Independence Day address by Director, BARC

Dear Colleagues, invitees, ladies and gentlemen,

Today, as we gather to celebrate our nation's Independence Day, we are reminded of the extraordinary journey that included extreme sacrifices by many and brought us to where we stand. It is my privilege to extend greetings to all on this 78th Independence Day. This day represents not only freedom from foreign rule but also is a celebration of our collective aspirations and achievements. It is also a time to reflect upon the core values enshrined in our constitution i.e., justice, liberty, equality and fraternity that define our great nation.

As scientist and technologists, we are well aware that the spirit of independence is also about scientific and technological advancement. As we stand on the cutting edge of research and innovation, we are committed to harnessing the power of science to contribute to national development and enhance the quality of life for every citizen through self-reliance and continuous progress. Our mission covers large expanse from pioneering advancements in nuclear technology to healthcare, food security, water security and national security.

Today, as we reflect on our achievements, we must also look forward with renewed resolve. As the country dreams of becoming a developed nation by 2047, it is our duty that we rise to the challenges and ensure our contribution towards the meeting targets set through Chintan Baithaks, Chintan Shivir and Maha Chintan Shivir. Our commitment to excellent research and development will ensure that we achieve these targets in time.

As you all are aware, BARC's gamut of activities is very vast, spanning in all areas of nuclear sciences in power and non-power sector. I shall give brief highlights of the achievements made in 2024.

I shall begin by highlighting some of the notable accomplishments in the front-end and back-end of the nuclear fuel cycle.

1. Our research reactors, Dhruva and Apsara-U continued safe operation in 2024 with availability factor of 75% and 85%, respectively. Apart from radioisotope production, wherein 300 samples have already been irradiated in Dhruva this year, the reactors were also used for neutron beam research.
2. Critical Facility was operated on 31 occasions for testing nuclear detectors which included special neutron detector for NPCIL and activation of 70 samples for neutron activation analysis.
3. Fuel for FBTR, Dhruva reactor and Apsara-U reactor is being regularly produced to ensure reactor availability at their desired power level. Fuel fabrication for PFBR was also continued.
4. Twenty two graphite reflector assemblies were manufactured for APSARA-U.
5. A digital radiography system was commissioned and an automated welding end plugs metrology system, codeveloped with RRCAT, was introduced for augmenting FBTR fuel pin fabrication line.
6. Extensive post irradiation non-destructive and other tests, such as visual inspection, ultrasonic testing, metallography and mechanical testing, were carried out on pressure tubes and out of core components of various nuclear reactors of DAE. These included pressure tubes of RAPS-2 and KGS-2 and out of core components from RAPS-2, TAPS 3 & 4 and KKNPP. Post-irradiation fuel sub-assembly of KAMINI reactor was examined for the first time.

7. Reprocessing & waste management plants at Trombay, Tarapur and Kalpakkam are operating safely to provide mandated spent fuel reprocessing and waste management services.
8. The direct denitration of uranyl nitrate in a fluidised bed reactor to simplify the conversion to oxide was successfully demonstrated for the first time in the back-end of the nuclear fuel cycle. It eliminated multiple steps of the previous process.
9. BARC has transferred its high-efficiency packed distillation column technology for heavy water upgradation to private industries and helped set up a manufacturing facility to supply 12 distillation columns to support NPCIL's fleet mode PHWR projects.
10. BARC provided indigenously developed special neutron detectors, technical guidance and supervision for first startup and low power physics experiments of RAPS-3 220 MWe PHWR after enmasse coolant channel and feeder pipe replacement (EMFPR).
11. Scientists and engineers from several divisions of BARC participated in activities for the successful achievement of commercial operation by Kakrapar Atomic Power Station 4 (KAPS4) and in the activities of fuel loading of the Prototype Fast Breeder Reactor (PFBR) at Kalpakkam.
12. For advancing the molten salt reactor programmes, a process flow scheme developed earlier for making Ni-Cr-Mo based alloys was used to successfully produce sheets of the alloy which were then used for fabrication of components of the loop.
13. BARC has successfully developed and demonstrated an innovative process for purification and upgradation of alkaline leach liquor from Tummalapalle uranium ore. The process significantly improves overall economy by enhancing product recovery and quality while reducing the number of operating steps and reagent consumption.

