Founder's Day Address

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By

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Dr. Banerjee, Chairman, Atomic Energy Commission, senior members of DAE family present here and dear colleagues.

It is indeed a matter of great pleasure and proud privilege for me to extend a warm welcome to you all to celebrate the 101st birth anniversary of Dr. Homi Jahangir Bhabha – the founder of this great institution, Bhabha Atomic Research Centre.

We celebrate Homi Bhabha's birthday every year on the 30th October by taking stock of our achievements during the previous year and rededicating ourselves towards our mission oriented tasks related to the development of nuclear science and technology.

This year, In keeping with the tradition, we are having this function today, the last working day before the 30th, which happens to fall on a week-end.

During the last one year, there have been numerous noteworthy achievements of BARC. In the given time my effort will be directed to give

you a broad over-view of our continued progress, taking only a few of the recent achievements, as examples.

Research Reactors

The completion of 50 years of operation of CIRUS on July 10, 2010 and 25 years of operation of Dhruva on August 8, 2010 are two very unique and significant milestones in the history of BARC. I am sure, you all will agree with me, that these two events in the year 2010 are fitting tributes to the memory of our founder Dr. Homi Bhabha. Both these reactors have served extremely well in our activities of isotope production, basic research, material testing and human resource development.

The APSARA reactor was shut down in June 2009 after 52 years of useful service and thereafter its decommissioning activities have been nearly completed. Transport of APSARA core fuel out of Trombay has commenced. The new design of APSARA will have several advanced features that include advanced dispersion type uranium silicide fuel. The process for production of the new silicide fuel has already been fully developed and established. The core will have a capability to deliver 2 MWth power at a neutron flux, which will be as high as that existing in the CIRUS reactor.

The old reactor structure has been evaluated for the fulfillment of modern seismic criteria. It was found that the external building structure would need to be replaced with a modern structure of higher seismic resistance. The new building of APSARA will be built after demolishing the old building and

all care has been taken to retain the major architectural features of the old building in the new building.

The Critical Facility (CF) for Advanced Heavy Water Reactor (AHWR) and 540 MWe PHWR was operated on 74 occasions for various experiments. Thirteen nuclear detectors were tested in graphite reflector region. After loading of a fuel cluster containing Thoria and Uranium pins, several measurements have been carried out satisfactorily. This facility was also utilised for large volume sample irradiations for Neutron Activation Analysis (NAA).

AHWR Programme

The full scale Integral Test loop for AHWR has been augmented with an additional 3 MW, instrumented fuel rod cluster simulator developed in-house. The augmented facility will serve as a test bed for validation of many new techniques, such as that for channel power measurement and detection of instability.

The Passive Poison Injection System (PPIS) is a unique system provided in AHWR to fulfill the shutdown function in the event of failure of wired shutdown systems. A prototype ‘Poison Injection Passive Valve (PIPV)’ to be used in PPIS of AHWR has been designed, developed and tested under simulated conditions. This is the third passive valve in succession, developed for various safety systems of AHWR, proving the technological maturity in the area of passive valve design and development.

We are interacting with the Indian industries for the development of some unique features in the major components of AHWR. An MOU for development of Pull-out technology for integrated nozzles in steam drum, inlet header and end fittings of Advanced Heavy Water Reactor (AHWR) was signed with a leading manufacturer of nuclear components.

High Temperature Reactor Programme

The physics design of the Compact High Temperature Reactor progressed further. Monte Carlo simulations have been performed to estimate the neutron flux in the core and at detector locations outside the reactor vessel for the purpose of reactor start-up and regulation.

PHWR programme

Technical and analytical support to NPCIL was provided for the ageing management activities. Wet scraping was successfully used to obtain scraped material samples from pressure tubes of RAPS-3 and KAPS-2 reactors, to determine hydrogen/deuterium contents for predicting residual service life of the tubes.

Nuclear Fuels Programme

BARC supplies Plutonium bearing fuels for the Fast Reactor Programme, including FBTR and PFBR (under construction) at Kalpakkam.

The experimental PFBR MOX fuel earlier manufactured and supplied by BARC has been undergoing irradiation at FBTR. The fuel has now reached a burn-up of 107,000 MWd/T, exceeding the design target burn-up of 100,000 MWd/T.

As a part of our R&D on metallic fuel for the advanced fast breeder reactors with high breeding ratio, a new thermophysical property evaluation laboratory has been set up in BARC. In this laboratory, various thermophysical properties for U-15%Pu fuel have been determined. Effect of fission products on thermophysical properties like thermal conductivity, thermal expansion etc. have been studied.

Fuel Reprocessing and Waste Management

A new reprocessing plant called ROP (Revamping of PREFRE) has been constructed at Tarapur for carrying out the reprocessing of power reactor fuel. The design of this plant takes into account the experience of construction and operation of other reprocessing plants in the country. I am glad to announce that this morning at 6.45 AM as a part of the commissioning process, the cold trial run of the plant has been started with the use of inactive natural uranium based fuel, in place of spent fuel, which will follow later. After the successful chopping of 30 fuel bundles the dissolution process is currently in progress.

