Dear Colleagues, Guests, Ladies and Gentlemen,

It is an honour to be here with you today on this momentous occasion. I extend my warm greetings to all the members of BARC family on the 79th Independence Day. Today, as we commemorate seventy-eight years of our freedom, we pay solemn tribute to the countless sacrifices made by our freedom fighters, whose vision and courage laid the foundation for a sovereign, democratic, and progressive India.

Independence brings with it not only the privilege of self-governance but also the responsibility to uphold the highest standards of integrity, dedication, and scientific excellence. As we look ahead, let us reaffirm our commitment to innovation, sustainability, and the application of science for the welfare and prosperity of our fellow countrymen.

The story of independent India is one of progress—a narrative of a nation that has built an incredible foundation of knowledge and innovation against all odds. From our very inception, our mission has been to secure India's future. Every discovery we make, every reactor we operate, and every research paper we publish is a brick in the wall of a stronger, more resilient India.

In these decades of independence, our country has achieved remarkable milestones in science, technology, and innovation, areas where BARC has played a pivotal role. From advancing nuclear technology for peaceful purposes to contributing to healthcare, agriculture, and industry, our journey is a testament to the spirit of Atmanirbhar Bharat.

As you are all aware, BARC's activities are vast, encompassing all areas of nuclear sciences in both the power and non-power sectors.

Recently the entire research and development activities of BARC have been categorised into 8 verticals. I will now present brief highlights of the recent achievements under each vertical.

Vertical 1

The first and most important among them is reactor programme which is central to BARC's R&D efforts. While continuing to operate safely, the Dhruva research reactor served as a key facility for radioisotope production and national facility for neutron beam research (NFNBR). Scholars from academic institutions actively utilized it under the UGC-DAE Consortium.

Apsara-U maintained a high availability of ~90%, supporting research activities. Its neutron imaging facility enabled non-destructive investigations and Neutron Activation Analysis was used to carry out material characterization.

The Critical Facility was operated several times, testing 18 nuclear detectors including B-10 lined proportional counters. It also supported start-up channel testing for NPCIL and dye sample activation.

As mentioned, the NFNBR at Dhruva, currently serves national research needs across DAE, universities, and laboratories. To meet rising demand, a new High Flux Research Reactor (HFRR) will be established at BARC Visakhapatnam. HFRR will provide thermal neutron flux five times higher than that of the current reactors (~1×10^{15} n/cm^2/s) supporting cutting-edge R&D in various fields. The project has obtained Environmental Clearance, and the Design Safety Review Committee has completed its design review of HFRR. The proposal for the Project has received broad inter-ministerial support and has been reviewed by the empowered technology group of the cabinet and the final cabinet approval is awaited.

Among the other upcoming research reactors, the Isotope Production Reactor (IPR) is designed for high-throughput radioisotope production, primarily for medical applications. The in-principle approval has been granted by the Atomic Energy Commission. Reactor design is complete, and the DPR is under review for administrative and financial sanction. IPR will play a key role in achieving self-reliance in medical isotope production under the Aatmanirbhar Bharat initiative, significantly strengthening domestic nuclear medicine capabilities.

BARC has assigned significant resources for design of small nuclear power reactors. Among them first one is the Bharat Small Modular Reactor (BSMR-200). Preliminary process parameters have been estimated and a physics design of the reactor has been evolved.

Similarly, work is also progressing at high pace for SMR-55.

Further, an indigenous High Temperature Gas Cooled Reactor (HTGCR) is being developed to deliver process heat at ~650 °C. It will use 4% enriched oxide fuel, CO_2 coolant, and graphite as moderator. The conceptual design includes integration with a thermochemical plant for clean hydrogen production. Key systems like active shutdown cooling, passive decay heat removal, and emergency core cooling have been worked out. These ensure safe heat removal during normal and accident conditions. HTGCR marks a step toward non-electric applications of nuclear energy.

The Molten Salt Reactors are envisaged as one of the options to utilize thorium. To support the MSR program, an integral experiment was conducted on 7th August by placing a substantial quantity of fuel salt in one of the central positions of Critical Facility and making the reactor critical. This experiment will play a crucial role in validating the MSR

design techniques and nuclear data. Evaluation of basic thermo-physical properties of the molten salt with Plutonium and Thorium was imitated.

In the area of medical applications of reactor technologies, a 30 kW LEU-fuelled reactor with natural convection cooling by light water is also under design for Boron Neutron Capture Therapy (BNCT). The conceptual design of the reactor has been evolved and the reactor building layout was worked out.

