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Department of Atomic Energy
Golden Jubilee Year
August 2003 - August 2004

BARC OBSERVES FOUNDER'S DAY

(As in the past, BARC Founder's Day was celebrated on October 30, 2003 with warmth and fond remembrance of the illustrious Founder, Dr Homi Jehangir Bhabha. Dr Anil Kakodkar, Chairman, Atomic Energy Commission & Secretary, to Government of India, and Mr B. Bhatacharjee, Director, BARC, addressed the staff members at the central complex auditorium. Dr Anil Kakodkar distributed the Homi Bhabha Science & Technology Awards, Technical Excellence Awards and Meritorious Service Awards to the recipients of these awards at a well attended function in the central complex auditorium, BARC. He also gave the prizes to the winners of XV All India Essay Contest in Nuclear Science and Technology..

Founder's Day lecture was delivered by Dr S.S. Kapoor, former Director, Physics and Electronics & Instrumentation Group, BARC and presently Professor, DAE Homi Bhabha Chair as a tribute to Dr Homi Bhabha.

The texts of Dr Anil Kakodkar and Mr B. Bhattacharjee speeches are reproduced below).

Address by Chairman, Atomic Energy Commission

Dear Colleagues

On the occasion of the 94th birth anniversary of Dr.Bhabha, let us first of all rededicate ourselves to the vision of our founder. This year is particularly special because it happens to be the Golden Jubilee

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Year of our Department. This year is also very important because we have launched the construction of India's first commercial fast breeder reactor, a very important milestone in the implementation of our three-stage nuclear power program.

Friends, NPCIL has now demonstrated world-class performance in operation of nuclear power reactors. Nuclear electricity generation of 19,358 million units was realized during the year 2002-03 with NPCIL reactors achieving an overall annual capacity factor of 90 percent, which is among the best in the world. The Kakrapar Atomic Power Station Unit 1 was adjudged to be the best performing PHWR worldwide during the rolling twelve-month period from October 2001 to September 2002.Shri Bhiksham, Station Director, Kakrapar Atomic Power Station was awarded the first WANO (Word Association of Nuclear Operators) Excellence Award for his contributions to excellence in nuclear industry, only a few days ago at the WANO Biennial General Body meeting held in Berlin. For the calendar year 2002, three NPCIL PHWR Units were among the five best PHWR Units in the world. Our fuel as well as Heavy Water plants have worked to near full capacity as in earlier years.

Clearly, we have been very successful in taking the indigenous development of nuclear power technology to the level of world-class excellence in spite of the restrictive international regime. We have to consolidate these gains and move forward to deliver to the nation, clean and green electricity in adequate quantity and at affordable cost. As all of you are aware, nuclear power is important both from point of view of sustainability as well as from considerations of protection of global climate. A very significant role of nuclear power is inevitable if India has to realize its dream and aspirations of becoming a developed nation. The realization of this goal before it is too late, is our responsibility.

There are thus many challenges ahead of us. The first challenge is to rapidly increase the share of nuclear electricity in the overall electricity generation in our country. In this regard, we now have as many as nine nuclear power units under construction. When completed, the nuclear power generation capacity would climb to 7300 MWe from the present 2770 MWe, a jump of more than two and half times. All our construction projects are in fact moving ahead of schedule. We have also launched several initiatives to meet the fuel requirements of our power stations. In addition to the production at Jaduguda, Narwapahar, Bhatin and Turamdih mines, the Uranium Corporation of India Ltd. has taken up the work to develop mines at Banduhurang, Bagjata, Lambapur and Domiasiat. We are also working to exploit other secondary resources. The Nuclear Fuel Complex is augmenting its Zirconium production capacity through expansion of its activities including a new zirconium sponge plant being set up at Palayakayal in Tamil Nadu. It should be our endeavor to enhance fuel production capacity as early as possible to meet the requirements of our expanding program.

Distinguished scientists and engineers & staff of BARC gathered at the founder's day celebrations in the central complex auditorium

Bharatiya Nabhikiya Vidyut Nigam (BHAVINI) Ltd, the fifth Public Sector unit of the Department of Atomic Energy, has come into existence a few days back for commercial implementation of fast breeder reactor technology. Setting up of the 500 MWe Prototype Fast Breeder Reactor would be its first task. As you can appreciate, this technology holds the promise of around 350,000 MWe power generation capacity using the spent

(Chairman's address continued on page 4 …)

Address by Mr B. Bhattacharjee, Director, BARC

Dr Kakodkar and Dear Colleagues,

In these glorious moments when Department of Atomic Energy celebrates its Golden Jubilee Year, it is indeed a matter of great pleasure and proud privilege for me to extend a warm welcome to each one of you – those who are present here as well as those who have joined from outside this auditorium – to celebrate the 94th birth anniversary of Dr. Homi J. Bhabha – the legendary founder of this great institution, Bhabha Atomic Research Centre. As a mark of our collective salutation, admiration and paying homage to Dr.Bhabha, every year we gather on this auspicious morning to celebrate his birthday by taking stock of our achievements during the last year and rededicating ourselves to accelerate our developmental efforts for utilization of nuclear science and technology for:

(a) improving the quality of life of our 1 billion plus population,

(b) staying at the forefront of nuclear science and technology in order to retain the place of honour and dignity for India amongst the world community; and

(c) also for enhancing the national security.

For improving the quality of life, our primary mandates are to:

(i) provide energy security by way of generation of nuclear power that is safe, reliable and economical in addition to its eco-friendliness; and

(ii) enhance use of radioisotopes and radiation technology in non-power sector for health care (which also includes nuclear desalination), agriculture and food preservation, isotope hydrology and industrial applications.

I am extremely happy to announce that last year has been yet another very successful year in our developmental efforts to exploit nuclear science and technology as we march forward to achieve our cherished goals.

Development Activities in the Power Sector

Our research reactors APSARA, CIRUS AND DHRUVA are all being extensively utilized for basic and applied research, isotope production, material testing and training for human resource development (which has been one of the strongest pillars of our success story).

Dhruva reactor continued to serve as a national facility for neutron beam research and a number of research scholars from various academic institutions in the country utilized the reactor under the aegis of the Inter University Consortium for DAE Facilities (IUC-DAEF). Production of radioisotopes at Dhruva reactor has been augmented by commissioning of another tray rod assembly with on-power handling capability.

Subsequent to commissioning of CIRUS after refurbishment last year, water seepage was observed at a few construction joints of the spherical surface of its 40-year old emergency water storage more commonly known as ball tank. The leakage was rectified by special technique and structurally strengthened to meet the revised stringent regulatory requirements of BARC Safety Council. CIRUS has since been put back to regular operation.

(Director's address continued on page 6.…)

(Chairman's address continued from page 2….)

fuel arising from Pressurized Heavy Water Reactors which we can set up on the basis of Uranium available in the country.

