Website : http://www.dae.gov.in

ISSN-09929-5523

Nuclear India

VOL. 42/NO. 3-4/Sep.-Oct. 2008

PM launches Birth Centenary of Dr. Homi Jahangir Bhabha

Prime Minister Dr. Manmohan Singh with the Lifetime Achievement Award recipients

"We have now removed the restraints that have hindered the atomic energy programme in the past. If we show the same wisdom, pragmatism and foresight that Dr. Homi Bhabha did, I have no doubt that we will move ahead purposefully and substantially to realize his grand vision."

Address by the Prime Minister Dr. Manmohan Singh, on the occasion of the launch of the Birth Centenary Celebrations of Dr. Homi Jehangir Bhabha, October 30, 2008

It gives me very great pleasure to launch the celebrations to commemorate the birth centenary of Dr Homi Bhabha. Over the next one-year, we will celebrate the far-sighted vision and scientific and intellectual legacy of Dr. Homi Bhabha. It was a vision that was shared and supported by Pandit Jawaharlal Nehru. These two great sons and intellectual giants of our country were the fathers of our atomic energy programme.

I thank Dr. Anil Kakodkar and all the scientists, engineers and officials of the Department of Atomic Energy for all the excellent work they have done. I congratulate the four distinguished scientists we are honouring today with Lifetime Achievement Awards. I wish each one of them still greater success in the years to come. They are truly role models for our future generations.

Dr. Bhabha's leadership of the atomic energy programme spanned 22 years. It began in 1944 with a letter he wrote to the Sir Dorabji Trust proposing the establishment of an institute devoted to fundamental research. He continued his work with passion and commitment right till his untimely death in an air accident in 1966.

Since the setting up of the Tata Institute of Fundamental Research in December 1945 we have come a long way. This has been possible because of the strong foundations laid by Dr Bhabha during his lifetime.

The three stage nuclear programme, based on a closed nuclear fuel cycle, was first outlined by Dr. Bhabha in a Conference on Development of Atomic Energy for Peaceful Purposes in India held as early as 1954 in New Delhi. It was based on self-reliance and sought to exploit our plentiful thorium reserves and our existing industrial capability.

The choice of Pressurised Heavy Water Reactors, PHWRs, for the first stage was guided by the industrial capability that existed in India at that particular time. The second stage is the Fast Breeder Reactor using plutonium fuel. The third stage is the development of advanced nuclear power systems for utilization of thorium.

Dr. Bhabha sought to achieve a balance between indigenous development and international cooperation. He negotiated the setting up of reactors at Tarapur on a turnkey basis to demonstrate our willingness to take recourse to international trade in commercial nuclear power. But he also went ahead with the opening of uranium mines at Jaduguda in Singbhum despite its seemingly unviable ore grade. That was at a time when uranium was available in the international market.

Thus we got a head start in nuclear power as well as our self-reliant three stage development with a robust and commercially successful first stage consisting of PHWRs that operated on natural uranium produced at Jadugoda.

The speed with which we can develop nuclear power is constrained by the availability of uranium. The initiative to open civil nuclear trade with the international community is a step towards accelerating the development of nuclear energy in the service of our country. This initiative will have far reaching effects on the growth of nuclear energy in India and I can say that it is a period of transition in our programme.

I warmly congratulate our scientists and diplomats on this spectacular achievement. It proves that when we put our mind to something, we can work unitedly and deliver the goods. It is with the same zeal and dedication that our scientific community has been working all along. The nation is proud of their impressive accomplishments.

The civil nuclear initiative is a good deal. It will open up new avenues of cooperation. The integrity of our 3-Stage nuclear programme will not be

affected. The autonomy of our Research and Development activity, including development of our fast breeder reactors and the thorium programme, in the nuclear field will remain unaffected. There will be no interference in any scrutiny of our strategic programme.

We are now working towards formalizing international cooperation with willing partners in the international community including the US, Russia, France, UK, Canada, Kazakhstan and others. The government will continue to provide its full support to continuation of all indigenous programmes.

As we develop and expand the nuclear power programme, I believe that we should redouble our efforts in promoting indigenous R&D and manufacturing capabilities and in the autonomous pursuit of the three stage nuclear programme and the strategic programme.

We have mastered the PHWR technology through the efforts of our scientists and engineers. As we open up to new technologies from abroad, the Nuclear Power Corporation of India should continue to develop the market for these reactors both in India and abroad. I understand there is interest among a number of friendly countries in this regard. Our scientists and engineers have shown that they can compete with the very best in the world.

