

Founder's Day Address

Director, BARC

Chairman, AEC, Senior Members of the DAE Family, Distinguished Invitees, Representatives of the Media, my dear Colleagues, Ladies and Gentlemen,

It is indeed my pleasure and proud privilege to extend very warm greetings to all of you on the occasion of the 110th Birth Anniversary of Dr. Homi Jehangir Bhabha, which is observed every year as Founder's Day of BARC.

It has been our tradition to pay respectful homage to our visionary Founder, Dr. Homi Jehangir Bhabha, on his birth anniversary.

Dr. Bhabha's played an important role in framing the science and technology policies of post-independence India and building infrastructure and capabilities to move forward on the policy objectives. He established the Department of Atomic Energy as a front line organisation to develop atomic energy as a source of electrical power and to promote its use in agriculture, industry and medicine. We have been largely successful due to the guiding principles laid down by this great man - not only in fundamental research aimed at adding to the sum total of human knowledge but also in carrying out technology development to implement our programmes within the ambit of requirements and available resources.

I shall now be briefly highlighting some of the major activities and achievements of the past year. Our programmes are multipronged- encompassing research and technology development pertaining to nuclear fuel cycle, developing and deploying technological solutions to societal problems requiring urgent remedies as well as R&D in basic and applied sciences to extend the frontiers of knowledge.

A. India has been following a closed fuel cycle and I shall now present some of the important activities and achievements in the front end and back end technologies

1. Research reactor Dhruva continued to operate with a high level of safety and availability at the rated power of 100MW. 670 samples were irradiated and delivered to the radiopharmaceutical Division. Apsara-U reactor was operated at 90% of rated power after achieving first approach to criticality on September 10, 2018. Trial production of radioisotopes including carrier free Cu-64 radioisotope for use in PET scan has been commenced.
2. Calandria Tube Rolled Joint Detachment System for removal of calandria tube of 220 MWe PHWR has been developed and deployed successfully to remove calandria tube of Q15

lattice position of KAPS-1 unit. This is the first instance of a calandria tube being successfully withdrawn from Indian PHWR for surveillance purposes.

3. An experimental facility **Dhruva Utilisation for Research using Gamma Array - acronym DURGA** consisting of four clover Germanium and six LaBr₃(Ce) scintillation detectors has been developed at Dhruva reactor to study nuclear spectroscopy of neutron rich nuclei produced in thermal neutron induced fission of ²³⁵U.
4. An experimental facility viz., mini-ISMRAN- Indian Scintillator Matrix for Reactor Anti-Neutrino detection has been deployed for measurements on reactor anti-neutrinos with the reactor in the running and shut down conditions.
5. Production of Uranium-Plutonium Mixed Carbide Fuel for FBTR was continued at highest rate. As a result, the FBTR is operating at a highest power so far. Fuel Fabrication Facility at NRB Tarapur has qualified a first of its Kind equipment for laser welding of the top end plug of PFBR pins inside a glove box.
6. Indigenously developed automated guided vehicle (AGV) has been commissioned at the New Uranium Oxide Fuel Production Plant (NUOFPP), NFC for transfer of pellet boats between compaction and sintering stations. Deployment of AGV will increase throughput of fuel fabrication process.
7. At the back end, reprocessing plant of NRB at Tarapur achieved a major milestone in its cumulative output in the month of July this year. The reprocessing plant at Kalpakkam is back on line after a major maintenance shutdown and continues to operate at its rated capacity. Joule heated Ceramic Melter, hot commissioned in December 2017 at WIP Kalpakkam continues to function without any stoppage.

B. BARC is known to be a technology powerhouse, with technology development across multiple domains remaining one of our core activities. I shall now draw your attention to some of the important and noteworthy contributions in this regard.

8. Technologies for Production of Tungsten Metal Powder as well as Fabrication of Tungsten and Tungsten Heavy Alloy shapes have been developed and also transferred to a private entrepreneur.
9. The Radio-Frequency Quadrupole (RFQ) of the Low Energy High Intensity Proton Accelerator (LEHIPA) has been successfully commissioned on 16 April 2019 and pulsed proton beam of 3mA current has been accelerated to 3 MeV.