The challenge now before us is to demonstrate a commercial success in this endeavour in a manner similar to what we have done with PHWR technology. Given the excellent knowledge and skill base at the Indira Gandhi Centre for Atomic Research, generated through years of comprehensive Research and Development on Fast Reactor Technology, established capabilities of Nuclear Power Corporation in project engineering and construction management and dedication of every one involved, we will no doubt be successful.

The completion of *en masse* coolant channel replacement and several upgrades at the 2nd Unit of Madras Atomic Power Station in a record time has been an important achievement. Successful incorporation of moderator spargers at this Unit has been a matter of personal satisfaction for me as this completes the planned rehabilitation to full power rating. Sustaining commercial viability in a changing environment often poses complex technological challenges. Life management activities at various plants, increasing the design output of 540 MWe PHWR Unit to 700 MWe, the new front-end under commissioning at the Baroda Heavy Water Plant and many other similar activities that have been recently completed, are further examples of such successfully met challenges.

While the mixed carbide fuel in FBTR has now reached a burn up of 1,13,000 MWD/T, the PFBR fuel pins under irradiation in FBTR have also reached 12,730 MWD/T burn up. These pins incorporate U233 to enable irradiation at required linear heat rating while keeping the chemical proportion of uranium and plutonium at the level of PFBR design value. Reprocessing trials for FBTR fuel pins have also been started. We have accumulated considerable industrial scale experience in the back end of nuclear fuel cycle. In the context of Fast Breeder Reactor Programme, we now have to quickly take recycle activities to commercial – industrial domain on one hand and develop short doubling time capability on the other.

Development of Thorium utilization technologies for energy production is our long-term goal. I am happy that the engineering peer review process of Advanced Heavy Water Reactor has been completed. We now have to take up independent safety review and detailed costing before we can launch the construction of this technology demonstrator. We have to also complete all necessary R&D activities including validation of AHWR core through critical experiments as early as possible. Thorium utilization capability along with related material development can open up not only vast potential for electricity production but also could offer superior alternatives for applications such as production of hydrogen, burning of actinides and other long lived wastes, long endurance remote power packs and many others. Coupled with accelerator driven spallation neutron sources, these applications could become even more viable making the vast thorium resource available in our country a truly primary energy source with assured degree of sustainability and with negligible environmental impact and residual waste. As you are aware, we have launched an integrated long-term development strategy for shaping the third stage of our nuclear power programme. Let us all put our might together to realize the goals of this programme as early as possible.

We have been able to achieve technological successes because our research base is strong. We have to ensure that we sustain and enrich the environment that nurtures research. I think we are at a level where we should pick up new challenges where our research can provide possible answers to address some of the problems of national importance. Given our technological strength we are in a unique position to translate such new research output into beneficial applications. We have already done

so commendably well in the field of food and agriculture, medicine and health, environment, water availability in addition to electricity production. DAE technologies can make significant difference to quality of life of our people and so special initiatives have been launched to reach them to the target beneficiaries. Facilitating this translation should be a part of endeavour of each one of us. I would urge all of you to get first hand acquaintance with these technologies from DAE website and also encourage other to do so.

While our research has to have a national focus, we must excel at the global level. Here again, the strong linkage between our research activities and our technological capability has become our strength. Our participation in the STAR experiment at the Relativistic Heavy Ion Collider in the Brookhaven National Laboratory of United States, the Large Hadron Collider and its experiments CMS and ALICE under construction at the European Centre for Nuclear Research (CERN), Geneva, participation of Indian scientists in several synchrotron and other facilities in several laboratories abroad has earned considerable respect for Indian capabilities. As you are aware, we are now among very few countries who have Observer status at CERN.

Our efforts to create world-class research facilities are also bearing fruits. The Giant Meterwave Radio Telescope (GMRT) is now a full-fledged international observational facility for radio astronomy below 1.4 GHz. Gamma ray astronomy facility at Mt. Abu is operational. INDUS-I synchrotron is working well. ECR facility at VECC has considerably enhanced the range of heavy ions available for experiments. Good progress is being made towards radioactive ion beam development. Phase-I of Superconducting LINAC Booster at Pelletron Heavy Ion Accelerator is now operational. The Advanced Centre for Training, Education and Research in Cancer (ACTREC) is now functional. The Accelerator Mass Spectrometry facility for carbon dating is now available at the Institute of Physics, Bhubaneswar. SST-1, one of the world's first Superconducting Steady State Tokamaks with elongated diverter plasmas and 1000 second operation capability is getting ready at Institute for Plasma Research. The Superconducting Cyclotron is making good progress at the Variable Energy Cyclotron Centre. INDUS-2 is getting ready at the Centre for Advanced Technology.

Colleagues, in all our work we have always placed highest priority on our safety and environment related programmes. I must add here that we are committed to not only maintaining the environment but to its further enrichment through our work. That has been our philosophy all along. We should be judged by our actual track record and not by unsubstantiated stories. All our operating power plants and Heavy Water Plants now have ISO environment certificate. Our vision on environment is not restricted to just our programme. We are perhaps the pioneers in comprehensive thermal ecology work in our country. Flue gas conditioning technology developed by Heavy Water Board is now helping reduce fly ash emission in thermal boilers. Nisarga-Runa developed here at BARC is helping convert biodegradable solid waste into useful manure and methane. The sewage sludge hygenisation plant (SHRI) at Vadodara is now providing dried hygenised sludge for use by farmers. In my view these developments are of far reaching value in value added recycle of wet solid waste in urban areas and Agricultural waste or residue in rural areas. I am confident that these technologies would grow on the strength of their viable utility not only in preventing environment degradation but to produce valuable fertilizer and energy of use in rural areas. We all should play a catalytic role to expand this application.

Finally, friends we must recognize that our human resource is our strength. Our links with academic institutions built around program

oriented research and training are being further strengthened through BRNS and DAE-UGC Consortium. It should be our persistent endeavour to search talent, inspire and orient them to our national programme during their education phase, nurture and empower them to pursue innovative ideas while they pick up experimental and technological skills in the early part of their career with us and facilitate their blooming as leaders in their respective areas. We owe it to this organization that has groomed all of us so well.

Thank you.

(Director's address continued from page 3…)

As part of the ongoing PFBR shielding experiments at APSARA research reactor, 7 bulk shielding and 3 radiation streaming experiments have been successfully completed for PFBR. At present, APSARA is being utilized to study radiation streaming through simulated ducts/ passages for AHWR.

As you are aware, we are committed to provide energy security to the nation on a sustainable basis, for which we have plans to increase the share of nuclear power from the present level of about 2.5% to about 5% by the year 2008 and then to about 10% by the year 2020 through systematic induction of about 20,000 MWe of nuclear power.

Our present generation of PHWR utilizes only about 0.5% of the total uranium fuel and our modest uranium reserves may not support more than 15,000 MWe installed capacity through existing PHWR route. That is why, our committed nuclear power of about 20,000 MWe by the year 2020 calls for induction of Fast Breeder Reactors (FBRs) to contribute about 2000 MWe and Advanced Heavy Water Reactor to contribute about 300 MWe. In the long run, our goal is to contribute about 25% share of India's electricity generation capacity through nuclear power programme by the year 2050.

