Independence Day Address

by

Director, BARC

Tuesday, 15th August 2017

Good morning,

My Colleagues from BARC, Colleagues from CISF and Honourable Guests for today's function,

We have gathered here today in front of our national flag to celebrate the 71st Independence Day of our country. I extend very warm greetings to you all on this auspicious occasion. Today we enjoy our freedom; freedom from exploitation; freedom of expression; and also freedom to pursue our goals. Today is also an occasion to remember the sacrifices made by our freedom fighters, to liberate our country from colonial rule. This is an occasion to look back and assess our achievements and also to prepare ourselves for greater accomplishments in future by keeping the national interests uppermost in our mind.

We are continuing our pursuit of excellence in frontier areas of science and technology for the betterment of the people of our nation. BARC's overall achievements and progress are too large to be listed here today; however let me bring out a few of our recent accomplishments.

I start with our achievements in developing and deploying new technologies in diverse areas, in line with our tradition of R&D.

A.1 A Gold reference standard BND 4201.01 has been prepared with assigned purity of 99.993% in collaboration with India Government

Mint, Mumbai and National Physical Laboratory, New Delhi. As you all know, making any reference standard is a very elaborate and systematic process and the process for the Gold Standard has been established for the first time in the country.

A.2 A visual detection kit of uranium in water has been developed where by observation of the colour, one can check the presence of safe or toxic levels of uranium.

A.3 Multi Effect Desalination-Thermo Vapour Compression plant was operated on a campaign basis and about 130 m^3 of distilled water was supplied to NRF for its use. This plant is a technology demonstration of OSCOM desalination plant.

A.4 The Radio-Frequency Quadrupole (RFQ) of the Low Energy High Intensity Proton Accelerator (LEHIPA) has been assembled with all four segments, having total length of 4 meters. The RFQ is powered by a 352 MHz klystron producing around 500 kW pulsed RF power.

A.5 Major Atmospheric Cerenkov Experiment (MACE) gamma-ray telescope installation work is progressing well at Hanle, Ladakh. Mechanical structure of the telescope has been fully assembled. Its camera has also been integrated with the mechanical structure. 63 out of 68 MACE camera-integrated-modules (CIMs) have been tested and 42 of these have been fully accepted for deployment at Hanle. The assembly and testing of elevation drive system of the telescope has been successfully completed. The testing of the azimuth drive system is in progress.

A.6 X-ray standing wave based multilayer interface probing facility has been established at EXAFS (extended x-ray absorption fine structure) beamline of Indus-2 synchrotron. This unique facility has the

capability to non-destructively probe interfaces in any thin film multilayer structures for ascertaining the quality and compositions.

A.7 Two Double Crystal Monochromators (DCMs) have been developed indigenously and deployed on a PES (photo electron spectroscopy) and PEEM (photo-emission electron microscopy) synchrotron beamlines at Indus-2, RRCAT, Indore. This indigenous development would be useful for other beamlines since most synchrotron beamlines use DCMs.

A.8 A detector array of 18 liquid scintillators (LS) has been setup and commissioned for carrying out fast neutron spectroscopy by neutron time of flight technique (N_TOF) at the Pelletron Linac Facility (PLF). The facility is being used for the study of fusion-fission dynamics and the study of shell effect and rotational enhancement of nuclear level density.

A.9 The 4.6 meter Ship Borne Terminal (SBT) jointly developed by BARC and ECIL was integrated on a ship and deployed in deep sea. The SBT successfully tracked the ISRO Launch vehicle PSLV-C38 during Cartosat-2E mission on 23rd June 2017.

A.10 Onboard functional evaluation of 0.45m Airborne Satcom terminal developed by BARC and ECIL was successfully carried out on Airborne Early Warning & Control (AEW&C) aircraft.

A.11 Hexapod for aligning a beamline, BL-10 inside a high vacuum chamber for the purpose of undulator based Angle Resolved Photo Electron Spectroscopy (ARPES) at Indus-2, RRCAT has been successfully installed.

We have continued our accomplishments in the domain of Research Reactor operation and also providing necessary support to Nuclear Power Programme.

B.1 During 2016-17, Dhruva reactor was operated at rated power with availability factor of 72% and more than 700 samples were irradiated towards production of radioisotopes. In addition, the low-power Critical facility has been operated for testing of nuclear detectors, reactor physics studies and neutron activation analysis.

B.2 Neutron radiography facility and Self serve facility at Dhruva have been commissioned and put into regular service.

B.3 A remotely operated 3D imaging and profile measuring system has been successfully completed and used for profile measurement of Q-15 coolant channel of KAPS-1 at PIED recently.

