Republic Day Address

by

Director, BARC

Thursday, 26th January 2017

Good Morning,

Dear Colleagues,

I extend warm greetings to everyone assembled here on the occasion of the 68th Republic Day of our nation. On this day, in 1950, the Constitution of India came into force and India became a Sovereign Democratic Republic, giving the supreme power to the people of this country to shape their destiny. This was a culmination of a long and heroic struggle against feudalism, foreign rule and colonialism.

For us this is also an occasion to look back into 2016 and cherish our contributions to our great nation. At BARC, we stay committed to the service of our nation through diverse and focused R&D program. I will now mention some of our recent achievements.

I start with our accomplishments in developing and transferring new technologies for societal applications.

A.1 The Multi Leaf Collimator System (MLC) has been successfully developed and integrated with telecobalt unit BHABHATRON. The system has undergone testing at ACTREC. Subsequent to the successful testing the system has been approved by AERB for clinical applications and the hospital has started treatment using this machine. This development is aimed at giving better dose conformity to irregular

tumour boundaries, leading to superior treatment outcome. This is for the first time that MLC has been developed for a telecobalt unit. Thus, BARC continues to provide reliable and cost effective technology in healthcare for cancer treatment.

A.2 Handheld low cost 12-Channel Tele-ECG Instrument, suitable for rural health care was developed. The instrument can be operated using Mobile phones via Bluetooth. The technology has been transferred to private firms.

A.3 Peripheral Pulse Analyzer for disease characterization based on physiological variabilities has been developed and the technology has been transferred to private firms.

A.4 A 15 MT/day Nisargruna plant has been commissioned at the Deonar abattoir for the disposal of slaughter house waste. This is the first environment friendly technology developed in India for managing abattoir waste, which contains undigested waste, animal stomach and a large amount of blood. This will help the abattoir to function in accordance with the orders of Maharashtra Pollution Control Board.

A.5 A composting protocol for high lingo-cellulosic materials like dry leaves and garden wastes has been developed. This protocol can convert the waste into manure in 20 days, as compared to 40-60 days or sometimes even longer, which is the duration for regular composting of such materials.

A.6 An MoU has been signed between BARC and Indian Rare Earths Limited (IREL) for setting up of 5.0 MLD Seawater Desalination Plant at IREL premises at OSCOM. The plant, upon operation, will cater to in-house requirement as well as drinking water supply to local villagers under societal benefits.

We have continued the R&D for research and power reactors. I will describe some of the important contributions for the same.

B.1 For power reactors, in case of severe accidents, it is postulated that core melt down may take place. An experiment was carried out in which, simulant melt, consisting of CeO_2, Zro_2, Iron and Al_2O_3 was poured at 2200 ºC. The experiment was successful in demonstration of the feasibility of “In-Vessel” retention of the molten melt within calandira.

B.2 Reactor Pressure Vessel material surveillance work for Tarapur Atomic Power Station 1 and 2 boiling water reactors, using specimens irradiated at the RPV wall location for 25.5 Effective Full Power Years (EFPY) has been completed to establish shift in RT-NDT.

B.3 Pt-Pd bimetallic catalyst for hydrogen mitigation in nuclear power plants has been developed. Performance of the passive catalytic recombiner device (PCRD) comprising of this catalyst has been evaluated by NPCIL at HRTF, Tarapur. Large scale production of PCRD is being carried out at ECIL, Hyderabad.

B.4 An indigenous device called “ANU NISHTA” has been developed to enhance cyber security of computer servers in I&C networks of Nuclear Power Plants.

B.5 Dhruva reactor continued to operate with availability factor of 71.5% and delivered 734 isotope batches for conversion to radiopharmaceuticals.

B.6 As you know, apart from production of radioisotopes, research reactors are used for testing of new fuel designs also. Irradiation of a test-cluster was successfully completed. The research reactor facilities have also been used for calibration of devices and components.