With this backdrop of Indian nuclear energy programme, the scientists and engineers of BARC, by utilizing its multi-disciplinary scientific and technological strength, are focussed for developing host of technologies through innovative ideas and creative design in three broad areas, viz., (i) to stay tuned to the horizontal needs of our expanding PHWR/LWR programmes to take care of the much needed technology uprates, aging management, life extension and fitness for service analyses; (ii) to shoulder substantial responsibilities for success of our next generation Prototype Fast Breeder Reactor (PFBR), which would provide the country an access to about 130 times more nuclear power from our limited uranium reserves, by way of providing the entire requirement of MOX fuel along with the fuel fabrication technology, waste management facilities, inclined fuel transfer machines, cell transfer machines and shipping cask, high temperature special sensors, validation of seismic design for reactor containment and major equipment/machineries etc., just to name a few of our major responsibilities; and finally (iii) to develop technologies for the vertical needs of India's nuclear energy programme, i.e., the technologies that are needed in the future based on India's vast thorium reserves (amount to ~ one-third of world's total thorium reserve).

As a part of our continued R&D support to ensure operation of the PHWRs at world class level both in terms of plant capacity factor as well as safety records, an MoU has been signed between BARC and NPCIL for manufacture of wet scraping tools including the training of manpower to carry out scraping operation in operating reactors which would enable estimation of hydrogen pick-up level in the coolant channels as part of In-Service Inspection programme. A large scale scraping operation in 87 coolant channels, was carried out to minimise the rehabilitation load at RAPS-I.

Further an extensive rehabilitation programme for

coolant channels of RAPS-I has been carried out by using specially developed Integrated Garter Spring repositioning system, as a result of which the operating life of coolant channels of RAPS-I has been increased from the existing 7 Effective Full Power Years to atleast 9 Effective Full Power Years with a possibility to increase it further (based on a few additional life management measures to be initiated later on).

To increase the power level of MAPS-2 from present 75% to 100% power, three sparger channels were successfully developed for MAPS-2. The shock and vibration experienced in the piping system feeding these sparger tubes during moderator dumping were also analyzed and appropriate corrective action has been implemented for obtaining the Regulatory clearance to operate the MAPS-2 reactor at full power.

A Miniature Underwater Radiation Resistant CCTV Camera has been developed and successfully used for inspecting the 220 MWe Calandria tubes at MAPS-2 and Pressure Tubes at KAIGA-1. This technological development has enabled NPCIL in saving considerable manrem consumption as well as reactor down time.

A modified chemical cleaning procedure for the moderator system of NAPS has been developed and high temperature chemical and electro-chemical parameters were monitored *in situ* for the first time in the country.

A Graphic User Interface based software to calculate leak rate for LBB qualification of Indian PHWR piping components has been developed and handed over to NPCIL.

As a part of our programme to develop PHWR fuels with about 40% higher burn up compared to conventional natural UO_2 fuel bundles, we have developed MOX fuels for PHWR that are ready for shipment.

For 500 MW(e) PHWRs coming up at Tarapur, a full scale test facility for Liquid Zone Control System (LZCS) has been developed for optimization of process parameters. This control system is first of its kind being introduced to PHWR system in India for fine tuning of reactivity in dynamic mode.

A test facility with state-of-the-art control system is in the final stage of commissioning for testing the 500 MWe PHWR fuelling machine.

Reliability analysis of piping system of 500 MWe PHWR has been carried out using fragility method. The thermal hydraulic analyses were also carried out for Kudankulam power plant.

A prototype of fast acting valves with an opening time of 3 milli-seconds that are needed for many nuclear engineering applications like simulation of Loss of Coolant Accident (LOCA), quick injection of liquid poison to scram a reactor, etc., has been developed and endurance tested at high pressure. Actions for endurance testing of the prototype under simultaneous high temperature and high pressure has been taken.

As a part of our commitment towards FBR programme, the mixed uranium-plutonium carbide fuels fabricated at BARC for Fast Breeder Test Reactor (FBTR) at IGCAR, Kalpakkam has already seen a peak burn up of about 1,10,000 MWd/te without any single failure. I would like to take this opportunity to compliment my colleagues of BARC for this great achievement for the first time in the world.

This has been followed by development of yet another special MOX fuel (UO_2-29% PuO_2) pins for PFBR which have already seen a burn up of 15,000 Mwd/te under irradiation in FBTR since July, 2003. This MOX fuel pins are of special nature because significant amount of U233 has been added to simulate the specified high linear heat rating of PFBR-500 for testing in FBTR.

Further in order to enhance the power generation capacity of FBTR, a hybrid core consisting of mixed carbide and MOX fuel containing 45% PuO_2 is under consideration. Before loading the mixed fuel to FBTR, chemical compatibility of this mixed fuel containing 45% PuO_2 with sodium

coolant as well as with D-9 cladding material has been established at BARC under simulated reactor condition along with the generation of a new data base on thermo physical properties of the fuel.

Keeping in mind that India has to fall back to its thorium reserves for energy security on a sustainable basis, we have the road map for introducing thorium (as ThO_2) in place of UO_2 in the blanket zone of FBRs at an appropriate growth level of installed nuclear power capacity in the second stage (because early induction of ThO_2 to replace UO_2 in the blanket zone of second stage FBR based on PuO_2 – UO_2 MOX fuel would retard the growth of nuclear power programme). However, we need to master well in advance all the technologies involved at the front-end as well as back-end of Th-U233 fuel cycle at plant scale (from our existing experience at pilot scale). Accordingly, as all of you are aware, one of our major tasks in hand is to start construction of a thorium fuel based 300 MWe Advanced Heavy Water Reactor (AHWR) within two years time. Designed for 100 years of plant life, AHWR will generate 65% of the power from ThO_2 based fuel. This reactor system (first of its kind in the world) has not only the most attractive feature of primary heat removal by natural circulation but it also incorporates host of other passive safety features that are in line with the approach being pursued world over for development of inherently safe reactor system by incorporating safety features that do not call for any human intervention or any active control devices for reactor safety. I am sure, from regulatory point of view, this reactor concept would be equally exciting because such reactors eliminate the need for any exclusion / sterilization zone and hence do not call for any planning for emergency-evacuation.

The peer review of the Detailed Project Report (DPR) of AHWR has been completed by 15 Review Groups of NPCIL. While the observations and comments of NPCIL Peer Groups are being studied by us, AHWR is also being subjected to review for its compliance with international standards through participation in the IAEA initiated International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO).

Parallel to such design reviews with reference to national and international requirements, extensive design validation programmefor AHWR is under way at BARC. An integral test loop, ITL simulating main heat transport and all other major systems along with the associated controls for AHWR is nearing completion in BARC for validation of its thermal hydraulic and safety analysis codes.

A Critical Facility is also coming up at BARC which would be utilized for validation of physics codes and library for AHWR as well as 500 MWe PHWR.