BARC has persistently put efforts for meeting the societal needs of the country in the area of healthcare, agriculture, food, water and environment. I shall now highlight some of the major achievements in these areas.

14. Based on the extensive R&D carried out by BARC on radioprotection and regenerative activity of chlorophyllin, a MoU was signed with an industry partner who completed phase-I clinical trials and obtained FSSAI licence to market chlorophyllin as a nutraceutical. The product was named as “AKTOCYTE” and can be used as an adjuvant for reducing the side effects of cancer radiotherapy.

15. *BARC* consistently maintained supply of 400 patient doses per month of Lu-177 radiopharmaceuticals generated using indigenously enriched Lu-176 to more than 85%.

16. Further, Yb-176 was isotopically enriched in-house to 96.8% and used as target to make no-carrier-added Lu-177 which was then utilised in combination with PSMA-617 and DOTA-TATE at Tata Memorial Hospital for radionuclide therapy of prostate and neuroendocrine cancers, respectively.

17. In-house produced Ru-106 plaques of various configurations have been continuously supplied to the hospitals as per demand and highly pure form of Y-90 has also been continuously supplied to RMC for medical use.

18. In the area of agriculture and food sector, SOPs were developed for preservation of irradiated whole fish as well as meat samples up to three to four weeks in chilled storage conditions using newly constructed chilled marine irradiator at BRIT.

19. More than 5000 quintals of certified seeds of Vikram Trombay Chattisgarh Rice (TCR) variety, developed by BARC and IGKV, have been distributed to farmers in Chattisgarh.

20. The ‘All India Co-ordinated Research Project, AICRP-Soybean’, by Indian Council of Agricultural Research (ICAR) has recommended the use of thiourea-containing foliar spray developed by BARC to enhance the soybean crop yield in India.

21. Project on deployment of BARC water purification technologies in 200 equivalent villages was completed. The water purification units and plants are providing drinking water to nearby villages, remote border outposts in Rajasthan and Gujarat, as well as Central Railway, Mumbai.

BARC has always emphasised on development of indigenous technologies for self-reliance. Several of these efforts have crossed significant milestones. I shall briefly mention a few of them.

22. During the year 2024, **32** technologies have been transferred till date to **38** industries across the country. It includes some prominent technologies such as:

    a. Shelf- life extension of hard mature mangoes var. 'Kesar' to enable export via sea-route.

    b. Synthesis of cathode and anode material for lithium-ion battery.

    c. Automated alpha particle irradiator – Bioalpha.

    d. AuRoClean -autonomous robot for cleaning.

    e. Technology of the indigenous tungsten filament-based scanning electron microscope with 20 nm spatial resolution.

    f. Technology for making free-standing carbon nanotube sheet and

g. Technology for making CNT-boron carbide composite tiles by hot pressing.

23. A pilot-scale facility using the copper-chlorine thermochemical cycle for nuclear hydrogen production was installed and commissioned. It demonstrated hydrogen production at 50 NL/h for 45 hours, confirming the performance of the reactors, auxiliary systems and integration scheme.

24. *An* indigenous high temperature glass sealant material has been developed for high temperature steam electrolyser (HTSE) system used for hydrogen production. Using the sealant, the system was successfully operated at 800 ºC for more than 300 hours.

25. The technology for manufacturing of rolling tools for coolant channels of 220 & 540/700 MWe PHWRs has been transferred to NPCIL for site use.

26. A BARCIS compatible eddy current technique based inspection tool to detect inner surface opening flaws of pressure tubes has been developed to detect flaws in the depth range from 91 micron to 455 micron.

27. A new technique for solid state diffusion bonded joint fabrication has been developed for joining tubular parts of S.S. 304 and aluminium 6061. The fabricated joints were successfully tested for various criteria.

28. Prompt fission neutron logging probe developed using indigenous sealed D-T neutron generator has been successfully tested in a bore hole at a field site in Jamshedpur, for on-site detection of uranium.

29. Continuous Pu in Air Monitor based on indigenous silicon detector coupled to a multi-channel analyser, electronics & associated

software has been jointly developed by BARC & IGCAR and field trials have been successfully completed at DFRP.

30. A technique for isotopic upgradation of Mo-98 to any specified level, has been successfully established, and upgraded sample with 65% enrichment is being used for its conversion to Tc-99.