BARC facilities at Visakhapatnam shall be the site of some of these reactors. The infrastructure work is progressing well. Financial sanction was obtained for "Construction of 2 Engineering Halls and 1 Science Laboratory".

Apart from operating the research reactors and designing new reactors, one of the very important work under this vertical is R&D support provided by BARC to various nuclear reactors in different DAE units. Several activities were carried out in this domain.

For example,

- Post irradiation examination (PIE) of KAMINI reactor fuel sub-assembly was carried out for the first time.
- PIE of several in core and out of core components of PHWRs and weld joints of re-circulation line of TAPS-1 was also carried out.
- Neutron depth profiling was established at APSARA-U reactor to facilitate non-destructive quantitative analysis,
- Accident tolerant fuel material containing FeCrAl ODS ferritic steels was produced and rod was extruded for the development of non Zr based Accident tolerant fuel clad material. Cr coating produced on Zr alloys have successfully provided protection under the designed basis LOCA condition upto 1200 °C,

- Photo Neutron Source assemblies were manufactured and dispatched to TAPS 1 & 2 BWRs for start-up,
- Standard operating procedures for determination of boron in borated wood samples was provided to NPCIL for optimising the manufacturing process parameters.
- Technology for fabrication of distillation column towers used in enrichment of off-grade heavy water of PHWRs was transferred to private firm who manufactured the columns conforming to the stringent quality controls.

Vertical 2

Uninterrupted supply was maintained for fuel clusters for DHRUVA, about, supporting operation at required level. Timely FBTR fuel supply enabled continuous operation at rated 40 MWTh. No fuel failures were reported over the past 18 months, reflecting robust manufacturing, QA, and reactor operation practices. Recently digital radiography for end plug welds has been implemented, enhancing inspection reliability and productivity. The PFBR fuel element fabrication continued at Tarapur. LEU target plates are being fabricated for sustained Fission Moly production for medical applications.

Reprocessing plants at Trombay, Tarapur and Kalpakkam continued to process spent fuel from research reactors and PHWRs, recovering valuable materials. This supports closed nuclear fuel cycle under Stage-1 of India's Nuclear Power Programme. Plant performance parameters such as product recovery, quality, radiation exposure, and discharges etc were all within regulatory limits.

For management of high level waste, an advanced vitrification system using a Joule Heated Ceramic Melter was hot commissioned successfully at Tarapur. Regulatory clearance was granted for full-scale operation

based on successful commissioning. All systems are functioning as per design intent.

Waste management plants at all the three sites are operating safely and continuously, supporting DAE facilities. Notably, contents of one Intermediate Liquid Waste tank has been fully processed.

An Organic Liquid Waste Incineration System (OLWIS) was established and commissioned for the management of spent solvents originating from various processes and facilities.

There have been several other developments in the area of fuel cycle. CORAL-origin organic waste was treated for the first time at Kalpakkam.

Titanium alloy based thermosyphon evaporators with enhanced service life were developed and delivered for deployment in reprocessing and waste immobilization plants.

A NUCON PLC-based Distributed Control System for one reprocessing stream at INRP Tarapur, handling 7500 I/Os, has been delivered; Additionally, two NUCON PLC-based control systems have been installed and commissioned at PREFRE-2, Tarapur.

Vertical 3

In the area of accelerator based R&D, infrastructure development for the Accelerator Complex at BARC Facilities, Vizag has commenced after project approval. The complex will house Proton Accelerator, Electron Linac (30 MeV), and SUBHIR facilities. Layout for the proton linac MEHIPA, including equipment and accelerating structures, has been finalized. Site preparation for the 30 MeV Electron Linac is also underway. The project marks a significant step toward advanced accelerator-based research capabilities.

The FOTIA and BARC-TIFR Pelletron LINAC have been operating satisfactorily. Fast neutron-induced fission experiments of ^{232}Th at FOTIA showed gamma-ray energy release to be 40–50% higher than model predictions. Experiments at the BARC-TIFR Pelletron LINAC facility revealed, polar and equatorial near-scission protons in heavy-ion induced fission, offering new insights into fission dynamics. Proton acceleration beyond ~2 MeV has been demonstrated using the Terawatt laser facility, enabling compact electron or ion accelerator experiments. This is a significant step towards using petawatt class lasers for table-top nuclear fusion experiments, nuclear transmutation experiments, and aneutronic fusion experiments.