We have also plans to induct nuclear energy as primary energy source in the near future, viz., nuclear energy as source of heat for variety of applications. For this, another innovative reactor being developed in BARC is a small capacity (~100 KW(th)) Compact High Temperature Reactor for addressing the needs of some specific applications like the need for small unattended power packs for electricity generation in remote areas that are not connected to the grid system or for production of hydrogen from H_2O using thermo-chemical means as an environment friendly alternative to hydrocarbon fuels for our transportation sector (which has a huge burden on our import bill, in addition to the environmental concern associated with hydrocarbon fuels) or even for refinement of low grade coal and oil deposits to high grade fossil fuel. The physics design of this small vertical natural circulation type totally passive CHTR (lm D x lm H) has been finalized with 19 fuel assemblies/channels with TRISO type coated particle fuels (where Th-U233 carbide kernel is encased by multi-layers of pyrolytic carbon and silicon carbide) with liquid metal like molten Pb or Pb/Bi eutectic, as coolant. Detailed design of various reactor systems like simulation and modeling of passive power regulation system, heat pipes etc. are in progress.

In parallel, we have already taken actions to complete the R&D task involved in development of technologies needed at the front end as well as back- end of Th-U-^{233} fuel cycle. In fact, from our existing position being recognized as an advanced country in terms of our achievement in nuclear science and technology, we aspire to be the world leader in the area of utilization of thorium for harnessing nuclear energy for the benefit of mankind.

As our nuclear programme is expanding, our programme at the back end of the fuel cycle has been assigned special attention to cope with the increasing demand from reprocessing as well as waste management facilities. Enhancing the availability factor of the existing plants at the back-end of nuclear fuel cycle (all of which are otherwise performing extremely well), through systematic induction of better technologies, capacity - uprating by way of improved process design and remote handling equipment and life extension through induction of components and control systems with better reliability have been some of our major technological challenges.

For enhancing the availability factor of our reprocessing and waste management plants, reliability of certain critical equipments/ components like spent fuel chopper, master slave manipulator, servo manipulator etc., have been improved through better design with full participation of Indian industries.

Similarly, while the Waste Immobilisation Plant (WIP), Trombay has been operated to vitrify the high level waste (HLW) from PP, the construction of an Advanced Vitrification System (AVS) at Tarapur for immobilization of high level waste using advanced Joule Melter Technology is nearing completion. After commissioning of this system by the end of the year, India would establish yet another advanced technology for vitrification of HLLW.

While we can continue for few more decades by storing the vitrified high level waste in the interim Solid Storage Surveillance Facilities (S3F), we have sustained our development efforts for locating a permanent storage facility for the vitrified waste in a deep geological repository.

In this context, we have also initiated a long term programme to develop Accelerator Driven Sub-critical System (ADSS) – yet another reactor concept for future – that could be used for either (a) power generation from Thorium or (b) production of U233 for our third phase FBR based on ThO2-U233 O_2 fuel; or (c) more importantly incineration of long lived actinides and transmutation of long lived fission products of present generation PHWRs to shortlived products with, say, few 100 years of half life, thereby drastically reducing the long term activity burden of HLLWs which will go a long way to enable us to store them in near surface burial under surveillance or make their disposal in geological repository at much reduced technological complexities depending on the half life of the finally achieved incinerated/transmuted products. R&D work for development of special solvents and for inducting the process for partitioning of minor actinides during reprocessing operation are in progress.

Developments in Non-Power Sector

Remarkable progress has been achieved during the year in applications of Radioisotopes and Radiation Technology in the areas of health care (which also includes nuclear desalination), nuclear agriculture & food preservation and industrial uses.

Our I-125 based miniature brachy therapy source developed at BARC has been tried for the first time for treatment of eye cancer on a 4 year boy on 11th September 2003 at Sankara Netralaya, Chennai. This brachy therapy source was dedicated to the nation by the Hon'ble President of India, Dr. A.P.J. Abdul Kalam on October 10, 2003.

The technology for preparation of single step Radiation Processed (Co-60 source) sterile HYDROGEL for treatment of burn injuries has

been handed over to M/s. ABS Medicare Pvt. Ltd., and the product Hi-ZEL has been received extremely well in the market.

To provide a low cost alternative teletherapy unit for the expensive teletherapy unit being imported, the first indigenous development of Cobalt-60 Teletherapy Machine has been completed with world class feature, like Zero collimator closing for full radiation safety, lower penumbra for better treatment results, 200-250 RMM Cobalt-60-source strength which is at par with any imported machine with total digital controls that are upgradeable to tele-maintenance. The machine is being installed at ACTREC, Navi Mumbai for source loading and commissioning.

Medical Cyclotron with Positron Emission Tomography (PET) scanning facility that was introduced for our needy people for the first time in the country last year is being effectively utilized to produce F-18 labelled FDG molecules for diagnosis of cancer as well as cardiac disorders.

A digital medical imaging system based on a Charge Coupled Device (CCD) has been developed for the first time in the country along with a variety of image processing software. This digital medical imaging system can be used in multifunctional modes viz., either as digital radiography (where, compared to conventional film type X-ray unit, the delivered dose to the patient for a given quality of picture is ~ one order less with a much higher dynamic range), or as a digital fluoroscopy (for real time observation) or even as digital angiography including the facility of getting the digital images archived for Telemedicine purpose. It would be installed at BARC Hospital soon. We are also exploring the possibility of introducing this advanced system of digital imaging system through collaboration with outside industries.

The Sludge Hygienization Research Irradiator (SHRI) using ~180 Kci of Co-60 source has been commissioned successfully to treat nearly 2500 m^3 of municipal waste at Vadodara and over 40 Te of hygienised bacteria free sludge with excellent NPK content was recycled for large scale field trials under the supervision of Krishi Vigyan Kendra, Vadodara as an effective bio-fertilizer and soil conditioner for green gram crop. A tripartite MoU has been signed a fortnight back for processing larger quantities of municipal sludge at SHRI facility.

As a part of our health care programme, our 1800 m^3/day Reverse Osmosis (RO) Desalination Plant coupled with Nuclear Power Plant at Kalpakkam is doing extremely well. The construction of the adjoining desalination plant based on Multi-Stage Flash (MSF) evaporation process is in progress. A 30 m^3/day desalination unit based on low temperature evaporation (LTE) process has been integrated with CIRUS research reactor to demonstrate sea water desalination using waste heat from the research reactor.

We have built a 30 m^3/day RO plant in Satlana Village of Jodhpur District for producing drinking water from bore well brackish water source. Our technology for online domestic water purifier based on ultrafiltration polysulfone membrane for producing bacteria free safe drinking water (@ 40 litres /day) has been transferred to 8 parties, out of which two have already launched their products in the market.

Work on building a 50 m^3/day barge mounted desalination plant for providing drinking water from sea water to flood affected areas is progressing well.