31. A tripartite MoA has been signed between BARC, M/s Joharilal Sancheti & Company (JSC), and Jodhpur Pollution Control and Research Foundation (JPCRF) for the operation, maintenance and large-scale demonstration of technology developed by BARC for de-colouration of cotton textile dye effluents.

32. BARC has developed hollow-fibre ultra-filtration membrane-based water purifying device for on-spot purification of turbid & biological contaminated water to potable water. This technology is now ready for transfer.

33. Five single view and dual view X-ray baggage inspection systems designed by BARC were produced by ECIL with CE certification.

I would now like to bring out some of the other noteworthy developments and contributions at our centre.

34. A pulsed disc & doughnut column (PDDC) based pilot scale solvent extraction plant has been installed to process feed slurries containing high silica and other solids. These columns can also be used for alternate solvents for processing SDU materials to nuclear purity.

35. A P-type HPGe detector of 50 cc active volume was indigenously developed for the first time on a procured high purity germanium single crystal.

36. Indigenously grown high purity prime grade silicon wafers were used to fabricate PAD type particle detectors for the first time in the country as per BARC technology at an industry partner's foundry and tested at TIFR showing similar resolution and performance to the best commercial detectors available.
37. A low temperature X-ray magnetic circular dichroism measurements facility has been set up and tested successfully at Indus-2 synchrotron using indigenously built electromagnet and cryostat.
38. A scientist of BARC participated in an Arctic expedition supported by the Ministry of Earth Sciences & conducted precise ground-level measurements of cosmic ray muons and neutrons using advanced tissue-equivalent proportional counters at the Ny-Ålesund research laboratory.
39. A indigenised micro hydro power unit of 15kW capacity was commissioned at PP lake. It presently generating electricity up to 7.5 kW from rain harvested water.

BARC takes pride in supporting academic institution of the and country and industry by providing various facilities.

40. During last six months, 230 users from various universities and institutes utilised the BARC beamlines at Indus synchrotrons, including .state-of-the-art small angle X-ray scattering (SAXS) beamline.
41. The National Facility for Neutron Beam Research at Dhruva reactor was utilised by more than 75 research groups across the country from various universities and institutions for neutron scattering experiments in condensed matter physics.

Dear Colleagues, suitable human resources and infrastructure are the foundations on which these achievements could be realised.

42. The future scientist and technologist of 67th batch of BARC training school have graduated and trainee scientific offices for the 68th batch joined us.
43. Engineering Services Group achieved more than 97% overall availability of all civil, electrical, HVAC, mechanical utility services and L&CM.
44. Fire services were augmented with new advanced tenders and equipment.
45. I feel very happy to share you with details of awards & honours received by our colleagues
    i. Dr. A K Tyagi, former Group Director of Chemistry Group has been awarded Vigyan Shri award by Government of India.
    ii. Dr. A.K. Satpati has been selected as a Fellow of Royal Society of Chemistry, UK (FRSC).
    iii. Dr. Mohit Tyagi was selected as member of National Academy of Science.
    iv. Dr. B. Modak has been selected for membership in the Indian National Young Academy of Sciences for a period of 5 years.
    v. Dr. Mahesh Sundararajan received SMC Bronze Medal awarded by Society for Materials Chemistry, and Tarun Datta Memorial Award by Indian Association of Nuclear Chemists and Allied Scientists.
    vi. Dr. P.K. Singh has been selected for Chemical Research Society of India (CRSI) Bronze Medal for the year 2025.
    vii. Dr. Veerendra K. Sharma received INSA Distinguished Lecture Fellow (2024) in Physics.

Dear colleagues, the achievements presented are the representative few of the big list. These achievements are the result of hard work put in by all of the members of BARC family and their commitment to excellence. I am confident that we will keep striving ever higher pedestals in future and keep serving the nation.

I would also like to take this opportunity to acknowledge the important roles played by 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 more, who individually and collectively facilitated the smooth functioning of the organisation. Special thanks are due to BARC Workers and Staff Unions for their support and cooperation. I am also thankful 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 good services to our employees.

I once again extend my Independence Day greeting to all and wish everyone a fulfilling, purposeful and successful year ahead.

Thank you, and Jai Hind