

Founder's Day Address 2020

by

Dr Ajit Kumar Mohanty

Director, BARC

Chairman AEC, senior colleagues of DAE family, distinguished invitees, representatives from media, my dear colleagues, ladies and gentleman,

It is a proud moment for me to be part of this great tradition of celebrating Founder's Day and pay respect to our visionary founder Dr. Homi Jehangir Bhabha on his 111th birth anniversary. I extend very warm greetings to all of you on this auspicious occasion.

Dr. Bhabha was not only founder of Department of Atomic Energy but also a guiding light for the entire scientific community in the country. He was instrumental in framing the science and technology policies required for a young country like ours and also in establishing several institutes which became the building blocks of development in the country. The guiding tenets of this great visionary are the main reason for the substantial success achieved by us in fundamental science as well as in technological developments.

As you are all aware, part of the year 2020 has been challenging due to the outbreak of COVID-19 pandemic. In spite of this, spirit of DAE to stand against all odds and achieve the objectives has come to fore once again. Our staff has taken the challenge head-on and ensured that work progressed at good pace.

During the year since the last Founder's Day, BARC has carried out many activities in line with our department's mandate and there have been many achievements to our credit. As you are aware, our programmes are multipronged, encompassing fundamental research, applied research, technology development in the entire gamut of nuclear fuel cycle, in health care, nuclear agriculture, nuclear medicine, water & water management and various other areas. Developing various technologies for societal benefits has been an important consideration in our activities.

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

A. The Indian nuclear programme follows a closed fuel cycle and I shall now present some of the important activities and achievements in the front end and back end programmes

1. Research reactor Dhruva continued to operate with a high level of safety and availability. The overall "Availability Factor" (AF) since last Founder's Day has been 70%. Around 600 samples were irradiated during the year and radioisotopes for medical and industrial applications were delivered.

2. Our support to the nuclear power programme continued. A prototype multichannel user configurable data acquisition system for monitoring of Vibration and Pressure Pulsation in PHT system of 700 MWe PHWR has been developed and is ready for field trials.
3. A tool, based on eddy current technique has been developed to measure the gap between Calandria Tube and Poison Injection Unit for 540 MWe PHWR. This has been qualified at TAPS 3 & 4 through BARCIS 540 system.
4. Automation of offline analysis of Uranium in aqueous solution drawn from the Uranium extraction process was successfully developed, deployed and tested, providing efficient control of process.
5. In the area of rare earths, technology for 99.99% high purity yttrium oxide production, preparation of lanthanum metal by molten salt electrolysis technique and preparation of europium doped yttrium vanadate lamp phosphor were developed and technology transferred to IREL.
6. Titanium Aluminum Carbide (Ti_2AlC), a MAX-phase carbide for accident tolerant Zircaloy fuel tubes with high temperature oxidation resistance in air and steam environment was successfully synthesized from elemental Ti, Al and C powders.
7. A simple, selective, cost- effective and rapid spectrophotometric method for the determination of ammonia in 10-500 ppb

concentration range in the secondary coolant of nuclear power reactors was developed.

8. In the back end of nuclear fuel cycle, a novel and more efficient process for recovery of nuclear pure zirconium and hafnium directly from zirconium frit powder was demonstrated on pilot scale.
9. Waste management facility at Trombay treated High Level Waste to recover valuable radio-isotope Cs for societal application. 30 numbers of Cs glass pencils were produced and supplied to BRIT for use in blood irradiators.
10. Recently, Uranium Oxide Facility for processing Uranyl nitrate Pure Solution was hot commissioned at Kalpakkam.

B. Development of new technologies has always been one of our core domain which has made BARC a technology powerhouse. I shall now draw your attention to some of the important and noteworthy contributions in this regard.

11. A 4-Tesla superconducting magnet for high gradient magnetic separation system was developed and qualified for its magnetic and thermal performance and commissioned.
12. About 2 kg of pure Neodymium metal required for making Nd-Fe-B permanent magnets was prepared from its fluoride by calcio thermic reduction process.

13. Cold plasma was employed in pollution mitigation and synthesis of useful chemicals. Synthesis of salicylic acid has been demonstrated using pollutants such as benzene and CO₂.
14. A Gold nanoparticles based plasmonic nano-sensor was developed and demonstrated for the visual detection of milk adulterant melamine.
15. A unique programme was undertaken for the production of certified reference materials to cater the needs of DAE and non-DAE institutes as well Indian industrial & social sectors. Under this programme, this year in-house reference materials were prepared for evaluating the concentration of trace elements viz. Al, Ca, Cr, Cu, Mg, Mn, Zn, Ni in soil.
16. A plasma gasifier plant based on three 30 kW air plasma torches with 1TPD capacity was made operational for waste incineration/gasification studies.
17. Extensive studies using animal models confirmed that an in-house developed radio-protector DSePA is a potential anticancer agent for the chemotherapy of leukemia and lung cancers. An US patent has been filed for the same.
18. Materials and methodology were developed jointly by BARC and Security Printing & Minting Corporation of India Ltd. Dewas, to prevent counterfeiting of the important government documents. A MoU has also been signed for the final testing as well as large scale preparation of the material.