In the field of Nuclear Agriculture, our groundnut variety TG-37A has been identified this year by ICAR for commercial release for Kharif (rainy) season in Zone I (Rajasthan, Punjab, Haryana and Uttar Pradesh). Large seed groundnut variety, TKG 19A was found promising for North Eastern Hill States. Two Trombay groundnuts TAG-24 and TG-26 were grown at Leh, at an altitude of about 3,505 meter above mean sea level with encouraging results in a collaborative effort between BARC, Defence Research & Development Organisation (DRDO) and National

Research Centre for Groundnut (NRCG), Junagadh.

BARC's Nisargruna (biogas) plants are a boon to solid waste management authorities. Two Nisargruna plants of 5 t/day capacity each have started operating at Shatabdi Hospital, Govandi and Deonar abattoir respectively. This follows BARC's MOU with Municipal Corporation of Greater Mumbai and Stree Mukti Sanghatna. Technology for the biogas plants is also being transferred to other entrepreneurs.

KRUSHAK (Krushi Utpadan Sanrakshan Kendra), a technology demonstration unit for low dose applications of radiation for food preservation became operational at Lasalgaon near Nashik in July this year. The unit started processing onion for sprout control and other agricultural commodities including cereals, pulses and their products, raisins and some spices for insect disinfestations. An MOU was signed between Hindustan Agro Cooperative Ltd., and BRIT/BARC for providing technical consultancy for setting up a radiation processing plant for onion and other agricultural commodities at Rahuri in Ahmednagar Dist.

As a part of our continued development in application of radioisotopes and radiation technology in industrial sector, our gamma scanning technology continued to be used for troubleshooting and process optimization in a number of process industries in the country. In fact, our Heavy Water Board has utilized this technology this year for troubleshooting of one of their 4.5 meter diameter Hot Towers at Manuguru.

In-house development of 10 MeV, 10 KW, RF Electron Linear Accelerator for industrial use is in advanced stage of assembling & testing.

Technology Developments

In our effort to develop Teraflop parallel Super-computers with more than 1000 processors, BARC has achieved a very significant milestone by commissioning an ANUPAM-ARUNA parallel supercomputer with 128 processors, giving a computational speed of 360 Gigaflops on the high performance Linpack benchmark. Within a period of next one year we expect to reach a computational speed of about 1.5 Teraflop using 512 processors.

Hermetically seated dry type low pressure compressor for special applications has been developed for the first time in the country at a cost less than half the cost of the imported machine.

A plasma materials processing facility based on a 2.5 GHz, 1.5 kW microwave electron-cyclotron resonance source has been developed for the deposition of hard tribological coatings of a variety of materials.

MAT Lab has been established for the first time in India for the preparation of ultra pure metals like gallium, arsenic, etc., and their organo-metallics with purity >6N for MOCVD experiments.

A Mobile Radiological Laboratory (MRL), equipped with various instruments required for environmental contamination monitoring and whole body monitoring has been commissioned. This is equipped with a specially developed simple yet very sensitive ^{131}I thyroid monitor and a stand alone computer controlled whole body counter for assessing internal contamination. It is a self operated system and would be especially useful in radiation emergencies.

A remotely operated hydraulic trolley manipulator (with 6 degrees of freedom) capable of handling 50 kgm pay load has been commissioned which will be an extremely useful tool during incidents/emergencies in nuclear power plants and other radioactive facilities.

Assistance to outside organisations

In addition to the heat shrinkable sleeves already supplied for Light Combat Aircraft (LCA) using Nickel-Titanium (50% Ni – 50% Ti) based shape memory alloys, a number of other critical components like 3-axis super elastic wave springs made of shape memory alloy containing 51% Ni and 49% Ti (for tightening the cap screws

of pumps) and the heat shrinkable hydraulic coupling for joining half alloy tubes of Titanium (containing 3Al – 2V as against 6Al - 4V of famous Ti alloy) to withstand high pressure.

Technology for commercial production of TBP with 60 MT/year capacity has been handed over to Heavy Water Board which would cater not only to the in-house requirement but also meet some of the outside requirements of non-ferrous metal industries.

The visual colorimetric reagent for the detection of fluoride in the ground water has proved very popular with water boards. The capability of providing specialized ultra-trace analytical services has been extended to a large number of chemical systems.

Recognising the urgent need for improving safety in Indian Railways, BARC has taken initiative for developing an online health monitoring system in collaboration with Konkan Railway Corporation Ltd. A PC based system has been designed, tested and commissioned on the Konkan route to monitor and record normal and abnormal rolling condition of the running trains.

BARC on-line creep-fatigue monitoring system (BOSSES) has been implemented at National Super Thermal Power Plant (Dadri).

Technologies for (i) Digital Pocket Dosimeter, (ii) the manufacture of $CaSO_4$:Dy Teflon TLD discs and (iii) the production of dust and airline respirators were transferred to private parties during the year.

International Collaboration

We have a strong collaborative participation with most prestigious international mega project at CERN, Geneva, where the most advanced basic science are planned to be pursued with facilities being created using the most advanced technologies in the world. I take this opportunity to compliment the entire DAE family in general and all my colleagues from BARC in particular whose contributions towards implementation of this mega project (which include 100 numbers of large area Silicon strip detectors for use in CMS facility at CERN) have been highly appreciated and earned the "Observer" status for India at CERN. It is indeed heartening to note that CERN is showing progressively more keenness to expand the collaborative programme with BARC particularly in the area of grid computing technology – a technology that could be the most cost effective technology for networking of all the available computational resources at national/ global level.

BARC participated in an IAEA sponsored international effort for searching of Sr-90 "orphan sources" at Georgia. Aerial Gamma Spectrometry System (AGSS), developed by BARC, was deployed in the search operations carried out in the western and southern regions of Georgia. The technical superiority of our AGSS in detecting the orphan sources and the expertise of BARC staff in locating the same and training of the staff of Nuclear Radiation and Safety Services (NRSS), Ministry of Environment, Georgia in the operation of the AGSS system have been highly appreciated by both the Govt.of Georgia and IAEA.

Friends, the actual list of achievement in BARC is too long to be covered in totality in a short term. However, before I conclude, I would like to take the opportunity to compliment all the staff members of BARC units once again for their outstanding performance for all round advances at BARC. A word of special compliment must be mentioned for BARC Safety Council for its excellent performance while discharging the duties.

Finally, on the memorable moments of the Golden Jubilee Year of the Department of Atomic Energy let us rededicate ourselves on this auspicious day for sustaining our development efforts in both basic science and engineering science for taking India to a position of super power through building a vibrant economy based on utilization of nuclear science and technology for long term energy security, food security and health care as a mark of our collective homage to our founder, Dr.Homi J. Bhabha.

Thank You.

CHAIRMAN PRESENTS DAE AWARDS TO STAFF

The Department of Atomic Energy instituted an Award Scheme in 1993 to recognise exceptional accomplishments and meritorious achievements in Science & Technology, and to create a congenial milieu for nurturing excellence and fostering creativity among the members of the DAE staff who are engaged in Research, Development and Engineering in the frontiers of Science and Technology dedicated to the development of the nation.

