

Republic Day Address of Director, BARC

Dear Colleagues and Fellow Citizens,

Namaste and a very happy Republic Day to all.

It is with great pride and joy that we gather here today to celebrate the 75th Republic Day of our beloved nation. This day holds profound significance in the hearts of every Indian, as it marks the adoption of our Constitution seventy-five years ago, a living document that embodies the dreams and principles of justice, liberty, equality, and fraternity.

Our forefathers, led by Dr. B.R. Ambedkar, gave us the gift of a Constitution that has guided our nation through myriad challenges and triumphs. On this day, we not only celebrate the birth of a republic, we also pay tribute to the countless sacrifices and struggles that have paved the way for our freedom and democracy.

On this auspicious occasion, it is befitting that we take a moment to reflect on the remarkable journey of our institute - the Bhabha Atomic Research Centre (BARC), which is one of the shining gems of our nation's scientific and technological arena.

Seventy years ago, the Atomic Energy Establishment Trombay was established, marking a crucial milestone in India's pursuit of scientific excellence and technological advancement. Later, renamed after the visionary Dr. Homi Jehangir Bhabha, the father of India's nuclear program, BARC has played a pivotal role in shaping the scientific landscape of our country.

Our research reactors, starting with Asia's first reactor Apsara, Cirus reactor, Zerlina, Poornima Series of reactors, the Dhruva and the latest one, Apsara-U, have made pioneering contributions for harnessing the power of atom to serve humanity in commercial power production, agriculture & food security, healthcare and several other areas. The extensive pioneering work carried out by BARC in nuclear fuel cycle, both front end and back end, is the foundation on which India's three stage power programmes is being built. BARC is the mother institution of nuclear energy in the country. Many institutions have budded from BARC and flourished to serve the nation. Over the past seven decades, BARC has emerged as a beacon of scientific innovation and has contributed significantly to the socio-economic development of our nation. The relentless pursuit of knowledge, coupled with a commitment to harnessing nuclear energy for peaceful purposes, has made BARC an exemplar of scientific achievement. Let us take a moment to

appreciate the unwavering dedication of the brilliant minds who have toiled and continue to toil within its hallowed halls with the spirit of self-reliance, progress and innovation for nation's growth.

One of the key aspects that define BARC's success is its firm adherence to safety and sustainability. The institution has played a pivotal role in ensuring that nuclear technology is harnessed responsibly and for the greater good. Through rigorous research, development, and implementation of safety protocols, BARC has set exemplary standards for the global scientific community.

Today I will share with you some of the important work carried out in the recent past.

Activities in the area of nuclear fuel cycle, & nuclear reactors

1. Research reactors, Dhruva and Apsara-U continued to operate with a high level of safety and availability. The overall Availability Factor for 2023 remained around 76.5 % and 90%, respectively.
2. Around 700 samples were irradiated for radioisotope production and irradiation of fission moly has commenced in Dhruva.

3. Critical Facility was operated on 66 occasions for testing of nuclear detectors and activation of large volume samples for Neutron Activation Analysis.
4. Regular production of fuels for research reactors, FBTR, Dhruva and Apsara-U, was carried out to ensure reactor availability at the desired power level. Fuel fabrication for PFBR was continued while meeting stringent technical specifications.
5. Pressure tubes from MAPS-1, Beryllia Reflector Assembly of APSARA-U and several out-of-core primary components RAPS-6, KKNPP & TAPS-4 were subjected to Post Irradiation Examination. The results from investigations were shared with reactor operators for improvements in design, material and operating conditions.
6. The Reprocessing and waste management Plants at Kalpakkam, Tarapur and Trombay continued to operate at designed capacity, meeting the targets of the Department.
7. A fuelling machine orifice assembly was qualified for DHRUVA to convert regular channel into tray rod channel for on-power handling of fission moly tray rods. It will help avoiding frequent shutdown to handle fission moly rods, improving the availability factor of reactor and performance of its components.

8. An underwater remote cutting and pin retrieval system (RCPRS) was developed for retrieval of the central Cobalt-element from the irradiated modified fuel bundle and demonstrated at KGS-3 in un-irradiated bundles. This has potential to increase Cobalt-60 radioisotope production.
9. A decision support system based on Eddy Current Testing for identification of defects in Alloy 800 Steam Generator Tubes has been developed and deployed at Nuclear Fuel Complex, Hyderabad.
10. BARCIS was successfully deployed to carryout volumetric inspection of 18Nos. of coolant channels and Inspection of 25Nos. of Rolled joints of KAPP#4.
11. BARC Scientists and Engineers played important role in design validation, safety analysis, experiments & safety review for KAPP-3 full power operation and KAPP-4 criticality.