We at BARC are committed to environmental and radiation safety. Let me bring out some of our recent efforts towards Environmental Monitoring and Radiation Safety.

C.1 Two mobile vehicles have been developed to serve as Radiological Impact Assessment Laboratory and Environmental Radiation Monitoring Laboratory. These vehicles are equipped with built-in state of the art radiation monitoring instruments, display unit, spectrometry systems, communication devices and personal protective gears for duty officers reaching the site. The vehicles would be used for carrying out radiological survey of Mumbai and other cities of India and to provide technical support during radiation emergency at affected or suspected radio-contaminated sites.

C.2 National audit programme of Iodine-131 activity measurements was conducted for all the nuclear medicine centres in the country during October 2016 to February 2017. This exercise was to confirm correctness of dose calibrators used for measuring activity. This program was carried out for optimising dose to the patients undergoing treatment by use of radiopharmaceuticals.

C.3 An Automatic Neutron Dosimetry System has been developed and deployed. The automation system along with image processing software is capable of handling up to 100 sensor foils at a time, and the doses measured are directly transferred to the personnel database.

D.1 **India has chosen the "closed" fuel cycle option for its programme. Hence, Reprocessing and Waste Management are among our core competencies. We have continued our progress in these areas. This also is an attempt to get "wealth from waste" and this development will enable our centre in development of affordable cancer care.**

Let me mention some of these.

D.2 Production of carrier-free Y-90 from recovered Sr-90 from high level waste at Waste Immobilisation Plant by using an in-house developed two stage supported liquid membrane based generator was continued for use at Radiation Medicine Centre for radiopharmaceutical applications.

D.3 Recovery of Cesium from high level waste was continued successfully and the milestone of Cesium pencil production of 100 nos. was achieved this year and supplied to BRIT.

Let me now bring out some of our achievements in developing facilities, new processes and research in the field of Material Science.

E.1 A process has been developed and demonstrated for recovery of 95% pure hafnium oxide from the acidic scrub raffinate of Zirconium Oxide Plant of NFC using in-house synthesised ligand. The process is more efficient than the conventional process with TBP, as nitric acid consumption and consequent waste generation is less.

E.2 Monodisperse Yttria-alumina-silica glass microspheres of 20-35µm diameter for selective internal radiation therapy of hepatocellular carcinoma was successfully synthesized and established to have chemical stability and radionuclide purity comparable to that commercially available. The Yttrium-90 microspheres are ready for pre-clinical investigation.

E.3 A database for thermo-physical properties of (Th,Pu)O2 and (Th,U)O2 mixed oxides (MOX) fuels up to 3000K has been generated using atomistic simulations. The database will be used for designing of Advanced Heavy Water Reactor (AHWR) fuels with varying composition, performance modelling of fuels at normal operating conditions and analysis of safety aspects at accidental conditions.

E.4 A demonstration line for producing SmCo5 powders by reduction-diffusion process has been successfully set up. The powder is

required for fabricating permanent magnets for several applications in DAE and defence.

E.5 FBTR Mixed-Carbide fuel production line has been augmented by changes in Carbothermic-Reduction (CR) process and modernization in Quality Control equipment. This has resulted in significant increase in FBTR fuel production rate.

We have continued to develop various technologies for societal applications. **I will describe some of the contributions made:**

F.1 As a part of public outreach program, a 1000 m^3/hr Water Treatment Plant at Holy Shiv Ganga Pond of Baba Baidyanath Temple, Deoghar (Jharkhand) has been commissioned. The plant was inaugurated by Hon'ble Chief Minister of Jharkhand on July 9, 2017.

F.2 In many parts of our country ground water fluoride levels are high. A simple and effective technology for removal of fluoride from contaminated ground water has been developed. The technology has been transferred to a private industry.

F.3 A Hybrid biofilm-granule based Sequencing Batch Reactor (SBR) method was developed for treating sewage water and a pilot plant of 2000 litre was established at Kalpakkam for treating the domestic waste water. This reactor is able to treat 11,000 litres of sewage per day. This concept of treating sewage has several advantages such as requirement of smaller foot print and lower operating cost as compared to the conventional activated sludge process. A similar plant of 3000 litre capacity has also been set up at BARC, Trombay for additional field trials and confirmation of data already obtained.

F.4 A water-soluble micro-neem organic pesticide formulation has been developed for controlling leaf-cutting caterpillars and fruit borers. This is ideal for organic farming and will increase the farmers' income immensely. The formulation can be used as a spray to protect vegetables, fruits, pulses and oil seeds, and can also provide mineral nutrition to the plants. Its technology has been transferred to private entrepreneurs.

