

On the occasion of the 72<sup>nd</sup> Independence Day of India, I extend my greetings to all the dignitaries, invitees and colleagues & school children gathered here for this occasion. As has been the tradition, we have just witnessed an impressive parade by our security forces and I have had the privilege of hoisting the national flag. Lakhs of such flags shall be hoisted today across the length and breadth of the country, arousing in the citizenry a sense of pride and patriotism which serves to energise the nation in its forward march. However, on this joyful occasion, one must never forget the difficulties and obstacles which have been faced by our fellow countrymen and our pioneers in the path of this progress, which has not been achieved quickly or easily. It takes blood, sweat and tears to move forward and, we have to continue to move on steadily, with grit and determination for our Nation.

As a premier R&D organisation and mother institute of DAE, the activities of BARC span a gamut of domains and disciplines which have been aligned into thirteen vision categories. In the next few minutes, I shall be highlighting some of the important activities and achievements of BARC under these vision categories during the past year. The list is not complete and comprehensive, but within the constraints of time available, it shall be my endeavour to showcase the wide range and depth of our activities.

A. Beginning with the contribution to **First and Second Stages of Nuclear Power Programme** which, encompass the first three vision categories, a few of the highlights are as follows.

1. BARC continues providing support for in-service inspection of reactor coolant channels of various NPPs. Recently, more than 50 channels have been successfully inspected at TAPS-3, MAPS-1, KAPS-2 and RAPS-2 using the BARCIS tool.

2. Research reactor Dhruva continued to operate with a high level of safety and availability. During this period, a technically challenging first of its kind repair of the primary heat exchanger system as well as the refurbishment of several other systems to enhance safety, improve operational convenience and extend the life time of the reactor, were successfully completed in a short duration of 65 days.
3. Installation and commissioning of the first of its kind research reactor simulator – ‘Dhruva Simulator’, has been completed at Dhruva reactor complex, BARC, Mumbai. The simulator was dedicated to the nation by the Hon’ble President of India on May 15, 2018 during his visit to BARC.
4. NFG has continued to meet the requirement of fuel supply of different reactors namely Dhruva and FBTR.

Substantial achievements have also been made in the development of waste management technologies. I shall now present some of the highlights

1. The waste management plants at Tarapur and Kalpakkam are operating well to meet the waste management requirements of BARC and NPCIL Plants. Facility for Treatment of organic liquid waste by alkaline hydrolysis process is hot commissioned and regular operations have commenced.
2. The Joule heated Ceramic Melter at Waste Immobilization Plant, Kalpakkam has been commissioned and is producing vitrified product canisters at the rated capacity.

3. Plasma incinerator for incineration of solid waste has been constructed and commissioned. This has the provision for graphite as well hafnium Torches provided by IPR and L&PTD respectively.
- B. In the **Health Care** sector, in-house production of radio-pharmaceuticals for prostate-cancer was established. The radio-pharmaceuticals are based on the isotopes- Gallium-68 and Lutetium-177. This has helped in providing free diagnosis to 350 patients and a treatment for castrate-resistant prostate cancers to almost 100 patients at a fraction of the cost of treatment in a private hospital.
- C. Contributions to the **Food Security** agenda of the vision plan have been noteworthy and a few significant achievements are:
1. TCDM-1, a high-yielding, semi-dwarf, shorter duration mutant of the aromatic slender-grained rice, developed by BARC in collaboration with IGKV, Raipur, for the benefit of the farmers of Chhattisgarh was released by SVRC in April 2018.
  2. Enzyme based technologies have been developed for making banana juice and non-bitter Karela juice. The shelf life of these products could be extended to six months by radiation processing or thermal pasteurization
- D. **Water and Waste Management** have significant relevance towards environmental hygiene and the well-being of the people and we continue to contribute to this agenda under our vision plan.

1. The polymeric based closed evaporation plant to purify and recycle treated process effluent has been commissioned and integrated with the Beryllium Facility, resulting in zero discharge from the facility.
  2. A simple, cost-effective technology for water quality assessment, working on the principle of detection of H<sub>2</sub>S produced by the pathogenic water and food borne Coliform bacteria present in contaminated water has been developed for domestic as well as field applications.
- E. A vast amount of **Basic and Directed Research** work is actively pursued at this centre. It is our endeavour to create an ecosystem which facilitates the harmonious transition of research outputs to technological innovations that are of relevance to our vision objectives. This approach has been fruitful and several technologies, products and processes have emerged during this period.

I shall begin by mentioning a few important technologies which have materialised

1. Precision Servo Control mechanisms for stabilization and positioning of the active radar seekers to point precisely towards the designated target were developed and successfully tested.
2. A Vacuum Induction Levitation Melter has been developed for producing high purity metallic samples for material characterization. This provides a cost-effective import substitute solution for the production of high purity metals.
3. A 150kW x 2 Electron Beam Melter was developed and commissioned at Special Materials Plant, NFC, Hyderabad. The facility was remotely

inaugurated by the Hon'ble President of India during his recent visit to BARC, Mumbai.