Operation of Plutonium Plant, Trombay was continued to reprocess spent fuel from research reactors.

Storage of spent fuel received from MAPS in Spent Fuel Storage Facility (SFSF) at Kalpakkam and its processing at KARP facility were continued.

In the area of nuclear waste management our noteworthy achievements include Additional Waste Tank Farm (AWTF) commissioning and 90% storage capacity utilisation in Spent Fuel Storage Facility (SFSF), following extensive work on seismic validation of stacked fuel racks.

The trials on second ceramic melter at Waste Immobilisation Plant, Kalpakkam have started with the initiation of the induction heating run yesterday.

The Cold Crucible Induction Melter was operated on regular basis to generate the operational data. Starting of the melter using a two coil inductor system was successfully demonstrated.

Flow sheets for recovery of radio-caesium from acidic high level waste and conversion of recovered caesium as a radiation source for blood irradiator have been successfully demonstrated with simulated waste.

^{90}Sr and ^{106}Ru present in high level waste were recovered for use in radio pharmaceutical applications.

Health, Safety & Environment

The nodal Emergency Response Centre (ERC) at BARC responded quickly to the radiological incident that occurred at Mayapuri, Delhi. The response team was also assisted by ERC Delhi, Narora, National Disaster Response Force and AERB in identifying and locating the Co-60 source and safely securing and transporting them in the shielded flasks to Narora. The affected shops were decontaminated and the roads suitably resurfaced with thick concrete, so as to bring down the background radiation in the affected area to normal pre- incident level.

The carbon doped aluminium oxide based Optically Stimulated Luminescence (OSL) phosphor has been developed in BARC. A new four element OSL dosimeter badge and a prototype OSL dosimeter badge reader have been developed. OSLD badges have been given to various facilities on trial basis.

Another phosphor, namely Lithium Magnesium Phosphate ($LiMgPO_4$:Tb) has been synthesised. Its OSL sensitivities, fading and linearity characteristics have yielded consistently promising results. This phosphor can be readily produced on a mass scale without imported components.

New model of environmental radiation monitors (IERMON) having 3 Geiger Muller (GM) tubes (two for lower range and one for higher range of radiation level detection) has been developed successfully. These are stand alone, solar powered systems with GSM and LAN based communication devices and are meant for installation at remote location

and unattended operation. Fifty such monitors have already been installed at different places in the country.

Studies have been carried out to assess the impact of recent oil spill incident occurred on 7th Aug., 2010 on Mumbai bay. Continuous analysis of oil & grease in sea water samples collected at intake point of CIRUS Jetty was carried out and the data submitted to Maharashtra Pollution Control Board.

Bench-top and portable continuous radon monitors have been developed, based on electrostatic collection and scintillation cell principles. These indigenous instruments have higher sensitivity, compensation for humidity effects on charged decay products, networking capabilities and are lower in cost, compared to commercially available ones

Remote Handling and Robotics

A robotic device named Compact Laparascope Manipulator (CoLaM) for control of endoscope (viewing apparatus) during a laparoscopic surgery using foot-operated joystick and switches has been developed. This allows the surgeon to directly control and adjust the view of the operating area, inspite of the fact that both his hands are engaged with surgical tools. The first prototype of this device has been delivered to Christian Medical College (CMC), Vellore, on 22nd September this year for field trials.

Electronics & Instrumentation

A facility has been setup at BARC for remote control and accessing the synchrotron FIP beamline located at Grenoble, France, through the National Knowledge Network (NKN).

A Scanning Electron Microscope (SEM) has been developed in BARC in association with an industry partner. It features a resolution of 4 nanometers at 30 KV and a maximum magnification of 1,50,000.

BARC has developed a prototype of a unique and compact Hand Scan Biometric System (HSBS) for verification of identity of personnel using an RFID card reader to provide PIN information. Four units of the HSBS, working in networked mode have been installed in BARC for evaluation.

A compact and portable system (Handheld Tele Radio Nuclide Detection System for covert operation) has been developed for detection of radioactive nuclides like Co-60, Cs-137 etc. On detection of activity above a set limit, the system sends alarm to a mobile phone and to a remote server along with longitude and latitude information.

Materials and Metallurgy

A pilot facility has been setup for producing nuclear grade beryllia, which is moderator cum reflector for CHTR and for refurbished APSARA reactor.

Studies have been carried on TRISO coating of particle type fuel to be used for CHTR, for online control of the coating of all layers in single campaign.

Boron carbide and refractory / rare earth metal borides are candidate materials for high temperature structures such as thermal protection of hypersonic re-entry vehicles, in addition to neutron absorbers in high temperature reactors and fast reactors. Near theoretical dense bodies of enriched boron carbide, hafnium diboride, zirconium diboride and titanium diborides were consolidated using spark plasma facility at relatively lower temperature, as compared to hot pressing.

Laser, Plasma and Accelerator Technology

In the search for development of novel ceramic protective coatings for liquid uranium, the plasma sprayed yittria coatings deposited on tantalum crucible were tested for resistance to attack by molten uranium in a specially designed facility. These coatings were stable and withstood chemical attack during continuous test run for 120 hours and a cumulative test run for over 400 hours,

The 3 MeV DC accelerator was regularly operated at 1.0 MeV beam energy and 4.6 mA beam current. Dosimeter films (B3) and 2.5 mm thick rubber samples from a local manufacturer have been irradiated for 80 passes at 2.2 m/min speed at the above ratings and analysed.