The Award Scheme consists of three categories of awards :

1. Homi Bhabha Science & Technology Award
2. Technical Excellence Award
3. Meritorious Service Award

These awards are given annually.

The Homi Bhabha Science & Technology Award is the highest award among them. It consists of a citation, a medal, and a cash award of Rs. 50,000/-. This award is given to a maximum of two Engineers or Scientists who have made outstanding contributions towards advancement of science and technology based on original research in the frontier areas of science and frontline development in engineering and technology, which would reflect excellence commensurate with national and international standards. This year the award goes to :

Dr Arun Kumar Bhaduri of Materials Technology Division, Indira Gandhi Centre for Atomic Research, Kalpakkam, and Dr Prasad Anant Naik of Laser Plasma Division, Centre for Advanced Technology, Indore.

Dr Arun Kumar Bhaduri is conferred the Homi Bhabha Science and Technology Award for the year 2002 for his outstanding contribution in the areas of welding of dissimilar metal, repair welding and hardfacing.

Dr Arun Kumar Bhaduri receiving the Homi Bhabha Science & Technology Award 2002 , from Dr Anil Kakodkar, Chairman, Energy Commission

Dr Bhaduri is an internationally recognized professional in science and technology of welding and hardfacing. Starting with R&D in the area of weldability of stainless steels, ferritic steels and nickel-base alloys, he has specialized in the area of dissimilar metal welding, repair welding and hardfacing. He has made many original and innovative contributions in the area of numerical, finite element and neural network modeling and development of new testing procedures for weld joints. He has consistently provided critical design and fabrication inputs for various nuclear reactor related technologies such as In-situ repair welding procedures for cracked shrouds and blades of steam turbines, characterisation of trimetallic transition metal joints for Pressurised Fast Breeder Reactor (PFBR) steam generator circuit including demonstration of superiority of service-life of the trimetallic joints over conventional bimetallic joints.

Dr Bhaduri's other outstanding achievement has been in developing a novel procedure for toughness characterisation (known as RBR method) using tension tests through two new toughness parameters based on "continuum damage mechanics" concepts. This procedure has been standardized for optimizing post weld heat treatment of weld joints with optimized end-of-life toughness. His other major development includes validation of a numerical simulation model for theoretically predicting temperature

distribution in the heat-affected zone during welding.

Dr Prasad Anant Naik is conferred the Homi Bhabha Science and Technology Award for the year 2002 for his impressive contributions in the field of high power lasers and laser plasma interaction.

Dr Prasad Anant Naik receiving the Homi Bhabha Science and Technology Award 2002, from Dr Anil Kakodkar, Chairman, Atomic Energy Commission

Dr Naik's work in this field has been primarily motivated by the possibility of achieving controlled thermo nuclear fusion, development of soft x-ray lasers and intense x-ray generation for a variety of scientific and technological applications. His successfully building a Nd:glass Table Top Terawatt laser system for studying laser plasma interaction at ultrahigh intensities is one of his outstanding achievements. This is the highest peak power laser system developed in the country with energy greater than 1J, pulse width less than 800fs and power level greater than 1 TW.

In addition to carrying out excellent developmental activities, he has performed a number of studies using his indigenously set up lasers and the diagnostic system and has obtained many important results of contemporary interest. These include optimizing the composition of laser heated mix-Z targets to achieve high opacity, generating harmonics from solid surfaces, enhancement in x-ray line emission from expanding plasmas, developing a new method to generate cylindrical plasma for XUV lasing studies, characterization of x-ray microscopic imaging of biological samples, stereoscopic imaging using twin laser produced plasma sources, intense K-α x-ray generation in laser driven diode, and generation of high current density electron pulses of over 100A/cm^2 from ferroelectrics.

The second set of awards is the **Technical Excellence Award**. This award is conferred on a maximum of two Engineers or Scientists who have made outstanding contributions and special efforts towards :

(a) Development of a new or improved equipment, machine, materials, process of device with proven results meeting the immediate use requirements of futuristic needs of bringing credit to the respective Unit or leads to import substitution, technology transfer etc.

(b) Practical constructive ideas and suggestions leading to better utilisation of human resources, materials, processes, devices, etc. resulting in higher efficiency and significant financial saving to the Govt; or

(c) Handling of emergency or crisis situations exhibiting rare alertness and skill thereby averting accident/serious plant situation; or

(d) Highly efficient planning and execution of important assignment in multidisciplinary and multiorganisational time-bound projects of vital interest to the nation, and excellence in trouble shooting or overcoming or expeditious implementation of ongoing projects.

The Award consists of a citation, a medal, and a cash award of Rs. 20,000/-.

This year the award goes to :

1. Dr Rameshchandra Joitaram Patel, Refuelling Technology Division, BARC and
2. Mr Mahadeva Padmanabhan, Division of Remote Handling & Robotics, BARC

Dr Anil Kakodkar, Chairman AEC giving away the Technical Excellence Award for the year 2002 to Dr R.J. Patel

Dr Rameshchandra Joitaram Patel is conferred the Technical Excellence Award for the year 2002 for his outstanding contributions in the areas of design and development of Fuel Handling Systems for Pressurised Heavy Water Reactors (PHWRs) including the development of cost effective, man-rem saving schemes / tools for the operating nuclear power reactors. These all are new and innovative technologies.

Dr Patel, during his 24 years of distinguished professional career contributed remarkably to the nuclear power programme of DAE. He has developed various in-service schemes and maintenance tools for life management of coolant channels for power reactors. The life management programme for coolant channels plays very important role in enhancing the performance of operating PHWRs. This needs to be done with minimum down time and man-rem expenditure and saving of the fuel. For this programme, Shri Patel has developed Wet Scrapping tool (WEST), special seal plug for BARCIS, channel isolation plug, etc. which have been successfully used in various operating PHWRs. He has also carried out design and development of spent fuel transfer system for 500 MWe PHWR.

Dr Patel's other important contributions are in the area of design and development of Accelerated Heavy Water Reactor (AHWR) fuel handling system and Inclined Fuel Transfer Machine (IFTM) for Prototype Fast Breeder Reactor-500 (PFBR-500). Many innovative concepts have been incorporated in AHWR fuelling handling system-involving designing of fuelling machine, FM carriage and various sub assemblies. Inclined Fuel Transfer Machine (IFTM) for PFBR-500 is a very novel concept.

Mr Mahadeva Padmanabhan is conferred the Technical Excellence Award for the year 2002 for his outstanding contributions in the development of Miniature Underwater Radiation Resistant CCTV camera for Remote Inspection of Coolant Channels of Pressurised Heavy Water Reactors (PHWRs), computer controlled Single Crystal X-ray Diffractometer (SCXRD) and BARC Channel Inspection System (BARCIS). All these developments involve technological novelties and are high-tech import substitutes.