4. An alkaline water electrolyser technology for on-demand, high purity hydrogen production at rates upto 10 Nm<sup>3</sup>/h was developed and the technology transferred for commercialization.
5. A Calorimeter for specific heat measurements on solids in the cryogenic temperature regime in the 10-300K range has been developed for applications in research laboratories.
6. A Pilot plant was set up for the recovery of pure hafnium from scrub raffinate of Zirconium Oxide Plant of NFC. About 3.5 kg of more than 99% pure hafnium oxide was produced and delivered to the User.
7. Indigenous Imaging software for X-ray Baggage inspection System (XBIS) has been developed and integrated with XBIS machine manufactured at ECIL. The machine is undergoing field trials and meets the image quality requirements of penetration, spatial resolution and contrast sensitivity on par with commercial systems.
8. A compact equipment for detecting vacuum leaks down to 10<sup>-10</sup> Torr employing Mass Spectrometry Detectors has been developed and the technology transferred to an entrepreneur for commercial production. The equipment is ~25% cheaper than a currently available equivalent system in the market.

I shall now move on to listing some products and processes which have been developed during this period

9. 15 uncompensated boron lined Ionization Chambers have been developed, tested and supplied to Dhruva reactor.
10. A robust assay system has been developed to qualify coatings for antifouling efficacy and the studies have been extended for use towards selecting antifouling paint for nuclear power plants.
11. 250 kg of Al-Si alloy, having high homogeneity, was produced using the Induction Skull Melting Facility developed at BARC to meet the requirements of the User.
12. Hot pressed boron carbide-carbon nano-tube composite with improved fracture toughness has been developed for ballistic applications.
13. NASICON based Lithium Germanium Phosphate glass ceramics solid state Li-electrolyte was synthesised and a high room temperature conductivity of  $3.4 \times 10^{-4} \text{S/cm}$  as well as 80% of theoretical specific capacity was achieved for the product.
14. Twelve sets of the 'Diode Sputter Ion Pump' (DSIP) based Hydrogen Gas detectors have been manufactured and delivered for use in PFBR.
15. Design, development and beam commissioning of a 2-Tesla, dipole electromagnet for X-Ray magnetic dichorism studies in INDUS-2 beamline was completed during this period.
16. Design and development of main cavity magnet for nation's first indigenous gyrotron at IPR was completed. An electron beam was guided through the tube and 125 kW RF power was successfully generated.

17. Photo-emission Electron Spectroscopy beamline at Indus-2 synchrotron source has been fully commissioned. More than 50 users, from all over India have carried out measurements using the beamline.

18. NCCCM Hyderabad has received accreditation as Reference Material Producer with an ISO 34 certificate from NABL for the assessment of two materials namely Lead in noodles and Quartz.

F. As a part of our '**Social outreach and Awareness**' mandate, collaborative programmes with 17 State Science & Technology councils have continued for dissemination of DAE Technologies from lab to land for benefit of the society. Two more DAE Technology Display & Dissemination Facilities have been inaugurated in Manipur and Nagaland making it total 7 such centres across the country.

G. Important programmes and projects are realised due to the efforts put in towards facility enhancements and **Infrastructure Development**, which form an important part of our vision plan. I shall now list one major infrastructure projects completed during this period.

1. The construction of New Engineering Halls 9, 10, 11 with associated service building has been completed. Many divisions and groups of BARC will house various facilities in these New Engineering Halls.

H. Robust **Regulatory, Safety & Security Administration** procedures and protocols are necessary for an organisation like BARC to function safely and

efficiently and these themes are an integral part of our vision objectives. The following programmes have been implemented during this period:-

1. Integrated Centre for Crisis Management (ICCM) has been commissioned to provide the mechanism and infrastructure for an effective response to any Conventional, Chemical, Biological, Radiological, Nuclear and Security related threats or emergencies. This state of the art facility was successfully completed due to the whole-hearted participation of a large number of Divisions, Groups and agencies of BARC. The facility was formally inaugurated and dedicated to the nation by the Hon'ble President of India during his visit to BARC, Trombay in May 2018.
2. A large network of our personnel continue to ably provide radiological protection services to occupational workers within plants and environmental surveillance services in and around the plants to demonstrate the safety and compliance of regulatory stipulations to all concerned stakeholders.
  - I. In view of the increasing thrust of DAE towards the future deployment of the Fast Breeder Reactors and Nuclear Power Plants, BARC Training School has commenced two new streams namely 'Fast Reactor Technology' and 'Quality Assurance & Quality Control Engineering' at its outstation campuses to cater to the manpower requirements for these activities.

Dear Colleagues,

All of these tasks have been whole heartedly supported by our auxiliary services and support personnel comprising a large number of silent and tireless work force and I gratefully acknowledge their contributions towards the success of our



programmes. This includes the services provided by the Administrative Group, Medical Group, Engineering Services Group, BARC Safety Council, Scientific Information Resources Division, Accounts Division, Public Relations Office, Security Section, Fire Safety Section, Landscape and Cosmetic Maintenance Section, Transport Section, Catering Section and many more, who individually and collectively contributed to this organisation, always there but hardly ever visible in the forefront. 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 provide services to our employees.

At the end, I would like to appeal to all of you that you should serve as true ambassadors of DAE, propagating and communicating the benefits of our programmes to the nation in a lucid, transparent and forthright manner. Let us all pledge to strive wholeheartedly towards achieving the goals and vision objectives of our organisation and our country.

Thank you and Jaihind