

## **Founder's Day Address 2023**

**by**

**Director, BARC**

Secretary DAE, distinguished invitees, senior colleagues of DAE family, ladies and gentlemen,

I welcome you all on this august occasion of 114<sup>th</sup> birth anniversary of the legendary founder of this great institution, Dr. Homi Jahangir Bhabha. We have gathered here to pay homage to this great visionary who is not just the Father of Indian Nuclear Programme but was a par-excellence persona who gratified scientific scenes of Newly Independent country. He was instrumental in putting the country on the course of a science and knowledge driven society that India was always known for. His excellent leadership, farsighted and imaginative scientific development path has been a guiding light for us. Today, when country is looking forward to Amrit Kaal and our institution is about to complete 70 years of excellent work, his philosophy still encourages us to achieve highest standards in scientific arena and in particular, guides us to be self-reliant in all sphere of nuclear sciences. It has been the mantra at BARC to target very high and put in all the scientific might to achieves the goals.

During last year too, BARC continued to carry out its mandated activities and successfully achieved the set goals. Our multipronged programmes encompass all fields of nuclear sciences, ranging from fundamental to applied research, technology development in the entire gamut of nuclear fuel cycle, health care, nuclear agriculture, nuclear medicine, water & water management and various other areas. Further, BARC significantly contributes to development of socially relevant technologies.

I take this opportunity to share some of the notable achievements during the year.

**A. Beginning with the front end and back end programmes of nuclear fuel cycle,**

1. Research reactor Dhruva and Apsara-U continued to safety operate with overall availability factor of 75 % and 85%, respectively.
2. Around 620 samples were irradiated in Dhruva during the year. 5 trial consignments of fission Moly plates were irradiated and delivered.
3. Critical Facility was operated on 65 occasions for testing of 38 nuclear detectors and activation of 134 large volume samples for Neutron Activation Analysis.
4. Regular production of fuel for FBTR, Dhruva and Apsara-U research reactors was continued to ensure reactor availability at the desired power level.
5. Regular production of U-Pu MoX fuel for PFBR.
6. Aging management activities taken up in Plutonium Plant were successfully completed and all systems were tested. The plant resumed regular operation after obtaining necessary regulatory clearances.
7. Radioactive waste management facilities at Trombay, Tarapur and Kalpakkam continued their operation safely. Reprocessing facility at Kalpakkam, KARP-II, also continued its safe operation.

8. Irradiated pressure tubes from Madras Atomic Power Station-1 (MAPS-1) were subjected to detailed post irradiation examination for characterization of pits and determination of chemical, microstructural and mechanical properties.
9. Post irradiation mechanical properties of calandria tube after long term exposure in PHWR environment were determined for the first time.
10. PRABHAVINI version 4.0, the reactor severe accident analysis software, was released for distribution to the users. Currently, the software is capable of performing safety analysis of normal and postulated off-normal conditions of power and research reactor along with public risk assessment as a part of design and licensing requirements.

**B. I shall now present some of the recent developments in the area of nuclear medicine and health care**

1. 153 Ci quantity of [ $^{177}\text{Lu}$ ]LuCl<sub>3</sub> radiochemical formulation with adequate specific activity and purity as radiopharmaceutical precursor was produced using isotopically enriched target prepared indigenously at BARC and 139 Ci of the product was supplied for targeted cancer therapy.
2. Special Plate Fuel Facility is fully commissioned and operationalised. The LEU target plates fabricated from the facility are handed over to Fission Molly Plant on regular basis for successful production of medical grade Fission Molly radioisotope.

3. During this period, a new variant of the Ru-106 plaque namely the 'Crescent moon configuration' was developed, and granted regulatory clearances by AERB. Supply of Y-90 to RMC in highly pure form for medical use has been continued as per requirement.
4. Phase 2 Clinical trial of Chlorophyllin in patients suffering from radiotherapy induced urinary bladder toxicity showed significant therapeutic efficacy.
5. A fluorescence ratio metric sensor was developed for creatinine detection in aqueous media for early diagnosis of kidney disorders.

**C. Another area where BARC contributes significantly is the food and water security of the country. Some important developments in this area are as followed.**

1. Two high yielding and multiple diseases resistant new blackgram crop varieties, namely Trombay Jawahar Uridbean -339 (TJU 339) and Trombay Jawahar Uridbean -130 (TJU-130) were notified for commercial cultivation.
2. Cs-137 based miniature Agro Irradiation Facility (AIF) has been operationalized at Gamma Garden, BARC.
3. Under the DAE's Project on 'Deployment of water purification technologies in rural & remote locations of India', domestic & community-scale water treatment units have been installed, commissioned and handed over to 130 equivalent villages of India for

removal of various contaminants like arsenic, fluoride, iron, nitrate and salinity.

4. After successful demonstration of radiation grafted cotton based 30 kilo litre per day plant to industry by treatment of effluent generated by cotton dyeing industry, the capacity of existing plant has been augmented to 75 kilo litre per day.

**D. Development of new technologies has always been one of core domains of BARC. I shall now draw your attention to some of the important and noteworthy contributions in this regard.**

1. Low Energy High Intensity Proton Accelerator (LEHIPA) has been operated successfully to demonstrate acceleration to rated energy of 20 MeV on 04<sup>th</sup> August 2023. Presently, beam intensity of 2 mA has been achieved.
2. PLCs developed indigenously by BARC and ECIL are being increasingly used for process control in recycling facilities.
3. Indigenous single view X-ray Baggage Scanner, with homegrown 1280 CsI-photodiode detectors for high and low energy X-ray imaging, has been developed. The system is equipped with in-house scanning & analysis software, data acquisition system and front-end electronics.
4. A Prompt Fission Neutron Logging Probe has been developed using the indigenously developed sealed D-T neutron generator, for on-site uranium ore quantification during borehole logging. The system has been successfully operated in the field trials.