10. A pilot plant facility of 15 Kg/batch capacity for the recovery of cobalt from Spent Ammonia Catalyst was transferred to Heavy Water Board for processing of spent catalyst stored at their facilities.
11. The ergonomic design for a fully automated PC controlled carbon-sulphur analyser (CS analyser) for the simultaneous determination of carbon and sulphur in solid samples has been completed and the prototype made ready.
12. Installation of the 21m diameter MACE (Major Atmospheric Cherenkov Experiment) telescope being set up at Hanle, Ladakh is at an advanced stage with the mounting of 356 mirror panels required for telescope. Trial runs of the telescope with 50 mirror panels and 64 Camera Integrated Modules have been completed successfully and analysis of around 40 hours of data collected with the telescope indicate satisfactory performance of various subsystems of the telescope.
13. A new parallel supercomputer 'ANUPAM-ATULYA', delivering a sustained performance of 1.3 Petaflops has been developed. This is the first system in the ANUPAM series to cross the significant milestone of 1 Petaflops.
14. A continuous pH monitoring system for slurry media and suitable for industrial batch application has been developed and the technology transferred to a private entrepreneur.
15. Special shapes of beryllium components have been made for indigenous development of Polarimeter Instrument in X-rays, named POLIX, undertaken by Raman Research Institute, Bangalore.
16. Red-Mud obtained from NALCO, Bhubaneswar was characterized and conditioned by employing suitable temperature and additives and the sintering conditions for obtaining model bricks with high chemical stability and mechanical integrity have been optimized.
17. An indigenously developed Induction Heated Vacuum Hot Press has been commissioned for the diffusion bonding of dissimilar metals. This indigenous development will support mass production of dissimilar metals joints with high strength and stringent quality requirements of reactor components.

C. I shall now bring out some of the recent accomplishments towards extending the use of nuclear medicine and radiation therapies for diagnosis and cure of several ailments including cancer

18. A novel Ga 68-based radiopharmaceutical has been indigenously developed and clinically evaluated in human patients for non-invasive monitoring of breast cancer and lung cancer by PET imaging.

19. Aready-to-use clinical formulation of Lu177-HA has been developed for radiation synovectomy in the treatment of inflamed medium sized joints such as elbow, ankle and wrist for the reduction of pain and swelling.
20. 10 numbers of Ru-106 plaques for eye cancer treatment have been fabricated from purified Ru-106 recovered from radioactive waste. A leading hospital is currently involved in the performance evaluation in the treatment of eye cancer.
21. A methodology has been developed for the formulation of medical grade $^{64}\text{CuCl}_2$ using Dhruva reactor to develop an alternative PET radiopharmaceutical for investigating recurrent prostate cancer and neuroblastoma. After successful preclinical investigations and RPC approval, clinical investigation was carried out in TMH and RMC on prostate cancer patients and a patient with suspected brain tumours. The studies have shown encouraging results in prostate cancer and Glioblastoma multiform imaging.
22. High specific activity clinical grade Y-90 Acetate in the range of $\sim 140\text{-}160$ mCi was separated using two stage SLM based Sr90-Y90 generator system and supplied to Radiation Medicine Centre, Parel, BARC, Mumbai for radiopharmaceutical applications.

D. Serving the societal causes with contributions to the food security agenda of the nation has remained one of our important mission objectives. Some noteworthy contributions are as follows:

23. Trombay Cowpea Mutant Variety (TC-901), Trombay Bidhan Mustard-204 (TBM-204) and Trombay Linseed Variety (L-99) have been released and notified by the Central Sub-Committee on Crop Standards Notification and release of Varieties-Ministry of Agriculture and Farmer's Welfare. These crops are expected to enhance the production of these crops in a significant manner. The official number of Trombay crop varieties now stands at 46.
24. An eco-friendly protocol for increasing the shelf life of mangoes stored in cold storage facilities has been developed and successfully tested for the preservation of Kesar mangoes for upto 40 days.
25. A popular variety of tomato in Maharashtra (Syngenta 1057) used for delay in ripening and shelf life extension studies showed delay in ripening of up to 23 days when irradiated at 1.0 kGy and stored at 10 °C. The total shelf life of tomatoes stored at 10 °C was around 60 days while retaining the nutritional parameters.
26. A Technology Demonstration Pilot Plant for Sewage Sludge Hygienisation set up in collaboration with Ahmedabad Municipal Corporation (AMC) was inaugurated in February 2019 and is in continuous operation since then.