NPCIL will also play a major role in the rapid assimilation of Light Water Reactor technology and we expect that it will soon come to India .

It will be necessary for foreign energy firms to manufacture nuclear equipment in India. This will boost our manufacturing industry. Our industry has the capability to emerge as an important player in the global market for nuclear equipment.

The DAE should continue R&D on new reactor systems as well as the associated fuel cycle, including reprocessing of spent fuel. We look forward to the early start of the construction of the Advanced Heavy Water Reactor.

We should use the opportunities offered by international cooperation to accelerate our R&D programme. In the area of nuclear science and engineering, development in India has been taking place in isolation. Many innovations developed by our scientists may not have any parallels in other countries. Therefore, we can make an intellectual contribution to the global scientific community, benefiting ourselves from such exchanges.

India has contributed successfully towards the construction of the Large Hadron Collider built by CERN in Geneva. We are a party to the most advanced global project in the area of fusion science - ITER. India is also part of the advanced research reactor project being built in France, the Jules Horowitz Reactor. Clearly our capabilities particularly in nuclear science and engineering are being recognized the world over.

An expanded nuclear power programme cannot be sustained without high quality human resources. I recall coming to BARC on the occasion of the 50th Graduation Function of the BARC Training School set up by Dr. Homi Bhabha. I had said then that it is our scientists and engineers who have laid the building blocks of self-reliance in the field of nuclear science and technology and of India emerging as a knowledge economy. I sincerely hope that the Homi Bhabha National Institute will carry forward the great intellectual legacy and vision of Dr Bhabha.

In August 1955, Dr. Homi Bhabha said "For the full industrialization of the under-developed countries, for the continuation of our civilization and its further development, atomic energy is not merely an aid, it is an absolute necessity. The acquisition by man of the knowledge of how to release and use atomic energy must be recognized as the third epoch of human history."

Dr. Homi Bhabha spent his whole life in pursuit of this grand vision. He inspired a generation of scientists with his bold dreams and ambitions for the nation and his selfless service. He was a great scientific pioneer and a great builder of modern India.

We have now removed the restraints that have hindered the atomic energy programme in the past. If we show the same wisdom, pragmatism and foresight that Dr. Homi Bhabha did, I have no doubt that we will move ahead purposefully and substantially to realize his grand vision. I would like to assure the DAE fraternity of the full support of the Government of India in this very important national endeavour. I commend every one you for your commitment to this great national enterprise.

"At the current crucial juncture, when the ability to access the vast energy potential of the atom by all is the need of the hour to prevent widening of disparities, fears arising out of the destructive power of atom are preventing wider access."

Address by Dr. Anil Kakodkar, Chairman, Atomic Energy Commission and Leader of the Indian Delegation, on the occasion of 52nd General Conference, Vienna, 2008

Dr. Anil Kakodkar, Chairman, Atomic Energy Commission and Leader of the Indian Delegation

Mr. President,

Allow me at the outset to congratulate you on behalf of my Government, and my own behalf, on your election as the President of the 52nd General Conference of the International Atomic Energy Agency. I am sure that under your able Presidentship, and with the support of your team and the Secretariat of the Agency, this General Conference will be able to accomplish the tasks before it.

I also take this opportunity to welcome the entry of the Sultanate of Oman, the Kingdom of Lesotho and Independent State of Papua New Guinea to the membership of the International Atomic Energy Agency (IAEA).

I would also like to compliment Dr. Mohamed ElBaradei, Director General on his able stewardship of the International Atomic Energy Agency for yet another year. Through his tireless efforts, he has guided the work of the Agency so that it can be better prepared to face contemporary challenges and also realize the immense opportunities that lie ahead.

Mr. President, this has been a remarkable year for India in the field of nuclear energy. The approval by consensus of the Agreement for the Application of Safeguards to Civilian Nuclear Facilities by the IAEA Board of Governors on 1st August, 2008 (GOV/2008/30), and the Statement on Civil Nuclear Cooperation issued by the Nuclear Suppliers Group (INFCIRC/734) on 6th September, 2008 have created conditions for India to make an even bigger contribution to the growth of international civil nuclear cooperation. Here we would like to acknowledge the contribution and point in global development efforts, which is marked by a huge increase in the energy requirements of emerging economies, unfulfilled developmental aspirations of a vast majority of the global population and the serious threat that our planet faces in terms of climate change. According to the Inter Governmental Panel on Climate Change, "warming of the climate system is unequivocal, as is now evident from observations of increases in the global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level". It is, therefore, clear that as we work towards meeting enhanced energy requirements, we need to realize this not in the business as usual mode but with much greater dependence on non-fossil energy sources. Such an approach is necessary as a part of climate change mitigation strategies, as well as for sustainability of available energy resources.