F.5 A semi-dwarf, aromatic mutant of Dubraj rice, TCDM-1 (Trombay Chhattisgarh Dubraj Mutant-1) is being released in Chhattisgarh. This variety has with >35% higher yield and 15 days early maturity than the native local variety. The Trombay moong variety (TMB37) which is resistant to yellow mosaic virus, has also been released in Punjab.

F.6 Development of 5 HP solar power driven Permanent Magnet brushless DC (PMBLDC) motors-pump set for irrigation purpose was completed. The PMBLDC motor driven pump assembly was successfully commissioned and operated for demonstration at BARC Nursery. Additional 10 more sets are being installed at different DAE units for more elaborate field trials.

F.7 Biochip reader has been developed to detect low light level fluorescence signal from the biochip for cancer related hormones. This is presently undergoing lab testing at BARC in close association with Radiation Medicine Centre (RMC).

BARC has continued the pioneering work in the field of application of radioisotopes including cancer treatment. Let me mention some of them:

G.1 Radiotracer Investigations were used to study dispersion of sediments on seabed in Kolkata Port and examine suitability of the dumping sites for the dredged sediments.

G.2 Radiation Medicine Centre has successfully accomplished nearly 2000 therapies with indigenously produced Lu-177 and the radiopharmaceutical ^{177}Lutetium-DOTATATE formulated treatment of neuroendocrine cancer patients, at nominal costs. RMC now has emerged as the largest and busiest centre in this part of the world administering this form of therapy.

G.3 Two new and promising radiopharmaceuticals, Ga-68 and Lutetium-177-labeled PSMA (Prostate Specific Membrane Antigen) are newly introduced in RMC for management of prostate cancer patients.

G.4 A demonstration unit for cleaning textile effluent has been put up in a textile factory in Surat and second unit, which is ready, is planned for a unit in Ahmedabad. The results are satisfactory and industry specific requirements are being worked out.

G.5 BARC continued its technical support to the Indian industry through its unique radiotracer technology being successfully employed for evaluating accurate measurement of cooling water flow rates in large diameter pipelines. The measurements helped to calibrate the installed flow meters and validate efficacy of the Vertical Turbine Pumps.

BARC has continued to participate and contribute in international collaborations. I will mention some of these:

H.1 Design, development and successful testing of a 4-Tesla, large warm bore, superconducting magnet was carried out to study

enhanced corrosion rates due to MHD effects. This is necessary for TBM programme of ITER.

H.2 Design, development, qualification and delivery of 21 nos. of focussing quadrupoles and 14 nos. of dipole correctors to Fermilab under Indian Institutions and Fermilab collaboration. The magnets have been successfully deployed in the Medium Energy Beam Transport line of PIP-II injector.

H.3 Beam Position Monitor (BPM) System has been designed, developed and tested under the "LIA FINS" agreement for SPIRAL2-LINAC at GANIL, France. 22 nos. of BPM modules are ready for shipment.

You all are aware that BARC carries out regular development and up-gradation of infrastructure including health care facilities. Some of the major infrastructure related activities completed are:

I.1 A robust, multi-layer communication infrastructure at one of the BARC labs was commissioned, which, has been built on fibre and satellite network backbones. The networks have been made compliant with all information security features as specified in the information security policy of BARC.

I.2 Fertility Clinic (IUI) and Skill Lab in Department of Gynecology and Obstetrics, at BARC Hospital were opened. Remote controlled motorized advanced silicon manikin ELITE PLUS for clinical practice by the DNB students has been installed in the Skill Lab. This will provide hands on training to the students working in the field of laparoscopic surgery.

I.3 A modern liquid medical oxygen plant has been established in BARC Hospital, which will ensure a constant and uninterrupted oxygen supply.

At the end of my report, I take this opportunity to appreciate the hard work and co-operation from all my colleagues in achieving the goals and outputs mandated on us. These achievements could not have been made possible without the support and the untiring efforts of those who have worked behind the scene. These achievers include Medical Division, Administrative Group and Engineering Services Group. Special thanks are also to Landscape and Cosmetic Maintenance Section, who have maintained the beautiful ambience of BARC. I also express my deep appreciation for the BARC Security and CISF personnel for their commendable contribution towards the physical protection of this establishment. We also appreciate the efforts of BARC Fire Service personnel for their contribution to the safety of this campus.

Finally, on this august occasion, let us once again pay tribute to all the patriots whose sacrifice gave us the freedom and rededicate ourselves to build a strong and self reliant India.

Thank you and Jai Hind.