B: BARC has continuously pursued development of technologies for nuclear as well as societal applications. Recently, some technology initiatives and projects achieved significant milestones.

A few among them are as follows:

1. Pursuing the quest for nuclear hydrogen, the bench-scale integrated facility of 4 step Copper-Chlorine cycle for hydrogen production was operated continuously for more than 165 hours in round-the-clock campaign at an average hydrogen production rate of 5 NLph.
2. Technology for fabrication of compact welded plate heat exchanger by low cost hydro-forming technique has been developed. The technology with unique features has been transferred to three indigenous manufacturers and finds application in oil & gas industry, refinery processes, pharmaceuticals etc.
3. Supercooled lipid emulsion based new process was developed for the production of liposomes used for encapsulation of hydrophobic drugs, nutraceuticals and proteins. An Indian patent has been granted for the process.
4. Magnetic Pulsed welding for high strength steel, SS/Ti and Al/SS were successfully qualified by users. (reprocessing group of IGCAR)
5. A pilot scale facility was established and demonstrated for up-gradation of Mo-100 isotope up to 99.00%.
6. The first indigenously developed helium liquefier, having capacity to liquefy helium at 4.5 k with liquefaction rate of 100 lit per hour, has

successfully completed trail run. The completely indigenous system will support superconducting accelerator programme.

C: Apart from technological development, there were some noteworthy R&D contributions and initiatives in both basic and applied research:

1. The radiological data gathered by Environment Survey Laboratories (ESLs) of BARC for two decades (2000-2020) from seven Indian nuclear power plants was analysed. The analysis revealed that calculated total radiation doses to the public constituted only a small fraction (i.e., $\ll 100$ μSv per year) of the regulatory limit (i.e., 1000 μSv per year) and it was much lower than the natural background doses, indicating a minor contribution of NPPs to the environmental dose.
2. BARC developed X-ray scatterer component was used in POLIX instrument made by Raman Research Institute, Bengaluru as a part of X-ray Polarimeter Satellite (XPoSat) launched by ISRO on January 01 for the measurement of polarimetry parameters of cosmic X-ray sources in medium energy range of 8-30 keV.

3. BARC designed 500-525 Amp Power Converters were produced at ECIL and delivered to Facility for Antiproton and Ion Research (FAIR), Germany under Indo-FAIR project.
4. In order to expedite training of AI applications on AI Supercomputing platform 'PRAGYA', a 1 PB high throughput data staging system has been developed.
5. The High-momentum Transfer Diffractometer at Dhruva reactor under the national facility for neutron beam research program has been aggrandized to a world-class neutron diffractometer resulting in 300% gain in neutron flux at the experimental station and a momentum resolution enhancement by a factor of three.
6. A High-speed X-ray imaging and tomography facility has been developed at the X-ray Imaging beamline at Indus-2 Synchrotron source resulting in reduced tomography time of 10 milli seconds compared to 5 seconds earlier.
7. Probabilistic Safety Assessment Software Tool (PSAT) required to quantify the risk of a plant has been developed indigenously. The development includes implementation of various modules such as Event Tree (ET) construction, Fault Tree (FT) construction, Minimal Cut Sets (MCS) generation and Bayesian updation.

8. A fully automated robotized Neutron Source Handling System is designed and manufactured for retrieval and storage of neutron sources required for calibration of neutron detectors. The system has been installed at Neutron Standards Lab of BARC.

D: During last year, some very significant developments could be achieved in the area of Societal application of BARC's technologies.

1. The Radiation Medicine Research Centre (RMRC), situated at DAE Campus, Newtown, Kolkata, became operational for patient services. This facility will provide low-cost state-of-the-art diagnostic and therapeutic Nuclear Medicine services to patients of Eastern and North Eastern states of India. In addition, this facility will support teaching and training for medical and science graduates, R&D work in Nuclear Medicine imaging and development of diagnostic & therapeutic radiopharmaceuticals.
2. Chlorophyllin tablets have been approved by FSSAI under the commercial name Aktocyte for marketing as a Nutraceutical. It will be released as 100 mg, 500 mg and 750 mg tablets.