As an in-kind contribution to Fermilab's project of Proton Improvement Plan II (PIP-II), BARC had earlier delivered a large capacity (2 kW at 2 K) custom built helium refrigerator consisting of cold box and helium compressors to Fermilab, USA. Presently, the 2 K helium refrigeration system is undergoing installation and commissioning at Fermilab site.

Operations of the 10MeV RF electron LINAC at EBC Kharghar was successfully restored with availability factor of 85 %. It was used by various DAE and Non DAE users for research in radiation testing of materials, food preservation application, electron beam induced mutation and curing studies.

Vertical 4

Nuclear sciences find several applications for societal benefits.

In health care sector, BARC secured US patent for use of D-DSePA as an Anticancer or Radioprotective Agent. ICMR issued grant to BARC and ACTREC for developing and clinical validation of a DSePA aerosol

formulation as a radiation protector against radiation induced pneumonitis.

The technology of Deep Brain stimulator, ANUCHITRA, used for treatment of neurological disorders and developed in collaboration with Shree Chitra Tirunal Institute of medical sciences was been transferred to private entrepreneur for manufacture of prototypes for clinical trials.

Mo-100 was enriched to 96% & 99% for experimental studies and medical applications.

In pursuance of wealth from waste philosophy, cesium pencil production was resumed and 20 cesium pencils were delivered to BRIT for use in blood irradiators and Ru 106 plaques of various configurations were supplied as per demand.

In the field of agriculture, this year, a new sorghum variety was developed in collaboration with University of Agricultural Sciences (UAS), Raichur. It was gazette notified and released for the farmers of Karnataka. Six oilseed varieties released earlier were gazette notified for extending the area of cultivation to additional states. A large requirement of 2,450 quintals of breeder seeds was received for two Trombay groundnut varieties. Furthermore, Maharashtra State Seeds Corporation Ltd. has produced and sold more than 17,000 quintals of BARC seed varieties as certified seeds to farmers.

The hgSBR technology for wastewater treatment has now been transferred to total of 36 licensee. This technology demonstrated its potential in Kumbh Mela 2025.

Vertical 5

BARC carries out significant work in the frontiers of basic sciences, including cosmic research. The MACE telescope detected intense gamma-ray flares from OP-313, eight billion light years away and NGC-1275, highlighting its deep-universe observation capability. Hon'ble Union Finance Minister visited the MACE site at Hanle and commended BARC's scientific contributions.

TACTIC telescope mirrors were re-polished and re-coated in-house with a durable three-layer thin film, enhancing optical performance. This upgrade significantly improved the life and efficiency of TACTIC's light collection system.

The Indian Coherent Neutrino Scattering Experiment setup, being developed for reactor antineutrino measurement at Kakrapar, was found to be capable of detecting neutrinos from supernovae explosion.

Among other area of basic research, a major milestone of depositions of 207 protein crystal structures in the international Protein Data Bank (PDB) was achieved. These structures were determined using the Protein Crystallography Beamline at Indus-2. Latest in this series was an artificial protein capable of binding to the SARS-CoV-2 protein which was designed using AI tools, synthesized, and structurally validated at the same beamline. This proof of concept demonstrates the potential for designing target-specific proteins, which, when tagged with radioisotopes, could one day serve as novel radiopharmaceuticals for cancer therapy.

Vertical 6

BARC has always been proactive in development of nuclear and spin off technologies for welfare of society. There have been some significant technological advancements across diverse domains this year.

Since the beginning of the year, ten new BARC technologies have been released in public domain for commercialization. Twenty-nine licenses for twenty-two technologies were granted to different industries nationwide. Additionally, two new AKRUTI centres were established for actively promoting BARC technologies and fostering entrepreneurship in remote regions. This brings the total number of Akruti Kendras to twelve.

AIC BARC Anushakti Foundation has been established as a section 8 company under companies act. This will facilitate BARC technology transfer process for new start-ups.

BARC has developed and demonstrated a fully indigenous 0.5 MW alkaline water electrolyser module supporting the Green Hydrogen initiative and achieved >99.5% H_2 purity. The system, built under an MoU with BPCL, marks a step toward Atmanirbharata in MW-scale hydrogen production. A unit is being erected at Kochi aerodrome.

In another similar development, A closed-loop thermochemical process has also been demonstrated for hydrogen recovery from H_2S, a refinery byproduct. This breakthrough offers a sustainable and clean pathway for hydrogen production from industrial waste streams.

An in-house PEM electrolyser with high-activity recombination catalyst was deployed and demonstrated for efficient de-deuteration of O-18 enriched water. It has been integrated at Heavy Water Plant Manuguru.

