

Dear colleagues, invitees, ladies and gentlemen,

I extend my warmest greetings to all on the 76<sup>th</sup> Independence Day of the nation. It is 75 years since we have gained independence from colonial rulers and this milestone is being celebrated as Azadi Ka Amrit Mahotsav all across the country. Progress and development of a nation happens due to the collective effort of a large number of individuals, institutions and organisations. It is, therefore, appropriate that we utilise this opportunity to recognise the achievements of our founders, stalwarts, mentors and predecessors, who have been instrumental in the birth, growth and successes of the organisation. BARC has held a series of meets and events at all levels for this purpose, in which we have invited our past achievers and leaders and honoured them for their contributions. The opportunity has also been utilised to widely propagate the missions and achievements of our organisation to the general populace, especially the younger generation, and I take this opportunity to compliment the organisers who have held events

and conducted visits for meeting this objective. Science and Technology play pivotal roles in the success and growth of a nation, and as a leading scientific institution of the country, it is incumbent upon all of us to contribute whole heartedly towards the economic and technological progress of our nation. True independence can only be said to be attained when we gain strength across all parameters of progress and equitably enhance the human development indices of the entire population.

As you all are aware, BARC is a multi-disciplinary research institution with footprints across diverse domains. We continue to focus our efforts on strong research and development programmes, aimed to benefit the society and the nation in multiple areas. This would become evident as I present some of the salient aspects of our work carried out during the last one year.

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

1. Dhruva continued to operate with a high level of safety. The overall availability factor for the year 2022 is around 70%. 350 samples were irradiated for radioisotope production during the year.
2. Apsara-U reactor operation continued with overall Availability factor of 90% with Capacity factor of 78%. Full power operation of the reactor was attained on 8th October 2021.
3. Critical Facility for Advanced Heavy Water Reactor (AHWR) was operated on 36 occasions for various studies.
4. Production rate of uranium-plutonium carbide fuel was enhanced to deliver more fuel sub-assemblies to FBTR-Kalpakkam which helped to achieve 100% power for first time since criticality.

5. An ultrasonic based void measurement system has been developed to measure voids in 700 MWe PHWR channel with an accuracy of +/-10%.
6. Strong motion Seismic Instrumentation Technology was successfully indigenised for safety of NPPs. The technology was incubated and demonstrated for installation in NPPs.
7. Fission Moly Production Plant (FMP) at BARC has been commissioned successfully for producing medical grade Fission Moly isotope. The target material was fabricated in the newly commissioned Special Plate Fuel facility. It was processed at FMP, after irradiation in Dhruva reactor.
8. Operation of WIP is continuing for treatment of High Level Liquid Waste (HLLW) to the expected capacity.
9. KARP Kalpakkam has completed 24 years of operation. It has been restarted after planned shutdown and is now providing the valuable services as it did previously.

10. Decontamination and replacement of major equipment carried out in PREFRE, Tarapur hence demonstrating that the life extension of Reprocessing plants is possible.
  
11. An upgraded version of shielded camera system with capability for independent as well as synchronised motions for scan and image correction has been developed for monitoring the interiors of hot cells of WIP.
  
12. A remotely operated surface defect Replication tool for assessing health of pressure tubes of reactors has been developed to cast replica and measure defect profile on the inner surface of a pipe.

**Our persistent efforts towards meeting the societal needs in agriculture, food, healthcare, water and environment have continued to yield dividends during the year. I shall now highlight some of them.**

13. BARC-Hydrogel Technology with water retention capacity of 550 times was transferred to two private entrepreneurs and its mass scale production has commenced. It was used for plantations carried out at the Statue of Unity.
  
14. Trichoderma virens mutant based formulation outperformed seven other Trichoderma formulations from ICAR in multilocation trials, recording a yield improvement of 73% over control. This mutant has become the first mutant microorganism to be registered for field applications.
  
15. Sixteen tonnes of 'Kesar' mangoes were successfully processed using a BARC and USDA-APHIS approved protocol involving chemical and radiation processing, resulting into first time commercial shipment of mangoes to USA by the sea route. Shipment reached USA after 25 days and was cleared by the United States regulatory agencies for marketing in the US.