Dr Anil Kakodkar, Chairman, AEC, giving away the Technical Excellence Award 2002, to Mr Mahadeva Padmanabhan

The development of state-of-the art technologies for in-service inspection of coolant channels of PHWRs was taken up at DRHR, BARC. A Miniature Underwater Radiation Resistant CCTV camera with radial viewing head and coolant unit for visual inspection of coolant channels in compatibility with BARCIS has been developed. Mr Padmanabhan has successfully carried out the design & development camera electronics and its integration with the mechanical and

optical components of the camera, which have been qualified for use in radiation field of 10^6 Rads/hour. The camera system has been successfully used for visual inspection of calendria tubes and coolant channels of power reactors. This indigenous development has not only saved the foreign exchange but has brought the self-reliance in this extremely important area of coolant channel inspection of our PHWRs. Mr Padmanabhan has also contributed towards the development of BARCIS by carrying out the commissioning of the systems at respective sites and in-service inspection.

Mr Padmanabhan has also significantly contributed for the development of computer controlled Single Crystal X-ray diffractometer (SCXRD), which is a high precision X-ray analytical instrument, used in crystallographic research. He was honoured with Indian Physics Association's S.N. Seshadri Memorial Instrumentation Award for his contribution in this project for the year 1999.

The third set of the awards is the **Meritorious Service Award**. This award is conferred on a maximum of six employees with a minimum continuous service of 20 years or more, who have exhibited consistent improvement in skill, technology ability, including outstanding performance in the maintenance of equipment and facilities resulting reduction in idle time and increase in effective utilisation. Emphasis is also on consistently high performance and achieving perfection in work.

The award consists of a citation, a medal and a cash award of Rs. 10,000/-.
This year the awards go to :

1. Govind Sakharam Ghanekar, Food Technology Division, BARC
2. Joseph Packianathan Asirvatham, Engineering Services Section, Nuclear Fuels Group, BARC
3. Shashikanth Laxman Karnik, Research Reactor Maintenance Division, BARC, and
4. Shaikh Baba, Materials Processing Division, BARC

Mr Govind Sakharam Ghanekar is conferred the Meritorious Service Award for the year 2002 for his significant contribution to the Food Irradiation Programme of the Department.

Mr G.S. Ghanekar receiving the meritorious service award from Dr Anil Kakodkar, Chairman, AEC

Mr Ghanekar has contributed significantly in the postharvest technology development programme and provided expertise in selecting the raw materials for the critical experiments for successful application of irradiation technology. He has helped in large-scale trials on radiation processing of foods especially for conducting 4 commercial trial runs on 50 tons of onion in association with National Horticulture Research Development (NHRDF), Nashik & National Agriculture Federation (NAFED), Mahuva. Shri Ghanekar is an expert in selecting suberized potato and cured onion for processing.

Mr Ghanekar has also significantly contributed by taking irradiation work involving fruits and vegetables and the development of process for dried fruits using a novel concept of encapsulation of moisture of food and thus preventing its spoilage.

Apart from the aforesaid technical contributions to our food irradiation programme, Shri Ghanekar has demonstrated remarkable skill in co-ordinating jobs involving other groups. He is very

sincere, hard working and co-operative person and accepts the work in pleasing manner.

Mr Joseph Packianathan Asirvatham is conferred the Meritorious Service Award for the year 2002 for his outstanding contribution to the specific areas of development of equipments for glove box application for Nuclear Fuel Programme of the Department.

Mr J.P. Asirvatham receiving the Meritorious Service Award from Dr Anil Kakodkar, Chairman, AEC

Mr Asirvatham has developed exceptional skills in understanding the various equipments being installed inside the glove box and their installation and commissioning in the glove box for handling strategic materials. He has contributed for the fuel fabrication campaign of Kamini / Purnima Reactors and Fast Breeder Test Reactor (FBTR). Apart from this, he has significantly contributed for the development of various gadgets required for Kamini / Purnima which include Swaging tool, Cladding tube-manufacturing fixture, Coolant channel manufacturing fixture, Riveting fixture, Numbering fixture, etc. including the development and modification of welding machine for FBTR fuel pins, furnaces, hydraulic press and various equipment housed inside the glove box.

Mr Asirvatham is an intelligent and very hard working person and has exhibited devotion to the duty in respect of various technological development and maintenance of active glove boxes required for handling strategic materials.

Dr Anil Kakodkar, Chairman, AEC, giving away the Meritorious Service Award to Mr S.L. Karnik for the year 2002

Mr Shashikanth Laxman Karnik is conferred the Meritorious Service Award for the year 2002 for his excellent contribution in the areas of process instrumentation systems for the Research Reactor. Mr Karnik has remained professionally focused over last 35 years in the areas of commissioning and maintenance of instrumentation systems of Research Reactors Dhruva, Cirus, Apsara and Zerlina. His contributions in commissioning of various instrumentation system of Dhruva have been very significant. He has solved post-commissioning problems of Dhruva fuel channel flow measuring devices. He has paid careful attention to the planning and implementation for the job of various replacements taking into the consideration the minimum man-rem consumption and their execution in shortest time. Shri Karnik's another worthy contribution is in imparting training to the technicians of the next generation which has helped building an efficient maintenance team. Shri Karnik is very hard working, sincere and extremely dedicated to his profession.

Mr Shaikh Baba is conferred the Meritorious Service Award for the year 2002 in recognition of his outstanding contribution to development of various processes and production of important materials for our Atomic Energy Programme.

Mr Shaikh Baba receiving the Meritorious Award for the year 2002 from Dr Anil Kakodkar, Chairman, AEC

Mr Shaikh Baba has been relentlessly working for the last 32 years for the various activities of the Materials Group. Some of his major contributions include the development of processes for preparation of elemental boron and fine grinding of the elemental powder for use as coating material for neutron sensor development, preparation of dense pressureless sintered boron carbide pellets for use as neutron shielding and control rod elements, synthesis of borides for use as boride based control elements for special research reactors, preparation of calcium metal by aluminothermic reduction of calcium oxide and purification of calcium metal by distillation.

Mr Shaikh Baba has demonstrated extraordinary quality and skill and has been very dedicated, sincere and cooperative. He has generously imparted his technical skill and knowledge to his colleagues and he is a role model to all of them.

Mr B. Bhattacharjee, Director, BARC, releases the Special Issue of "BARC Newsletter" on the Founder's Day.

After the DAE awards, Mr B. Bhattacharjee, Director, BARC, released the special issue of *BARC Newsletter* which was brought out as a homage to Dr Homi Bhabha and which contains some of the research papers that won various awards.

XVTH ALL INDIA ESSAY CONTEST IN NUCLEAR SCIENCE AND TECHNOLOGY

The All India Essay Contest in Nuclear Science & Technology for students studying for graduation in any discipline was started by the Department of Atomic energy in 1989 and has since been an annual feature. This year's contest is the 15th in the series. This year's contest is the 13th in the series.

This year being the golden jubilee year for the Department, a common topic titled **"Fifty years of India's Atomic Energy Programme: Evolution and Achievements"** was specified in addition to the normal two sub-topics.