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India has been practicing a comprehensive programme in atomic energy covering the entire fuel cycle in respect of uranium, plutonium and thorium based fuels. While the three stage development of our nuclear programme is dictated by our prime long-term objective of realizing energy independence on the basis of our vast thorium resources, our understanding and experience with thorium clearly reveals several benefits of the thorium fuel cycle, particularly in heavy water reactors, in terms of proliferation resistant nuclear energy production as well as efficient fissile plutonium disposal which may also be of interest to other countries. We are organizing a side event this Friday that would highlight the role of Thorium in this regard in some detail.

Mr. President, I would now like to present a few highlights from Indian nuclear power programme, which

has by now clocked 285 reactor years of safe and economic nuclear power generation. A new national record for continuous power operation was achieved by the Kaiga-2 reactor by registering 529 days of uninterrupted run during August 2006 to January 2008. In addition to the seventeen operating reactors, three 220 MWe Pressurised Heavy Water Reactors, two 1000 MWe Light Water Reactors and one 500 MWe Prototype Fast

Breeder Reactor (PFBR) are currently in advanced stages of construction. An important milestone of erection of the 13.5m diameter safety vessel into the reactor vault of PFBR was reached in June 2008. I am also happy to inform you that the MoX fuel for PFBR, which is being irradiation tested in the Fast Breeder Test Reactor at Kalpakkam, has now

reached a burn-up of 80,000 megawatt days per tonne of heavy metal. The initial construction activities related to Fast Reactor Fuel Cycle Facility that would recycle the PFBR fuel have commenced. The programme of development of metallic fuels that would enable shorter doubling time of fast reactor capacity is moving on course. We are also pursuing pre-project activities for four 700 MWe PHWRs and development of a new uranium mine at Tumallapalle.

A new critical facility for validating the physics design of the thorium based Advanced Heavy Water Reactor core, as well as for investigation of core lattices based on various fuels, moderator materials and reactivity control devices is now operational at the Bhabha Atomic Research Centre and is being used for various experiments for the purpose. The design of a new multi-purpose research reactor is progressing well and studies are currently underway to incorporate features in the design for its possible coupling to a lead-bismuth-eutectic spallation neutron source driven by a 650 MeV proton beam. The 3rd generation high level waste vitrification melter based on cold crucible technology has been in regular operation. Based on the operational feedback, a new melter has been designed and is under manufacture. An industrial electron beam irradiator based on 10 MeV RF-LINAC has been commissioned. This machine is capable of delivering an electron beam over a 100 cm x 5 cm area in air for various materials processing applications. A 1:4 size model of our 540 MWe PHWR containment has been constructed to conduct experimental studies on various failure modes of the containment up to its ultimate load capacity. An international round-robin exercise has been organized using the results of these experiments that will enable bench marking of various computer codes for analysis of containment behaviour under accident conditions. Similarly, there are other major round robin exercise activities being pursued in India covering large RCC structures, tsunami effects, atmospheric dispersion, etc. We would welcome participation of interested research groups in these exercises. INDUS II, the 2.5 GeV Synchrotron at Raja Ramanna Centre for Advanced Technology at Indore has reached its full energy level with a number of experimental beam lines operational. The Superconducting Cyclotron at Variable Energy Cyclotron Centre, Kolkata has also been commissioned with an internal beam.

India has also played an important role in several international projects that help further fundamental nuclear research. We are happy that the LHC has been completed and would start producing valuable experimental results as soon as the initial teething troubles are overcome. We value our participation in the ITER project which is important in terms of the long-term energy needs of the world. India is also participating in FAIR and many other mega-science projects.