We have continued creditable contributions in the field of reprocessing and waste management. Our plants have been performing very well. Some of the salient details are:-

C.1 The waste Immobilization plant at Kalpakkam has processed a large inventory of ion-exchange resin received from MAPS.

C.2 One noteworthy activity completed is recovery of more than 1,00,000 Ci of Cs-137 from High Level Liquid Waste and immobilisation of the same in glass matrix. This has helped in production of 100 Cs-pencils for their use in blood irradiator.

C.3 An Indigenous development of Induction Skull Melting technology, which has found importance in waste treatment as well as in frontier areas of material research was initiated in past. The development and production has been completed and regulatory clearances were obtained for regular operation.

C.4 High specific activity Sr-90 was separated from PUREX High Level Liquid Waste. This will help in the generation of high specific activity, carrier-free Y-90 for radiopharmaceuticals.

BARC teams have made newer achievements in developing and producing Advanced Nuclear Fuels & Special Materials.

D.1 An Integrated MgF2 Slag Recovery Facility has been commissioned successfully. Regular operation has been started for re-utilisation of the slag.

D.2 As a part of metallic fuel developmental programme, U-Pu-Zr ternary alloy fuel fabrication campaign in BARC was carried out successfully. Several test fuel slugs have been supplied to IGCAR for irradiation in FBTR.

D.3 As a part of Cermet fuel development, Plutonium based (U-PuO_2), (U-PuC) and (U-PuN) fuel samples were fabricated on laboratory scale and characterization was carried out.

D.4 A process has been developed and demonstrated for recovery of 95% pure hafnium oxide from acidic scrub raffinate of ZOP, NFC by using an in-house synthesised Alkyl Phosphine Oxide ligand. The process is more efficient than the conventional process with TBP, as it can separate at lower free acidity.

D.5 A process has been developed and demonstrated for the synthesis and fabrication of large scale production of Lithium titanate (Li_2TiO_3) pebbles by Solid State Reaction Process for Indian Test Blanket Module (TBM) to be installed at ITER. The process has distinct advantage of near zero waste generation compared to other processes.

D.6 Production of specific shapes of metal beryllium and beryllia ceramics has been continued at beryllium Facility, Vashi. These materials are required for use as sub-source assembly of PFBR (BHAVINI) as well as moderator & reflector for research reactor. In continuation with the effort on management of beryllium bearing wastes, a process has been developed for immobilization of beryllium bearing process waste through vitrification by addition of glass forming reagents.

D.7 Hydrogen reduction of tungsten tri-oxide for producing pure tungsten metal powder was successfully demonstrated on 1 kg scale batches.

D.8 A process based on hollow fibre membrane technique using organo-phosphorus extractants has been developed to recover rare earths from

Nd-Fe-B magnetic scrap material which also contains dysprosium and praseodymium. The technical feasibility of the process was demonstrated in continuous operation mode.

Let me now bring out some of the major outputs of our R&D efforts in Chemical and Physical Sciences

E.1 In a supramolecular strategy, a novel cucurbituril-hepta-molybdate hybrid material has been constructed, for the first time. Its application as a generator bed for the facile and efficient separation of ^{99m}Tc radiotracer was demonstrated.

E.2 Di-seleno-dipropionic acid (DSePA), synthesized in BARC, has been found to be highly effective in reversing radiation induced lung pneumonitis in mice models.

E.3 A software controlled portable extracellular acidity analyser (ECAA) has been developed for differentiating cancer cells from normal cells. The sensor can also be used for evaluating the efficacy of glycolysis inhibiting anti-cancer drugs.

E.4 The low flux Proton irradiation set up for radiation damage studies at Pelletron-Linac facility has been extensively utilized to test ISRO's space bound electronic devices.

E.5 Under super-heavy nuclei research, the spontaneous fission of ^{258}Rf (Rutherfordium-258) has been explained through symmetric mass split formalism and the average number of neutrons emitted by the fission process. The results are consistent with systematics of spontaneous and neutron-induced fission in heavy nuclei.