3. Supply of Y-90 to RMC in highly pure form for medical use has continued as per requirement.
4. Every Month, Laser route produced 400 patient doses of Lu-177 were supplied to BRIT.
- 4.1 Extra-cellular Acidity Analyser (ECAA) was developed to differentiate between cancerous & normal tissues. It was validated using human biopsy samples from Tata Memorial Hospital and can be used in pathology labs. The technology been extended to determine cancer biomarkers in blood.
5. In Agriculture sector two new high yielding and multiple disease resistant blackgram crop varieties (Trombay Jawahar Uridbean-339 (TJU-339) and Trombay Jawahar Uridbean-130 (TJU-130)) were notified by Government of India for commercial cultivation.
6. As a part of MoU between BARC and Department of Consumer Affairs along with National Cooperative Consumers' Federation of India Limited (NCCF), 1000 tons onions were successfully marketed after long term storage, as per BARC developed radiation technology protocol.
7. Water purification technologies of BARC have been deployed in about 70 villages in last year, taking it to a total of 150 equivalent villages till date.

8. A new Nisargruna Plant was commissioned at BARC Hospital with new features for improved efficiency. It is 361st plant in the country based on solid kitchen waste treatment technology of BARC.

F: Dear colleagues, all these achievements can be made only with the suitable infrastructure. The service providers in BARC have tirelessly ensured that everything is available all the time.

1. All facilities and projects of BARC are functioning with excellent safety record thanks to the excellent regulation enforced by BARC Safety Council.
2. The services of Anunet have been extended to various remote locations and a high-speed link between BARC Trombay and Hanle for MACE experimental data transfer has been established.
3. The new 50 MVA Transformer with state of art protection was successfully commissioned to replace more than 45 years old transformer.
4. A 2 MLD capacity Sewage Treatment Plant was made operational in BARC and treated water is now being used for gardening through rejuvenated garden water piping network.
5. More than 97% overall availability of all Civil, Electrical, HVAC, Mechanical utility services & security systems and L&CM was achieved.

E: Dear colleagues, the work carried out by our fellow scientists is recognised by various national and international bodies who bestow awards and recognitions on our scientists. I am elated to share some of these recognitions.

1. Kum. Elina Mishra was awarded the Young Engineer Award from Indian Society for Particle Accelerators.
2. Dr. Brindaban Modak was selected as a Member of Indian National Young Academy of Science (INYNAS).
3. Dr. Asim Pal received the third prize in the 38th Young Physicists' Colloquium of the Indian Physical Society.
4. Dr. S. Santra has been elected as a Fellow, Maharashtra Academy of Sciences.
5. Dr. Archana Sharma has been recognized as Fellow of National Academy of Sciences, India (NASI) in Dec.2023.
6. Dr. Krishna Kumar Singh has been selected as the Member of Indian National Young Academy of Science (INYNAS).
7. Dr. Prabhat K. Singh has been selected as an Associate Fellow of Indian National Science Academy (INSA) and inducted as Member in the

National Committee for International Union of Pure and Applied Chemistry (IUPAC) for 3 years.

8. Dr. Sugam Kumar has been selected as a Young Associate of the Maharashtra Academy of Sciences.

9. Dr. Tapas Das and Dr. Santosh Gupta were elected Fellow of the Maharashtra Academy of Sciences.

10. Dr. A. K. Tyagi has been elected as the Fellow of The World Academy of Sciences (FTWAS) and awarded the prestigious J C Bose National Fellowship.

11. Dr. S. M. Yusuf awarded the prestigious J C Bose National Fellowship.

12. Shri T V Dinesh of BARC Fire Service Section has been awarded with President's Medal for Meritorious Services, a distinction announced as part of the Republic Day celebrations of 2024.

Dear Colleagues, I have only presented a few achievements of our Centre which were achieved only due to the sustained efforts of our scientists and technologists. On this Republic Day, I acknowledge the role played by every individual who has contributed to this magnificent team effort. I would also like to take this opportunity to gratefully acknowledge all personnel providing auxiliary and support services for their contributions towards the

success of our programmes. This includes the Administrative Group, Medical Services Group, Engineering Services Group, Security Services, Fire Safety Services, Landscape and Cosmetic Services, Transport Section, Catering Services and many more, who are undoubtedly one of the strengths of this organisation. 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.

Looking ahead, BARC continues to be a beacon of inspiration for the next generation of scientists and innovators. On this Republic Day, let us celebrate not just the birth of our republic but also the indomitable spirit of scientific exploration that has propelled us forward for seven glorious decades. May the flame of curiosity continue to burn bright at the Bhabha Atomic Research Centre, lighting the path to a brighter, more prosperous India.

At the end, my dear colleagues, I would like to once again extend Republic Day greetings to all our employees.

Thank you, Jai Hind