27. A hybrid biofilm granular sludge (HBGS) based technology has been developed for the treatment of waste water. This technology significantly reduces the land footprint and plant cost as compared to conventional waste water treatment techniques.
28. Cellulose based radiation grafted matrix has been developed for efficient removal of arsenic from water to provide safe drinking water. The technology has been transferred to two private entrepreneurs.
29. A first of its kind plasma based incineration facility has been commissioned with actual waste at 25 kg/hr capacity for processing of mixed cellulosic, rubber and plastic waste with negligible toxic gas generation.
30. Aerial Radiation Monitoring Exercise have been jointly conducted with US Department of Energy (DoE) at Nevada National Security Site (NNSS), Las Vegas, Nevada, USA. Two Aerial Gamma Spectrometry Systems (AGSS) developed by BARC were installed along with Aerial Measuring System of US DoE in a Helicopter. The measurements carried out by both the teams were found to be comparable.

E. Some of the other significant contributions deserving mention are as follows

31. BARC has recently been recognized by the National Accreditation Board for Testing and Calibration Laboratories (NABL) with the "Certificate of Accreditation", authenticating the competence of ACD in chemical testing for "Metals & Alloy" and "Water", which are the major analytical activities in the Division. The certificate is valid up to 19th March, 2022.
32. Towards appropriate manpower development for augmenting Nuclear Medicine services, two new post-graduate courses viz. Nuclear Medicine & Molecular Imaging Technology & Hospital Radiopharmacy are being introduced at RMC, the latter being the first course on Hospital Radiopharmacy being introduced in the country.
33. Dr. S. Patwardhan Raghavendra has been awarded with Young Scientists Indian National Science Academy Award for developing a plant based radioprotector formulation for applications in lowering the risk of normal tissue radiation toxicity in cancer treatment. The work has been granted a US patent and is being incubated with a pharmaceutical company for deployment.
34. Implementation of the official language is being carried out with considerable success and BARC has been awarded for three consecutive years in the category of central government offices for excellent implementation of Official Language.

37. Cyber security has been enhanced by the development and deployment of a big-data analytics platform for passive network security monitoring of Internet/Intranet traffic at the centre.

What I have mentioned today are only some of the achievements, aimed at providing a glimpse of the breadth and scope of our activities. As it is apparent, we have a large footprint across many spheres of activities in the nuclear science and technology arena which shall always remain one of our prime mandates. However, these contributions are substantially augmented with our contributions to the health care, food security and other sectors, primarily as spin-off benefits of the nuclear sector but often as standalone activities as well. Such outcomes have been enabled by our top-class research facilities and outputs, as evident from the excellent track record in terms of quality and quantity of our scientific and technical publications, with the average citation index, h-index and number of publications from our organisation being consistently high as seen in a recent analysis.

There are numerous other achievements which have been made possible due to the sustained efforts of our scientists and technologists and which I could not present before you due to the paucity of time. I take this opportunity to acknowledge the role played by every individual, group, section and division who have contributed collectively to this magnificent team effort.

Sincere expression of gratitude is also extended to personnel of auxiliary services and support personnel who work tirelessly behind the scenes to keep the machinery and ecosystem of BARC running smoothly. This includes the services provided by the Medical Group, Engineering Services Group, BARC Safety Council, Scientific Information Resources Division, Personnel &Accounts Divisions, Security Section, Fire Safety Section, Landscape and Cosmetic Maintenance Section, Transport & Catering Sections and many more, who individually and collectively contributed silently but whole heartedly to the success 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.

Thank you and Jai Hind