19. An ultrasonic technology based, minimally invasive, self-calibrating instrument which employs a novel and robust signal processing algorithm was developed to detect liquid-liquid interface in process vessels in industrial environment.
20. A 4-tube tantalum membrane reactor of 50 LPH capacity was developed and demonstrated for enhanced hydrogen iodide (HI) to hydrogen conversion and ultrapure hydrogen production in Iodine-Sulphur (IS) thermochemical process. This is first of its kind development involving refractory metal-based membrane reactor.
21. Indigenous development of 8kV Energizers for Electric fence-based Perimeter Intrusion Detection System was completed. In addition to intrusion detection, it deters the intruder by giving a very sharp and irritating but non-fatal electric shock.
22. Indigenously developed import substitute Prussian blue active ingredient of international standard was successfully incorporated into blank gelatine capsule.
23. The first international publication using the indigenous Particle-In-Cell code PASUPAT was reported this year. PASUPAT is a fully indigenous 3D Particle-In-Cell code developed at BARC.
24. Quadrupole and dipole magnets, developed and qualified by BARC, were delivered to Fermi National Accelerator Laboratory under inter-institutional collaboration. One RF amplifier was also delivered, installed and commissioned at Fermilab under same programme.

25. BARC supplied indigenously designed and developed electronic system for Beam Position Monitors of Linac to GANIL France. This electronic system was successfully used for tuning the linac with beam.
26. High quality, reusable HEPA mask was designed, developed and tested for effective removal of all sub-micron size particulate matter from air, including SARS-CoV-2 virus particles.

C. I shall now bring out some of the recent developments in the area of nuclear medicine

27. To ensure local availability of radiopharmaceuticals, seven radioisotope-based medical formulations have been developed by BARC. Production technologies along with QC monographs of these seven products were transferred to BRIT for large scale production and commercial supply to hospitals.
28. No-carrier-added ^{64}Cu isotope produced using APSARA-U reactor, received regulatory clearance for clinical utilization in India. A radiochemical separation process was developed to obtain the product for non-invasive diagnosis and staging of different types cancers by positron emission tomography (PET).
29. Ten batches of high specific activity, clinical grade ^{90}Y -acetate in the range of ~140-160 mCi were separated using two-stage Supported Liquid membrane(SLM) based ^{90}Sr - ^{90}Y generator system and supplied to Radiation Medicine Centre for radiopharmaceutical applications.

30. Fifteen ^{106}Ru eye-plaques developed by BARC for ocular brachytherapy were evaluated for their dosimetric performance. Dosimetry of four notched and rounded plaques was also carried out using EBT3 film and indigenously developed image based dosimetry system.

D. It has always been our strong intent and important mission to contribute for the food and water security of the country. Some important developments in this area are as follows:

31. A surface treatment protocol was developed using GRAS chemicals and edible coating for shelf life extension and quality retention of kinnow fruits. The shelf life increased from 20 days to 45 days.
32. A sustainable micropropagation protocol was developed for pineapple and turmeric. This offers a continuous source of numerous uniform sized and disease-free plantlets in a relatively short span of time and space.
33. Superior crops varieties such as Trombay Linseed Genotype TL- 99, Trombay mustard variety TBM-204 and Rice variety 'TKR Kolam' were approved by Ministry of Agriculture & Farmers Welfare, Government of India.
34. A BioKit for detection of group of Organophosphate (OP) and Organocarbamate (OC) pesticides for qualitative detection of presence of pesticides in food commodities such as vegetables and fruits were developed.

35. Under the DAE Vision-6 Project on 'Deployment of Water Purification Technologies in 50 villages in India', 1000 LPH water treatment plants based on RO technology were commissioned at villages of Maharashtra and West Bengal. Plants have water ATM facility in which water is dispensed at a nominal cost using a preloaded card. These efforts are in alignment with the Jal Shakti Abhiyan and Jal Jeevan Mission of Government of India.
36. A more efficient thermal seawater desalination technology based on Multi Effect Distillation-Thermal Vapour Compression (MED-TVC) has been indigenously developed. This technology has been demonstrated and product water is provided to Dhruva Reactor for fulfilling their make-up water requirements with minor polishing.

Dear Colleagues

As you can see our Centre has substantially contributed in the areas of health care, food security and other sectors, which are primarily spin-offs of the nuclear sector but are generally major activities on their own.

The excellent quality and quantity of our scientific and technical publications with high citation and other indexes speaks volumes for the quality of research carried out at BARC.

Our scientist Dr. Kinshuk Dasgupta of Materials Group was conferred Dr. Shanti Swarup Bhatnagar award for excellent contribution in development of 'Bhabha Kavach', an indigenous bullet proof jacket.

The Sugar Technologists' Association of India (STAI) appreciated the work carried out by the Department on Chitosan-Silvernano-composite-Trichoderma for sugarcane production enhancement by awarding silver medal during annual convention meeting of STAI.

I have only presented few achievements that our Centre has made during the year. This could be achieved only due to the sustained efforts of our scientists and technologists. I would like to take this opportunity to acknowledge the role played by every individual, section, division, group, 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 have worked tirelessly behind the scenes and ensured that the machinery and ecosystem of BARC runs without any hiccups. This included services provided by Medical Group, Engineering Services Group, BARC Safety Council, Scientific Information Resources Division, Personnel & Accounts Divisions, Security Section, CISF, Fire Services Section, Landscape & 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 other service providers such as BARC Employees Co-operative Credit Society Ltd., State Bank of India and India 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