The two topics specified were:

(a) Electricity from Atom: Achievements and Looking beyond

(b) Radiation and Radioisotopes for Better quality of life

The written essays are evaluated by 8 to 9 groups of experts drawn from BARC, NPCIL and BRIT. The evaluations are first subjected to a normalization process within the group. The short- listed essays from all the groups are then further assessed through inter-group evaluation and another round of normalization. The contestants of the final merit list so prepared are invited to come to BARC for making oral presentations before a panel of judges. Prize winners are decided on the basis of total marks obtained for the written essay and the oral presentation, both carrying equal marks. Essays

could be written in any official Indian language or English.

690 essays were received, 400 on the first topic and 290 on the second topic. Out of these, 179 essays were written in languages other than English. 71 specialists in 9 groups evaluated these essays.

Dr Anil Kakodkar, Chairman, AEC, and Mr B. Bhattacharjee, Director, BARC, with winners of the XIIIth All India Essay Contest in Nuclear Science & Technology.

After evaluation, 17 contestants from the rust topic and 15 contestants from the second topic were qualified and were invited to Mumbai to make oral presentation of their essays in twenty minutes before a panel of ten judges comprising of senior scientists and engineers drawn from DAE organisations.

On 30th October, 2003, Dr Anil Kakodkar, Chairman, AEC, distributed the prizes to the following contestants :

Prize Winners : Topic (a) - " Electricity from Atom: Achievements and Looking beyond"

First Prize (Rs. 7,500/-)	:	Ms Aparna Narayan, B.E. II Surat, *English*
Second Prize (Rs. 5,000/-)	:	Ms Riddhi H. Kardekar B.Sc. I Ratnagari, *English*
Third Prize (Rs. 3,000/-)	:	Mr K. Murugeshan, B.Com. II Hyderabad, *English*

Prize Winners : Topic (b) - " Radiation and Radioisotopes for Better quality of life "

First Prize (Rs. 7,500/-)	:	Ms Soniya Bopche, B.Sc. III Damangaon, *English*
Second Prize (Rs. 5,000/-)	:	Ms J. Sarala, B.Sc. I Hyderabad, *English*
Third Prize (Rs. 3,000/-)	:	Ms Aarti Upadhyay, B.A. III Khandwa, *English*

In addition to the above prize-winners there were several consolation prize winners of Rs. 1,500/-. for both topics.

This year being the golden jubilee year, a logo competition was conducted. In all 236 entries were received and one logo was selected. This logo is already displayed in all departmental communications of DAE.

This prize winning logo was created by Mr Mandhar Kanvinde. On the logo, the reactor dome with are symbolic of growth and prosperity of the nation and enhancement in the quality of life of the people accrued from the research and development work being pursued in the department.

FOUNDER'S DAY LECTURE

This year's lecture was delivered by Dr S.S. Kapoor, former Director, Physics and Electronics Group & Instrumentation Group, BARC and presently Professor, DAE Homi Bhabha Chair on "Frontiers in Nuclear Research".

Nuclear Research has held a prominent place among the developments in Physics in the last century particularly due to the discovery of Nuclear Fission. Indeed Nuclear Fission which is one of the most important scientific discoveries of the 20th century is also a fascinating nuclear process involving large scale nuclear dynamics. The studies of nuclear dynamics especially in

*Dr S.S. Kapoor, former Director, Physics and Electronics & Instrumentation Group, BARC and presently Professor, DAE Homi Bhabha Chair delivering the founder's day lecture at central complex auditorium**

heavy ion fusion-fusion reactions is a very active field of nuclear physics, particularly in the context of the present day efforts to synthesize superheavy nuclear around the next doubly closed shells (Z-114, N-184), which are theoretically expected to be surprisingly as stable as some of the known actinides. Heavy-ion based nuclear physics research brought forth due to developments in particle accelerators has now expanded in many dimensions, and ultra relativistic heavy ion collisions are aiming to create quark-gluon plasma - the state of matter which is believed to have existed at the time of creating of the universe according the big bang model. Further, particle accelerators, largely developed to explore structure of matter, are now finding new promising applications in the field of nuclear energy. Possible generation of the fusion energy through inertial confinement fusion and also through muon-catalyzed fusion and the emerging applications of the Accelerator Driven sub-critical reactor Systems for harnessing fission energy are good examples of the spin-offs of the accelerator based research to practical application in nuclear energy development. The lecture attempted to bring out some highlights of the current scenario in the above areas of basic research as well as applications in the field of nuclear energy.

भा.प. अ. केंद्र के वैज्ञानिक को सम्मान / BARC SCIENTIST HONOURED

डॉ.वी.वेंकेट राज, अध्यक्ष, स्वास्थ्य, संरक्षा एवं पर्यावरण वर्ग को नाभिकीय रियक्टर द्रव्य चालन, अभिकल्पन तथा संरक्षा विशलेषण के क्षेत्र में प्रमुख योगदान को मान्यता देने के लिये प्रसिद्ध पत्रिका नाभिकीय इन्जीनियरिंग तथा अभिकल्पन के सम्पादकीय मंडल का सदस्य नामित किया गया है। यह पत्रिका नाभिकीय इन्जीनियरिंग तथा नाभिकीय रियक्टर अभिकल्पन तथा संरक्षण के क्षेत्र में आधुनिक सुझाव तथा विकास का अन्तर्राष्ट्रीय माध्यम है।

विभिन्न नाभिकीय सुविधाओं से संबन्धित नियमित एवं संरक्षा आश्वासन कार्यक्र म में सक्रिय रुप से ग्रस्त होने के अतिरिक्त डॉ. वेंकेट राज के क्षेत्र में इंजीनियरिंग संरक्षा, विकिरण संरक्षा से संबन्धित कई प्रयोगात्मक अध्ययन भी शामिल है। इनकी विशेषज्ञता तथा अभिरुचि का वर्णक्रम विस्तृत है जिसमें नाभिकीय रियक्टर द्रव्य चालक एवं संरक्षा, संरक्षा संभावना का मूल्यांकन, प्रबन्ध कौशल अध्ययन, सामग्री योग्यता अध्ययन, एवं विकिरणीय संरक्षा आदि भी शामिल है।

Dr V. Venkat Raj, Director, Health, Safety & Environment Group has been nominated as a member of the Editorial Board of the reputed international journal, Nuclear Engineering & Design, in recognition of his excellent contributions in the field of nuclear reactor thermal hydraulics, design and safety analysis. This journal serves as a standard and well recognised international forum for exchange of new ideas and developments in the field of nuclear engineering and nuclear reactor design and safety.

Apart from his active involvement in regulatory and safety assurance activities related to various nuclear facilities, the R&D activities of Dr. Venkat Raj include various allied areas, such as engineering safety, radiation safety, experimental studies related to safety etc. His expertise and research interests cover a wide spectrum including nuclear reactor thermal hydraulics and safety, Probabilistic Safety Assessment, Ageing Management Studies, Equipment Qualification Studies, Radiological protection, etc.

Edited and published by Dr Vijai Kumar, Head, Library & Information Services Division, Bhabha Atomic Research Centre, Trombay, Mumbai 400 085.

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