E.6 A Digital Holographic Microscope (DHM) system has been developed at BARC-Vizag facility for imaging of phase objects such as living cells which generally have only refractive index contrasts in their structures. This DHM system offers quantitative phase information unlike phase contrast microscopes which give only qualitative information and its use can also be extended to the 3-D profiling of various microscopic biological units.

E.7 A micro-focus x-ray camera has been developed using the Gadolinium-gallium-garnet single crystal based scintillator with a resolution of about 5 micro-meters. The camera has been successfully tested on the Imaging beamline on Indus-2 synchrotron radiation source.

E.8 Secondary Ion mass spectrometry (SIMS) was used for the first time to analyse the surface (2D), spatial (3D) imaging and depth elemental distribution. Surface elemental distribution suggest that secondary phase particles (SPP) are more diffused in corroded regions as compared to non corroded regions. These observations help in confirmation of the nodular corrosion for zirconium alloys.

E.9 A novel technique based on laser induced breakdown detection (LIBD) has been set up for determining the size and concentrations of colloids in aqueous streams at concentrations as low as 10^5 particles per cubic centimeter. This will enable determination of solubility of actinides, such as, Thorium and Plutonium in environmental aquatic streams.

As you all know BARC has been providing technical support for activities of DRDO and other Defence Laboratories. Some of the recent activities completed are:-

F.1 As an important milestone in the collaborative development of indigenous Seekers, air-worthiness qualification and Safety of Flight Tests (SOFT) have been successfully completed. This is a significant indigenous capability development by collaboration between BARC and ECIL for strategic application.

F.2 Indigenous X-ray baggage scanning system (XBIS) is developed using an in-house developed 640 pixels of low and high energy detectors in colaboration with Bharat Electronics Limited. The pixellated X-ray detectors, the most critical part of the system, are developed for the first time in India.

Now, let me bring out some of the recent achievements in Environmental Monitoring and Radiation Safety.

G.1 The Indian Environmental Radiation Monitoring (IERMON) programme was expanded with new installation of ten IERMON units in Andaman & Nicobar Islands. This is to act as radiation early-warning system in case of airborne trans-boundary spread of radioactivity. With this, the total

IERMON systems installed in the country under the monitoring program is 462.

G.2 A Portable Thyroid Monitor has been developed for use during nuclear emergency situations for the detection of I-131 deposited in Thyroid. The system is small in size and can be conveniently transported in a suitcase and can be made operational at site in less than an hour.

G.3 *A* light weight portable battery-operated TL reader system has been developed. This is developed as per the requirement of national level preparedness for radiological emergencies. This will help in quick, on-field assessment of radiation doses to public.

G.4 Two scientists from BARC participated in the Antarctica expedition-2016. The scientists had carried indigenously developed instruments for measurements of radiation level due to cosmic rays and terrestrial radiations around Indian station 'Bharati'. An important finding is that thorium rich rocks have been found in Betts Island in the Larsemann hills area in Antarctica which read over 600µR/h and is comparable to that found in High Background Radiation Areas in India.

As we all are aware that a large laboratory like BARC will require regular augmentation and up-gradation of infrastructure. As a part of the work:-

H.1 RCC Pool for establishing Nuclear Facility has been completed. The hydro test of the pool has been completed and further works are in progress.

H.2 Foundation stone was laid for the new multi-speciality hospital building for BARC Hospital with modern, state of the art Operation Theatres & other diagnostic facilities, and its construction work is in progress.

Colleagues, we have done well in many sectors of our activities. I appreciate the co-operation from my colleagues and associations in this regard, and seek your continued support.

However, we owe the nation a resolution to do better in the areas of high technology and frontier sciences. We are also required to have a prominent role to contribute more significantly to the fast paced growth of our nation. Therefore, on this day, let us all rededicate ourselves to continue contributing to the Indian nuclear program and the frontier areas of nuclear science and technology with extra vigour.

Let us be the catalyst in our nation's economic growth and in the endeavour for the betterment of the quality of life of our large population.

Thank you and Jai Hind.