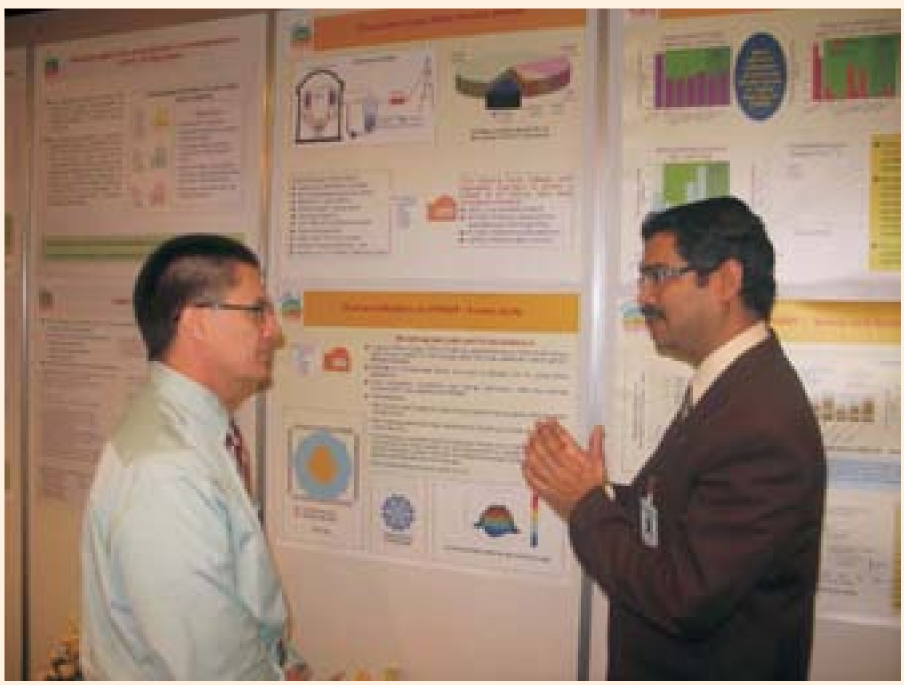
Mr. President, I am also happy to inform this august gathering that in the area of cancer treatment, the indigenously developed tele-cobalt machine, Bhabhatron, is increasingly being sought after by cancer hospitals. Nine Bhabhatrons have already been installed and more are currently under manufacture. On the nuclear agriculture front, 8 new mutant varieties were notified by the Central Government for commercial cultivation during the year. This takes the total mutant varieties developed in BARC to 35.

As a member of the IAEA's INPRO activity right since its inception, we are glad to note the progress made during recent years. India is a participant in eight of the twelve Collaborative Projects under INPRO Phase II. The collaborative projects, particularly in the fields of

water cooled reactors, fast reactors, high temperature reactors, and thorium utilization, have been offering an unique opportunity for the participating Member States to jointly work towards taking these technological approaches forward, to fulfill the needs of the future and to cater to enhancement of the volume, reach and range of deployment of nuclear energy in the world. It is rather ironic that this important technological activity, which is at the core of a holistic solution to global access to nuclear energy in a safe, secure and sustainable manner, is still not a part of regular budget of the Agency. We once again stress on the need to provide full budgetary support to the INPRO activities, which we believe would be a most efficient and sustainable use of the Agency resources in meeting its objectives according to its Statute.

Mr. President, human development has primarily resulted from creative thinking and actions based on observations of things around us. Science and Technology has played a major role in this evolution. At the current crucial juncture, when the ability to access the vast energy potential of the atom by all is the need of the hour to prevent widening of disparities, fears arising out of the destructive power of atom are preventing wider access. Several proposals for solutions are on the table. While one needs out of box ideas to make progress, it is clear that S&T based solutions are the ones that are likely to be most successful. Among all agencies in the UN family, the IAEA is uniquely placed in this respect as it has the necessary S&T resources with global representation. What we need is to emphasise S&T approaches to such solutions and INPRO is a case in point.

While we recognize the importance of nuclear power development world wide, we also need to take into account the factors that have constrained its growth. The number of countries that have taken up construction of a new power reactor has remained stagnant at 33 since the year 1985. However, there are ambitious plans now for expanding the nuclear power generating capacity in many countries and several countries have plans to build their first nuclear plant in the near future. Clearly, the required infrastructure needs to be in place in a timely manner to service this nuclear renaissance. One of the crucial elements of the infrastructure is the availability of trained human resources. Fortunately in India we have a robust programme for manpower development that is in existence for over five decades now. In keeping with the spirit of international cooperation, we would like to offer to train foreign young scientists in our Nuclear Training School, that regularly conducts a one-year orientation course for engineering graduates and science post-graduates, on mutually agreed terms.