16. BARC has developed a standard operating procedure for radiation processing of onion and potato to extend their shelf life. The quality remained unaffected as proven by the successful sale of 28 tons of potato and 15 tons onion, 8 months after storage. This technology will help towards price stabilization and ensure the availability of quality onions and potatoes during the lean periods.
  
17. An Agro Irradiation Facility (AIF) has been built and commissioned at Gamma Garden for demonstration of technologies of radiation processing of food grains using Cs-137 pencils. The Cs-137 source has been loaded in the facility and trial runs have been carried out.
  
18. BARC has developed a cost-effective and industry-friendly process for synthesis of Active Pharmaceutical Ingredient (API), o-Tolylbenzotrile (OTBN), which is an advanced intermediate for making drugs. This technology has been

transferred to a private entrepreneur and is expected to reduce import dependency.

19. Twelve lots of carrier-free  $^{90}\text{Y}$ -acetate solution were separated and supplied to RMC, Parel for radiopharmaceutical applications.

20. Type approval for hospital supply of Ru-106 paediatric plaque for brachytherapy was received from AERB. Two Ru-106 notched plaques and three round plaques were fabricated and supplied to four different hospitals. Ruthenium Brachytherapy Plaque Simulation Software was developed to assist doctors with optimal planning of treatment.

21. A 12500 LPH capacity BARC technology-based water purification unit has been deployed at Khardoi Border Outpost, Indo-Pak Border, Kutch, Gujarat to cater to the potable and non-potable requirements of BSF personnel. Four community-scale water treatment units, of 2000 LPH capacity each were, deployed in Gujarat and Odisha.



22. Two demonstration plants based on radiation-grafted cellulose matrix for removal of colours from industrial dye waste-water were installed at Jetpur in Gujarat and Jodhpur, in Rajasthan in collaboration with the industry. The plant has a treatment capacity of about 80,000 litre effluents with dye load of about 100 ppm.

**As part of our efforts in directed research a number of technologies have been developed and transferred to private entrepreneurs and PSUs. Several new technologies have crossed significant milestones. I shall briefly mention a few of them.**

23. Technologies for Electron Beam Welding, RF LINAC, Water Purification CLEAN Technology, Ultra Flexible Lead-free X-ray Shields, Radiation Monitoring Watch and Quick Scan Whole Body Monitor, have been developed and transferred to entrepreneurs.

24. Indigenous Cargo scanner has been qualified as per IEC standards and type approval for field deployment is under process at AERB.
25. Dissimilar metal welding for SS/Ti and Al/SS was successfully developed and demonstrated by magnetic pulsed welding.
26. A portable and plug-in type, high purity Hydrogen generator based on alkaline water electrolysis has been developed. It can produce 18 NLPH hydrogen of with more than 99.995% purity at 5 bar pressure which is ideal for chemical laboratory applications.
27. The experimental facility for demonstrating Iodine-Sulfur Thermo-Chemical process in metallic closed loop for producing hydrogen was successfully commissioned. The facility has been demonstrated to produce hydrogen at 150 NLPH for two hours.

28. BARC in association with ECIL and IGCAR has developed Safe and Secure PLC NUCON series 1000 and 2000. These secure PLCs find applications in several areas ranging from atomic energy to space to petroleum and power sector.
  
29. A cost-effective import substitute Environmental Gamma Spectroscopy System was designed and developed indigenously. It is a Thallium doped Sodium Iodide based standalone solar-powered and battery-operated system.
  
30. BARC has developed the technology for production of high purity metals Neodymium (Nd), Neodymium-Praseodymium (Nd-Pr), Dysprosium (Dy) as well as high purity Praseodymium (Pr), required for making different grades of Nd-Fe-B permanent magnets. These technologies are developed to utilize Indian ores for rare earths. Using BARC produced Neodymium metal, DMRL has converted it to Nd-Fe-B magnet and the magnetic properties exactly match the magnetic properties of the magnet produced using imported

Neodymium. The design of the equipment for producing Nd-Pr at 12 Tonnes/year scale has been provided to a private party to enable industrial production of rare earth metals for the first time in the country.

