Independence Day Celebration
Monday, 15th August 2016

I wish a very Good morning, to my all 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 70th Independence Day. I extend warm greetings to you all on this august occasion. We are all aware, that freedom of our country from the foreign colonial rule was achieved by the untiring and selfless efforts of our freedom fighters. I am sure that many of us who are present today would have grandparents and great grandparents, who have had active participation in freedom movement. This is an occasion to pay homage to all those who have made supreme sacrifices to attain freedom of our country and to rededicate ourselves to build a strong and self reliant India. Let us use our national freedom for accomplishing the freedom from all ills affecting our country and for attaining greater heights.

This is also an instance to look back and assess our achievements and prepare for greater accomplishments in

future by keeping the national interests uppermost in our mind. BARC campuses are located all over the country and have contributed in multi-disciplinary areas. 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. Even though some of the achievements have not been listed here, it does not make them in any way less significant.

BARC has continued to provide R&D Support and Other Services to Power Plants and Nuclear Facilities. Some of the major works carried out are:

1. Successful completion of in-service inspection of TAPS Unit#2 BWR RPV. This includes data analysis, uncertainty assessment and flaw evaluation. The inspection for the upper shell and core belt region was carried out during the 24th refuelling outage. TAPS Unit 2 was synchronized to grid on 25th July 2016. Today power stations at TAPS-1 and 2 are able to supply electricity at a cost of less than one rupee per unit.

2. Sag measurement tool, developed for coolant channels of 220 MW PHWRs, has been successfully deployed in RAPS-3. This will help NPCIL in addressing AERB requirements in a superior manner.

3. An Autonomous Guided Vehicle (AGV) based Automated Pellet Boat Transfer System has been developed for Nuclear Fuel Complex (NFC), Hyderabad. The system will be used for transfer of Pellet Boats between the Compacting and Sintering stations. The system has successfully been lab tested in BARC and is being made ready for further field trials at NFC. I may add here that the good performance of NPCIL reactors has put an equally high demand on fuel production at NFC. This development will help in improving rate of production at NFC.

4. AHWR, in its design has incorporated many new features. These features, as you are well aware, need verification. A set of full scale experiment on small break LOCA leading to flow stagnation in coolant channel and experiments simulating loss of heat sink during severe

earthquake were successfully carried out for addressing regulatory requirement for licensing of AHWR.

5. A full-scale automation system has been developed to demonstrate remote handling and inspection of (Th-U^{233}) MoX sintered fuel pellets inside shielded facility. This mock-up facility has recently been installed. Thorium fuel cycle is to play an important role for AHWR as well as other future thorium utilisation plans.

Research Reactors as well as Research and Production Facilities have continued to perform very well during this period.

1. Dhruva Reactor has operated on sustained basis at 100 MW power and the overall capacity factor improved to 63.24% from 62% of the previous year. This performance has helped in ensuring adequate supply of various radioisotopes to hospitals in India.

2. Dhruva reactor has completed more than 30 years of operation. For ensuring safer and reliable operation, continued upgrades are necessary. Some of the salient upgrades completed recently are:-

- Dhruva Reactor Start-up logic system based on TPLC-32 platform was commissioned as a safety upgrade.

- An Adjuster Rod was commissioned in Dhruva for effective utilization of fuel and for production of high specific activity cobalt radioisotopes.

3. Fuel pin supply for FBTR, consisting of 5 mixed-carbide fuel sub-assemblies, was continued for its uninterrupted operation.

We have contributed significantly to Environmental Monitoring and Radiation Safety. Some of the recent developments are:-

1. Under the Indian Environmental Radiation Monitor Network (IERMON) MetroNet program, target of installing 30 stand-alone automated units under the Kolkata MetroNet program has been successfully accomplished. IERMON serves as an early warning system in case of a nuclear emergency.
2. As you are aware, this year in the month of March, Kakarapar power station had experienced an event. The

Environmental Survey Laboratory at Kakrapar, along with experts and team members from Mumbai and Tarapur, has rendered efficient environmental monitoring services during the plant emergency situation at Kakrapar site. The detailed environmental monitoring clearly indicated that there was no increase in dose to the member of public due to the plant emergency condition at Kakrapar.

3. A low-power portable gamma dose rate logging system 'Gamma Register' has been designed and developed. The system is GM detector based and covers a measurement range from background to 5 mSv/h. The system provides data logging at selectable intervals of 1 minute, 10 minutes and 30 minutes along with real-time tags in terms of date, hour and minute. The data can be retrieved through a USB interface and processed with a "Gamma Register" specific GUI. The new system will help in superior environmental radiation monitoring in routine as well as emergency situations.