As members of a responsible global community, we need to understand the issues that inhibit access to nuclear power and find solutions for their resolution. Clearly there are issues concerning human resources, capable infrastructure, safety regulation and security. What we need is a balanced approach which maximizes development and minimizes risks. The International Atomic Energy Agency, through its more than five decades of scientific and professional work, has established itself as a credible organization that fulfils its mandate as enshrined in its Statute. With its strong science base and rich experience, the Agency is in a unique position to identify and promote holistic technological solutions that are optimum, that minimize constraints and are accessible to all.

The Director General's bold initiative last year to set up the Commission of Eminent Persons (CEP) for going into the nature and scope of IAEA's programme upto 2020 and beyond is highly commendable. The Report clearly brings out the need for a greater role for the Agency in piloting global development through the use of atomic energy which appears almost inevitable today. While the Report does cover all relevant dimensions, especially the need for enhanced resources through regular budget, perhaps it could have been more balanced. The Report, however, does not provide many practical ideas and strategies to enable new entrants to access the benefits of nuclear energy. We would have been happier to see the focus of the Report on such and other related aspects within the scope of Agency Statute rather than on aspects outside. The CEP report alone, as it stands, cannot be the basis for IAEA's future. Clearly, more work needs to be done. However, we welcome this opportunity provided by the release of the Report to generate constructive

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"While we pursue the Three Stage development path, we have to remain aware of the rapidly increasing electricity generation needs. For nuclear power to play its due role, its rate of deployment has to be much faster. Only then can we expect to enhance the share of nuclear power."

Address by Dr. Anil Kakodkar, Chairman, Atomic Energy Commission, on the occasion of Founder's Day, 2008

Dear Colleagues,

As we do every year on this day, we have assembled here to pay homage to our Founder, Dr. Homi Jehangir Bhabha on his 99th birth anniversary. Today we enter the Birth Centenary Year of Dr. Homi Bhabha who gave us a vision for Atomic Energy programme in the country. The year-long Homi Bhabha Birth Centenary Year celebrations would be inaugurated by our Prime Minister today at 5 p.m.

We now stand at the threshold of a new era, the era in which we wish to accelerate deployment of nuclear power and also push the frontiers of nuclear power technology with an eye on the future. The Three Stage vision given to us by Dr. Bhabha will continue to guide us in this process.

In technological terms, we have done well. We now have a robust Pressurized Heavy Water Reactor Technology with world class performance and a globally Advanced Fast Breeder Reactor Technology which we expect would play a rapidly increasing role in the years to come. Thorium utilization on a large scale remains our ultimate objective since that has the potential to become the basis for our eventual energy independence. In terms of technology for thorium utilization, we have many unique achievements to our credit. That we have made this progress in the Three Stage Nuclear Power development programme in a self reliant manner is a singularly important feature of our achievements. It is on the basis of this capability and its further development in the years to come that we wish to expand the role of

nuclear energy for sustainable development of our country.

While we pursue the Three Stage development path, we have to remain aware of the rapidly increasing electricity generation needs. For nuclear power to play its due role, its rate of deployment has to be much faster. Only then can we expect to enhance the share of nuclear power. The three stage development programme which inherently has a huge in fact several ten folds multiplier effect in terms of nuclear power generation capacity without additional new fuel remains relevant and in fact is the key to realization of this objective. However, we need to realize that inspite of our success in technological terms with respect to first and second stage, and with their most optimistic deployment rate, there would still be a very large gap between electricity generation requirement on one hand and the generation capacity on the other.

This gap would in fact increase and become alarmingly large over next three or four decades. Bridging of this gap through import of energy at that time would become very difficult because of concerns regarding availability and prices. Further the serious issues with regard to climate change would get aggravated with increasing use of fossil fuels which in any way appears inevitable. Enhancing the size of the first stage of our programme from the present 10,000 MWe to something four or five times larger in as short a time frame as possible is thus a good solution to this problem that has both a near term as well as a long term importance. In the near term it would enable the much needed augmentation of electricity generation capacity and in the long term it would enable bridging the vast electricity generation gap without having to depend on imported energy. The opening up of the international civil nuclear cooperation in fact would enable us to enlarge the first stage of our programme to a level that could through the multiplier, as a result of three stage implementation strategy, enable us to reach a level of energy independence before it is too late. We are thus entering a new era in which we would continue to implement the domestic Three Stage Nuclear Power programme and supplement it with additional nuclear power generation capacity through external inputs. This also underscores the importance of our approach that as we build additional Pressurized Heavy Water Reactor and Light Water Reactor Units on the basis of domestic and imported technology respectively, we would make the Fast Reactor Technology along with its rapid deployment robust enough to support a short doubling time and competitive commercial performance. This is already a part of our current R&D mission and I have no doubt that the entire approach is feasible. I had presented an outline of this approach in a Public Lecture at the Indian Academy of Sciences, Bangalore on July 4, 2008. This is available on DAE website.