A flywheel energy storage system operating at 10,000 rpm has been prototyped, delivering 50 kW pulses for 20 ms, demonstrating reliable performance for high-power pulse applications.

There have been several other technological developments such as

- Air Plasma Torches of 25 kW and 100 kW with extended electrode life have been developed for active waste incineration.
- An agglomeration event onset detection system has been installed at INRP Kalpakkam.
- Technology for Emergency in-situ advanced leakage arresting devices for piping were transferred to industry and deployed at HWP Baroda.
- Technology for large-scale synthesis of carbon nanotubes has been transferred for commercial production of high-quality multi-walled carbon nanotube powder.
- Trials of Lu-176 enrichment using the Electromagnetic Isotope Separation facility has been conducted successfully and has achieved ~90% of theoretical collection efficiency.
- A compact, laser-spectroscopy-based online HDO monitor was developed and installed at Dhruva for detecting heavy water leaks at parts-per-billion levels.
- A sensitive solid analysis method using electrothermal vapourisation interfaced with inductively coupled plasma optical emission spectrometer was developed for accurate, high-throughput quantification of trace rare earths and thorium in complex matrices.

Vertical 8

Technical services and infrastructural services provided by various groups of BARC play very important role in overall progress made by the institute.

BARC Safety Council conducted comprehensive safety reviews across all facilities, which operated with an excellent safety record during this period. Eighty regulatory clearances were granted, and two key safety documents on event reporting and regulatory inspections were published.

Alternate Integrated Centre for Crisis Management (AICCM) has been established and operationalised at DAE Convention Centre.

Material Management System (MMS) has been augmented for paperless procurement process in DPS and its services have been extended to BRIT, HWB, AERB and DCSEM.

Among others, an in-house Reference Material (RM) for Millet was prepared and made available for users, type testing of nine and triennial Calibration of 36 units of RGMS was completed, X-ray Imaging Beamline of Indus-2 was utilized by a private firm and 132kV main receiving sub-station was completed and made available.

More than 97% overall availability of all Civil, Electrical, and Mechanical utility services was achieved.

Awards

Scientists and engineers of BARC are regularly recognised by various organisations for their outstanding contributions. This year, several of them received notable honours, including:

Dr. R. N. Singh, Mechanical Metallurgy Division

Dr. B. P. Mandal, Chemistry Division

Dr. K. Bhattacharyya, Chemistry Division

Dr. Anup Kumar Bera, Solid State Physics Division

Shri Ponagani Bhumeshwar, Ion Accelerator Development Division

Dr. (Mrs.) Vinita Grover Gupta, Chemistry Division

Dr. Santosh K. Gupta, Radiochemistry Division

Dr. P. K. Singh, Radiation & Photochemistry Division

Dr. Manoj Mohapatra, Radiochemistry Division

Dr. V. K. Sharma, Solid State Physics Division and

Dr. Mohit Tyagi, Technical Physics Division

In addition, Shri S. J. Gadshi, Leading Fireman, and Shri J. S. Nagoankar, Fireman, were honoured with the Director General's Disc (DG Disc) by the Director General, Civil Defence & Fire Services, Ministry of Home Affairs.

Shri K Karthikeyan, Senior Commandant, was conferred with the CISF Director General's Commendation Disc for his outstanding service.

Dear Colleagues,

As we look to the future, we must carry the torch of innovation and patriotism. The challenges ahead are significant, but so are our capabilities. We have brilliant minds, state-of-the-art facilities, and, most importantly, an unwavering commitment to serve our nation. Let us

increase our efforts to push the boundaries of what is possible, ensuring that India becomes a leader on the global stage of scientific advancement.

The achievements presented are just a few examples from a longer list. These accomplishments result from the hard work and commitment to excellence demonstrated by all of us. I am confident that we will continue to strive for ever-higher standards in the future while serving our nation.

I would also like to take this opportunity to acknowledge the important roles played by the Administrative Group, Engineering Services Group, Medical Group, BARC Safety Council, BARC Security, Anushakti Nagar Security, CISF, Public Relations Office, Fire Services Section, Landscape and Cosmetic Maintenance Section, Transport & Catering Services Section, and many others, who individually and collectively facilitate the smooth functioning of the organisation. Special thanks are due to BARC Workers and Staff Unions for their support and cooperation. I am also grateful to all the personnel of BARC Credit Society, State Bank of India, and Indian Post who are stationed at our campus and have been providing excellent service to our employees.

Once again, I wish you all a happy Independence Day. May the coming year be filled with purpose and success.

Thank you, and Jai Hind.