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. Let me mention some of these.

1. Strontium specific solvent (Di-tertiary-butyl dicyclo hexano-18-Crown-6) was synthesized and used for separation of Sr-90 from high-level waste. This was concentrated and purified to generate Y-90 in a liquid membrane cell. 40 Ci/l of yttrium thus produced, was delivered for the first time for radiopharmaceutical application.
2. A nano-adsorbent and a solvent (Di-tert-butyl dibenzo-18-Crown-6) was developed for separation of technicium-99 from alkaline waste. This will pave the way for treatment of alkaline waste from reprocessing operation.
3. The Reprocessing plants at Tarapur and Kalpakkam, as well as fuel fabrication plant at Tarapur continued to achieve excellent performance, meeting the targets of the Department.
4. Warm commissioning of the new reprocessing plant PFREFRE-3A at Kalpakkam is progressing well and has

achieved a major milestone by successfully dissolving and processing DDU fuel bundles.

5. Construction of the first Integrated Nuclear Recycle Plant (INRP) at Tarapur was started and excavation of four major front-end blocks was completed. INRP uses all the past experience of reprocessing and waste management and forms an important milestone in achieving future DAE goals.
6. The activities mentioned earlier are the new activities initiated. These are in addition to the important regular activities related to waste management and recovery of important radioisotopes.

In line with our tradition of R&D, we continue to develop and deploy new technologies in diverse areas. Let me bring out some of these.

1. Multilayer neutron Super-Mirrors have been developed. These consist of 1082 thin, graded-thickness layers of Co/Ti/Gd. A process-automated 9-meter magnetron sputter coating facility was used for the same.

2. A Thermal Ionization Mass Spectrometer (TIMS) for precise isotope ratio measurements of uranium has been supplied to KARP, Kalpakkam. The salient features of this instrument include isotope ratio precisions of better than 0.1% for natural uranium, small sample size of less than 1 micro-gram, and 6 collector system with advanced zoom optics.
3. $^{55}Fe(n,p)$ cross-sections were measured for the first time using surrogate method at Pelletron-LINAC facility. These cross-sections are very important for fusion technology applications.
4. For the first time, the synchrotron beamline facilities have been extended to commercial use on payment basis, especially for drug design application and advanced research in the field of catalysis.
5. A Neutron Multiplicity Counter (NMC) has been indigenously developed for estimation of plutonium in sealed containments and finished products of various configurations. This is a next generation development to existing Neutron well coincidence counters (NWCC). The counter has been tested using several standard sets of PuO_2 samples. The lower detection limit is seen to be 30 mg and it has potential for counting Kg quantity of Pu.

6. Quartz certified reference material was developed in collaboration with National Physical Laboratory (NPL), New Delhi. The certified material was released for public use.

7. The Critical Design Review of the MACE imaging camera was concluded at ECIL Hyderabad, This involved integrated testing & demonstration of 25 Camera Integrated modules (CIMs). The camera is being readied for dispatch and eventual installation at Hanle site by the year end.

8. BARC has developed stabilization & Tracking Servo Control System for the 4.6 Metre Ship borne terminal (SBT). The terminal, being built by ECIL, will be used for tracking the re-entry modules and launch vehicles of ISRO's future manned space missions.

9. Research on Electron Beam Machine has been continuing in BARC for a long time. The technology has considerable amount of societal applications. A trial run for continuous operation of the machine was taken for

about 80 hours to check reliability of electronics and mechanical components. Excepting two to three trips due to spurious reasons, machine could satisfactorily operate for about 80 hours.

Many of the intricate simulation models require extensive computational facilities. New developments have taken place in enhancing the facilities, which are:-

1. A new parallel supercomputer **'ANUPAM-AGANYA'** has been developed in-house and setup at BARC Computer Centre, Anushaktinagar. The system consists of 210 CPU servers and 20 GPU servers interconnected using Gigabit Ethernet and Infiniband networks. The peak performance of the system is 380 Teraflops and the sustained performance is 270 Teraflops. The system has been released to BARC users.

2. A centralized mass SAN storage system of a raw capacity of 4 Petabytes has been developed and deployed. It is a modular system based on standard commodity hardware

and open-source software components augmented by in-house developed software.