5. The technology for CsI:TI single crystal based one dimensional pixelated detectors has been developed indigenously in BARC as an import substitute.
6. Prototype alkaline water electrolyser cell module of 0.5 MW rating was fabricated and tested for hydrogen production. The technology conforming to international standards has been transferred to 12 entrepreneurs. The indigenously developed technology for making of membrane used in the electrolyser has been transferred to 4 industries.
7. A first of its kind integrated facility for hydrogen production by Cu-Cl thermochemical cycle was commissioned and production of hydrogen at 5 NLph throughput was successfully demonstrated for a period of 40 hours.
8. Advance Effluent Water Treatment Plant (AEWTP) based on micro-bubble ozonation technology developed at BARC to treat oil contaminated effluent water successfully demonstrated at ONGC Mehsana under an MoU between BARC and ONGC Energy Centre Trust (OECT).
9. A water-repellent jute has been developed by high energy assisted chemical modification as an alternative to plastics for safe storage in humid areas.

**E. BARC also works in forefront of research basic and applied sciences. Some of the developments are enlisted here.**

1. A Certified Reference Material (CRM) of Bauxite (BARC B1201) has been developed and released in collaboration with National Aluminium Company Limited (NALCO). An in-house Reference Material (RM) for Zirconium diboride ( $ZrB_2$ ) was prepared as it finds wide applications in nuclear, space and defence sectors.
2. The MACE telescope, located at Hanle in the UT of Ladakh, detected two historical giant gamma-ray flares from the radio galaxy NGC 1275. Statistically significant gamma-ray emission has also been observed from the direction of an active galactic nuclei 1ES 1959+650. A team of 28 young delegates, belonging to diverse fields from ten nations, visited the MACE telescope.
3. A total of 15 Sodium Iodide (NaI:TI) single crystal based detectors were made and incorporated in the Backpack Gamma Spectrometer System (BGSS) for radiation surveillance at the G-20 summit at New Delhi.
4. A multi-purpose neutron radiography beamline has been set-up at Apsara-U for implementing thermal and epithermal neutron radiography, fast & thermal neutron induced mutagenesis and other neutron based elemental analysis techniques.
5. BARC for the first time generated a natural background radiation (NBR) dose-rate (cosmic and terrestrial components) map of India using more than 100,000 survey data points.

6. Indigenously developed 5 ton, six degree of freedom, electro-hydraulic servo shake table facility has been commissioned for seismic qualification of structures, components and equipment.
7. BARC has always strived to keep updated with times and newer technologies. In this context, Centralized Data Storage Facility of BARC has been upgraded by 15 PB to meet the increasing requirements on ANUPAM, AMBAR & Megh facilities. In order to expedite training of AI applications on AI Supercomputing platform 'PRAGYA', a 1 PB high throughput data staging system has been developed.

Dear colleagues

The achievements enlisted here are part of elaborate activities of BARC during last year. Our scientists continued to contribute to the scientific knowledge in outstanding manner. The quantity and quality of the research work published by our scientists is reflected highly by the various indices. Several BARC scientists and engineers were honoured during last one year. Dr. A.K. Tyagi has been elected as a 'Fellow of Indian National Science Academy'. He has been selected for Distinguished Materials Scientist of the year award by Materials Research Society of India (MRSI) as well as for D.N. Agarwal Memorial Award of Indian Ceramics Society. Dr Sandip Basu was conferred the 'Fellowship of the National Academy of Medical Sciences'. Dr. P.K. Singh has been selected as a 'Young Affiliate of The World Academy of Sciences'. Dr. Celin Acharya was elected 'Fellow of Maharashtra Academy of Sciences - Life Sciences'. Dr. Mayanak Kumar Gupta has received the 'INSA Associate Fellowship'. Dr. Dhiman Chakravarty was conferred with the NASI-



Platinum Jubilee Young Scientist Awards by National Academy of Science India. Dr. Archana Sharma was conferred EMC engineer awards by SEMC(I) and Member Achiever Award by Asia-pacific jury during golden jubilee celebration of Indian Women Scientist Association (IWSA). Dr. Veerendra K. Sharma, has been selected for Society for Materials Chemistry (SMC)'s Bronze Medal and Dr. Dimple Dutta has been selected for MRSI Medal. In the fire services department, Shri R. S. Agrahari was awarded President's Award on the occasion of Republic Day – 2023 for meritorious service and Shri E K Nile was awarded Director General's Bronze Disc and Commendation Certificate.

I would like to take this opportunity to acknowledge the role played by every individual, section, division and group, who have contributed collectively to this magnificent team effort.

All facilities and projects of BARC are functioning with excellent safety record thanks to the excellent regulation enforced by BARC Safety Council.

I would like to express my sincere gratitude to all, who have worked to ensure that the machinery & ecosystem of BARC runs smoothly. This included services provided by Administrative Group, Medical Group, Engineering Services Group, Knowledge Management Group, Security Section, CISF, Fire Safety Section, Landscape and Cosmetic Maintenance Section, Transport & Catering Sections and many more who individually and collectively contributed silently to the success of this organization. Our acknowledgements are also due to the other service providers such as BARC Credit Society, State Bank of India & Indian Post, who are stationed at our campus and provided services to our employees.

Special thanks are also due to the unions and associations for their support and cooperation.

**Thank you and Jai Hind**