31. Compact Vacuum Pumps suitable to maintain Ultrahigh vacuum in sealed vacuum chambers have been developed. The pumps can maintain high vacuum even during power failure and will find usage in accelerator installations.
32. A 1K cryocooler based cryogenic system suitable to test Superconducting RF cavities has been designed and developed.
33. An inflatable, rapidly deployable "Portable Personnel Decontamination Unit" (PPDU) has been designed and developed for use during Radiological Emergency in Public Domain.

34. A dedicated supercomputing facility called “PRAGYA”, consisting of high-end GPUs and 48-core CPUs, for solving problems in the domain of Artificial Intelligence and Machine Learning has been developed.
35. Low Level RF control system (LLRF) including Resonance Control system (RCS) and RF Protection Interlock (RFPI) System has been developed and successfully commissioned.
36. The Low Energy High Intensity Proton Accelerator (LEHIPA) beam was accelerated from 3 MeV to 6.8 MeV in February, 2022 with a current of 2 mA and then to 11 MeV in May, 2022. In both instances beam operation was conducted 24x7 for over a week, to ensure repeatability and stability of the beam.
37. A sealed compact D-T neutron generator has been developed indigenously for the first time using all in-house developed components. The neutron generator was

successfully used to detect U-072 and U-042 grades of uranium ores at AMD.

38. The indigenously developed MACE telescope at Hanle is now fully deployed for carrying out science observations. The telescope has recently detected very high energy gamma-ray photons from an Active Galactic Nuclei known as Markarian 501.

39. BARC scientists also characterized the black hole in the black hole x-ray binary MAXI J1348-630 which was discovered in 2019.

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

40. To give further impetus to paperless office, the pension processing module was developed for AAIS. It will expedite the processing and reduce the tedium of manual filling of pension forms by retiring employees.

41. The South Site Park, developed in early 1970s at BARC Trombay to serve as a repository of living botanical specimens, is being revived and renamed as the “Bhabha Botanical Garden”. Further, a dedicated website on flora and fauna found within BARC Trombay campus and Anushaktinagar residential colony has been launched.

42. BARC synchrotron beamline facility at RRCAT Indore has been used for material characterizations. It has effectively catered to 209 research groups from all over India, which includes 104 non-DAE institutes and 3 pharmaceutical industries.

43. I have great pleasure to announce that a PAN-INDIA scheme has been introduced for all CHSS beneficiaries. This liberalized scheme aims to seamlessly integrate all CHSS stations and facilitate beneficiaries to avail medical facility at any of the CHSS stations.

44. The medical facilities in BARC Hospitals have been upgraded. It included installation of an MRI machine, necessary software development to deliver Pathology/Radiology reports to CHSS beneficiaries on their registered personal email-ID and cashless medicines facility for Anushaktinagar CHSS beneficiaries.

I am immensely happy to congratulate following of our colleagues for recognitions received by them.

45. Dr. A. K. Tyagi, Director Chemistry Group has become a Fellow of the World Academy of Ceramics, Dr. S. M. Yusuf, Director Physics Group received the Distinguished Lecturership Award of the Materials Research Society of India (MRSI). It is also worth mentioning here that Dr. Sugam Kumar of Solid State Physics Division has been awarded the 'Young Scientist Platinum Jubilee Award-2021' of The National Academy of Sciences, India.



Dear colleagues, the achievements presented in this address are just a gist of our accomplishments in the very recent times. They represent the collective effort of all our employees who have contributed in equal measure to this large team effort. I urge them to continue to serve the organisation with the same spirit of teamwork and cooperation which has fetched rich dividends to the organisation and 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 Post Offices, Banks, and Credit Societies of BARC and Anushaktinagar, who have been providing good services to our employees.

Dear colleagues, even as we march steadily forward, let us rededicate ourselves to vigorous scientific efforts to achieve the dream of 'Sampoorna Atma Nirbhar Bharat' and go one step further to strive and reattain the glory of 'Jagat Guru Bharat', a position which we held for long periods of time in our rich history.

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

**Thank you & Jai Hind**