilot plant to manufacture a domestic, low-temperature heat transfer fluid. The fluid operates effectively at temperatures as low as -80°C.

FBTR Alarm annunciation system has been upgraded using indigenously developed TPLC-32 Platform and Distributed Plant Information & Supervisory Control System.

High sensitivity gamma compensated ionization chamber is developed for upcoming reactors.

First-of-a-kind ultrasonic based ammonium nitrate concentration estimation system has been indigenously developed and installed at INRP Kalpakkam.

Image analysis based automated system for metallographic inspection of PHWR fuel end cap weld has been developed and installed at NFC, Hyderabad.

Development of indigenous high throughput data concentrator for full profile capability of the camera electronics of upcoming gamma ray telescopes has been completed.

Indigenous cyber-security appliance Secure Network Access System (SNAS) developed by BARC has been commercialised & deployed in multiple networks of important organisations. With this nearly 100 appliances have been deployed across the country.

A completely indigenous turbomolecular pump has been developed consisting of multi-stage high precision rotor-stator assemblies and high-

speed motor, which has a capability of achieving a high vacuum of 10^{-8} millibar at a compression ratio of 1 million. This development is a significant achievement as an import substitute.

A new miniature thermal ionization mass spectrometer for boron isotopic analysis was developed and successfully deployed at Heavy Water Board Facility (HWBF), Talcher in November, 2025.

A dedicated single crystal alignment facility has been successfully commissioned at the APSARA-U reactor. The instrument employs an indigenously developed double-focusing monochromator based on multiple copper crystals arranged in bent geometry, to maximize flux and is designed for precise alignment of single crystals along desired crystallographic axes and measurement of bulk crystal quality.

A new package of technology ‘Trombay-Actino C3 Formulation’ was developed for enhanced plant defence and growth in vegetable crops and is ready for transfer to interested users/companies.

As part of our ongoing Technology Transfer efforts, thirteen new DAE technologies have been released to the public domain for commercialization since August 2025.

Excellent efforts of our engineering services, ensured more than 97% overall availability for all civil, electrical, HVAC, mechanical utility services at Trombay campus.

A 132 kV incoming substation has been made round the clock operational ensuring reliable and uninterrupted power supply for various facilities at BARC Vizag campus. A state of the art quality assessment laboratory for testing of civil construction materials is fully operational at the Vizag site.

Vertical 8

All the activities described above could be made possible by dedicated researchers and service providers working tirelessly. To sustain the capabilities, more than 200 graduated and post graduates joined as trainee scientific officers in 12 disciplines. Additionally, more than 85 research fellows also joined the institute, while about 1500 students completed their internships in BARC.

Several of BARC officers and scientist received various honours during las year. Some of these are

1. Dr Soumyaditya Mula, from Biosciences Group.
2. Dr. Mrinal R. Pai, Dr. Ratikanta Mishra, Dr. Atindra M. Banerjee, Dr. Srinivasu K. and Dr. K. Sandeep Rao, from Chemistry Group
3. Dr Shashwati Sen, Dr Mohit Tyagi, Dr. Sugam Kumar and Dr. Swayam Kesari from Physics Group.

I would also like to take this opportunity to congratulate the members of the CISF team who have recently been conferred with prestigious recognitions. The awardees include

1. Shri Hiraman Kadarn Babulal – President's Police Medal (2025)
2. Shri M. V. Satyanarayana and Shri Koli Pramod Narayan – DG Commendation Disc (2025)
3. Shri Shiva Swamy, Shri K. Venkat Raman, Shri A. N. Uthaiah, and Shri Rajesh Singh – Utkrisht Seva Padak (2025) and
4. Shri Manoj Solanke and Shri Shabbir Murtuza Sheikh – Ati Utkrisht Seva Padak (2025)

Our Centre was conferred with the Official Language Shield for the year 2024- 25by the Town Official Language Implementation Committee (TOLIC) for effective and excellent implementation in the field of official language Hindi.

Dear Colleagues,

On this Republic Day, we recognize and appreciate the efforts of each individual who has played a part in our collective success. We would like to express our heartfelt gratitude to all those providing auxiliary and support services, whose contributions have been vital to the success of our programs. This includes the Administrative Group, Medical Group, Engineering Services Group, Fire Safety Services, Landscape and Cosmetic Services, Transport Section, Catering Services and many more, who are undoubtedly one of the strengths of this organisation. We express our sincere gratitude to the CISF for safeguarding the perimeter of our campus, BARC Security and Anushaktinagar Security, as well as the Divisions that provide vital support to security services. We would like to take this opportunity to specifically thank Security forces, Fire Service personnel, and all those involved for their efforts in making this Republic Day function so grand.

Our thanks are also due to all the personnel of BARC Credit Society, State Bank of India and Indian Post who are stationed at our campus and provide services to our employees. Special thanks are also due to the unions and associations for their support and cooperation.

As we look to the future, BARC remains a shining symbol of inspiration for the next generation of scientists and innovators. This Republic Day, let us honour not only the birth of our republic but also the unwavering spirit of

scientific discovery that has driven our progress over the past more than seven decades. May the flame of curiosity continue to burn brightly at our Centre, guiding us toward a brighter and more prosperous India.

Finally, we would like to again extend our heartfelt Republic Day greetings to all our employees.

Thank you, and Jai Hind