3. A 1Gbps Secure Network Adapter (1G SNA) has been developed. It is an IPSec protocol based Virtual Private Network (VPN) adapter, which uses the in-house developed encryption algorithm and key management protocols. Various options of clustering have been attempted and current implementation of the parallel crypto library has successfully achieved a speed of 900Mbps.

Let me now bring out some of our achievements in developing facilities and process for Materials and Fuels.

1. Sb-Be composite pellets have been developed to prepare controlled porosity pellets by vacuum hot pressing, using a special grade beryllium powder. A large number of other type of composite pellets, made of B4C & ZrO2 have also been made.

2. As a part of metallic fuel development program for future FBR, characterization and thermo-physical property evaluation of U-23.5%Pu-6%Zr alloy was carried out.

We have continued to work for various societal applications of nuclear energy and its spin-off technologies.

1. Chemical formulation for Sea Water Reverse Osmosis Membrane preparation has been developed with thin film casting sequences and technology has been transferred for trial production to a private firm. First unit produced has been qualified for the required use with specified salt rejection and permeate flux. For onsite replacement test, additional units are under production. This action has been taken for import substitution.

2. MoU has been signed for technology incubation relating to commercial production of portable water disinfection device based on chlorine dioxide releasing polymer.

3. A simple, low cost and portable kit has been developed for detection of chromium in drinking water and is made available through technology transfer.

4. Technology of turmeric based Neutraceutical was transferred to a private firm for commercial production.

5. A novel ^{68}Ga-based radiopharmaceutical agent (^{68}Ga-labeled RGD peptide derivative) has been indigenously developed and clinically tested for non-invasive monitoring of breast cancer prognosis by PET imaging.

6. The drug, 3'-deoxy-3'-^{18}F-fluorothymidine (^{18}F-FLT) is used for positron emission tomography (PET) imaging of tumours. The synthesis of the ^{18}F-FLT precursor has been indigenized and is being used to make the drug at the Radiation Medicine Centre (RMC), Parel, Mumbai. The developed method will obviate the need of importing the precursor and provide the drug at a cheaper cost to benefit the patients.

7. A natural wound healing formulation has been developed using an Indian herb. Topical application of the formulation provides faster and better healing of external wounds than the commercially available cream.

8. Radiotracer investigations for leak detection in high pressure heat exchanger systems were carried out at M/s IOCL, Panipat Refinery, Haryana. This investigation has led to a benefit of about Rs 30-50 Crores to the industry.

9. The quantum of exported irradiated mangoes was 750 MT this year which accounted for 25% of the total mango export.

10. Litchi preservation technology was successfully demonstrated on a fairly large scale at Muzzafarpur in Bihar which is a predominant litchi growing region in India.

11. Nisargruna plant of 15MT/day capacity based on abattoir waste has been commissioned under MoU with Municipal Corporation of Greater Mumbai at Deonar abattoir. Five new plants have been commissioned under MoU with

Municipal Corporations of Chandigarh, Chennai and Thoothukudi.

BARC has also continued to participate and contribute in international arena as a part of international collaborations. Some of these are:

1. As a part of International Collaboration with Fermi Lab USA, Quadra-pole magnet lenses and Dipole corrector magnets, developed at BARC, have been successfully installed at the PIXIE beam-line at Fermi Lab. The prototype RF protection interlock system (RFPI) developed and delivered by BARC is also being integrated and validated at Fermi Lab.

2. Continuing our contributions to the detectors for LHC, ANUINDRA ASIC has been developed for the new generation high luminosity particle physics experiment Focal, as part of ALICE upgrade at CERN.

We all are aware that a large laboratory like BARC requires a regular development and up-gradation of infrastructure. Some of the major infrastructure related activities completed are:

1. New Electronics & Safety Complex building has been completed and all electrical, HVAC and mechanical services have been commissioned in BARC.

2. New Inflammable Material Stores building is ready with all services, for commissioning.

3. New Dental Lab at BARC Hospital has been commissioned.

4. Five million litre capacity water reservoir along with pumping distribution system and one million litres per day capacity water treatment plant for utilization of lake water has been completed and commissioned.

I take this opportunity to appreciate the hard work and co-operation from 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 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 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 auspicious day, we once again salute the freedom fighters, whose sacrifice gave us the freedom.

Let us continue our best efforts to sustain the BARC tradition of excellence, to make India a strong and developed nation.

Thank you and Jai Hind.