LEHIPA is a “Drift Tube Linac” in which permanent magnet, water cooled drift tubes (DT’s) are lined up along the axis of the DT tank. Two prototype DT’s were designed and fabricated by BARC. Magnetic flux measurements and cooling tests (with simulated heat loads) of these tubes were also successfully carried out.

Isotope Aplications

177Lu-DOTATATE, a peptide based radiopharmaceutical has been successfully prepared for use in clinical setting and demonstrated for its use in treatment of patients suffering from neuroendocrine tumors, by collaborating with 5 hospitals in India. Till date, more than 100 patient doses have been prepared using the 177Lu-DOTATATE prepared using our method and the high grade Lu177 produced at our Centre.

National Institutions like DRDO, ISRO, IGCAR have been supplied ^{55}Fe , ^{57}Co and ^{63}Ni sources for their research work. Many of these sources are far less expensive than the imported sources and some are not even available for buying.

In our Radiation Medicine Centre, the development of synthesis protocols, radiochemical evaluation and commercial production was carried out for two Flourine-18 (F-18) containing diagnostic agents for cancer viz; [^{18}F] Fluorothymidine ([^{18}F] FLT) for imaging cell-proliferation in cancers and [18-F] Fluoromisonidazole ([F-18] FMISO) for imaging of hypoxic regions in tumours.

Chemical Engineering

An Electro-De-Ionisation (EDI) unit has been integrated to Low Temperature Evaporation (LTE) sea water desalination plant for producing electronic grade (Type E-III/ Type E-IV) ultra-pure water with conductivity less than 0.1 micro-siemens/cm and silica content less than 50 ppb for high end applications such as super-computers.

A two stage pulse tube cryocooler with Helium as refrigerant was developed. It is capable of reaching a lowest temperature of 2.8 Kelvin. The cryocooler will be utilised for calibration of temperature sensors for cryogenic applications.

Under nuclear instrumentation programme, operating parameters for pulling single silicon crystal through float zone technique were established. Characterisation of major parameters of single crystal have been carried out and are satisfactory with respect to international standard.

Physical Sciences

Phase contrast imaging facility (capable of revealing light element profile in a matrix of heavy elements) and Neutron induced electron radiography facility (useful for inspecting documents, painting and biological samples) have been recently commissioned at CIRUS.

High quality thallium doped caesium iodide single crystals for applications in gamma-ray detection have been grown.

A new seven collector `Thermal Ionization Mass Spectrometer` has been designed and developed for Atomic Minerals Directorate for Exploration and Research (AMDER) for high precision isotope ratio measurements in its geo-chronological applications.

Chemical Sciences

A procedure has been established for online corrosion/wear rate measurement using Thin Layer Activation method. This work has direct application in Flow Accelerated Corrosion (FAC) monitoring in PHWR feeders

A polymer system has been developed, with a capability of continuous in-situ production of chlorine dioxide, a superior biocide currently gaining acceptance as a bio-fouling control agent. The biocide-releasing polymer will have application in biomedical fields and in industrial settings.

Nuclear Agriculture

Two more new varieties of mutant breeder seed varieties developed in BARC, one each of groundnut and tur (pigeonpea) are released by State Variety Release Committee, Andhra Pradesh and Maharashtra respectively, and are awaiting Central notification. This brings the total number of mutant breeder seed varieties developed in this Centre to thirtynine.

Fifty Nisargaruna solid waste treatment plants were established in various places in the country under the guidance of Nuclear Agriculture & Bio-Technology Division, BARC.

Food Technology

Biodegradable and antimicrobial packaging material was prepared using different natural biopolymers. Glycerol was used as a plasticizer and essential oils as antimicrobial agents.

In-vitro experiments on a microbial system have shown that honey has anti-mutagenic and radio-protective properties.

Human Resource Development

The BARC Training School took several steps to upgrade its infrastructure and start evening lectures for the benefit of scientists and engineers as part of its continuing education programme.

Medical Facilities

The infrastructure available at our BARC Hospital has been recently expanded to provide further enhanced medi-care services to beneficiaries under the DAE's Contributory Health Service Scheme.

Dear Colleagues,

Even without a mention of our voluminous contributions in the strategic domain, a coverage of all the highlights of recent work done by our organisation of more than **15,000** persons, spanning practically all scientific and technological disciplines, is impossible in a short time. Any omissions in my speech do not undermine the importance of the value of all such work.

While concluding my address, I would like to emphasise that with the envisaged massive growth in the nuclear sector in the country, we have plenty of challenges ahead. With the synergetic effort of all of us in BARC, I am sure, we will be able to rise to the occasion to meet these challenges in a manner consistent with the tradition of BARC.

Friends, finally on this very special day, let us firmly resolve and rededicate ourselves to continue our pursuit of excellence in the frontier areas of nuclear science and technology for the betterment of life of our people.

-Thank you –

Jai Hind