We have to ensure that we pursue our three stage development programme, our research and development activities and our strategic programme in an autonomous manner on the basis of our self reliant approach. While sufficient in-built precautions have been ensured to prevent any external constraint on our autonomous development, we need to make rapid progress in our domestic development without any laxity. Our goal of seeking energy independence at an early date crucially depends on success on both fronts i.e. rapid deployment of PHWRs and LWRs and speedy maturing of our three stage development involving reactors and associated fuel cycles. I think, as we enter the Homi Bhabha Centenary year, thanks to the vision given to us by Dr. Bhabha, we are in a very sound position to confidently move further on this path. At this point I wish to re-emphasize that our commitment to self reliant approach in our autonomous pursuit of our R&D should remain undiluted. We cannot afford any kind of vulnerability that could compromise our independence in terms of implementation of our nuclear programme in national interest.

While we have very successfully pursued our R&D as well as deployment programme in mission mode, our approach to R&D has been broad based and comprehensive covering all related disciplines and the entire research, development, demonstration and deployment chain. In recent times we have taken major initiatives such as Homi Bhabha National Institute, Prospective Research Fund and Specialist Groups to strengthen research-technology development linkages as well as a much larger student programme. We should expect these initiatives to enable faster transition of new knowledge into new technologies. It is also worthwhile to note several major international collaborations in which we now are partners. We had a very important and well acknowledged involvement in building of LHC which was recently completed and its detectors CMS and ALICE. We are now partners in major projects like ITER, JH Reactor and others. Such collaborations enable us to access major international facilities for research and at the same bring in technological benefits for our laboratories and industries. Our participation in such activities has brought us international recognition. There is now even greater interest in seeking our collaboration. We must ensure that there is complete complimentarity between our domestic programme and possible international collaboration. This is necessary to maximize the national benefit out of international collaboration. During the year, Indus-II Synchrotron radiation source at RRCAT has reached its full energy level and a number of beam lines are now ready for use by researchers. The superconducting synchrotron is in advanced stage of commissioning and should become available for experimental research soon. Our technologies such as radiation hygeinization of sewage sludge and nisargaruna have been recommended by the Planning Commission for funding under Jawaharlal Nehru Urban Renewal Mission. Similarly there is now greater funding support for food irradiation plants. Planning Commission has also shown interest in Bhabhatron Teletherapy system. It is gratifying to note that we have also made all round progress in terms of large scale deployment of our socially relevant technologies related to water, agriculture, food, health and waste management.

We are aware of the several new dimensions of our mission involving accelerator driven systems, high temperature reactors, hydrogen production and utilization and fusion energy including solar energy. These programmes are well underway and would yield results in near future.

One of the major thrust that we should bring in our mission is to develop technologies to reduce radiotoxicity of radioactive waste to a level comparable to a uranium mine in a period of say around 300 years. Based on present day knowledge this seems to be a realizable goal and we should take up this challenge. While we already have a proven industrial scale technology to manage high level waste, the above approach along with advanced safe reactors such as AHWR would be a very welcome development in the context of large scale deployment of nuclear power that one could expect taking place world wide in the future.

Dear colleagues,

As we enter the Homi Bhabha birth centenary year, we also see accelerated growth in terms of new technologies and their deployment. As we move with time, we see greater role for our domestic R&D leading to new technologies ready for deployment ahead of others. Our success in doing so with our country men benefiting from our work in a major way would be our greatest tribute to the memory of Dr. Homi Jehangir Bhabha.

"As a premier R&D centre of the country, it is our responsibility to rise up to the occasion to develop nuclear energy systems and play a dominant role in providing long term energy security to the country."

Excerpts from an address by Dr. Srikumar Banerjee, Director, BARC, on the occassion of Founder's Day, 30 October, 2008

As a mark of our collective salutation and admiration to Dr. Bhabha, every year we assemble here on 30th October to celebrate his birthday by taking stock of our achievements during the previous year and rededicating ourselves to accelerate the pace of our work.

I am extremely happy to announce that last year has been yet another successful year in our developmental efforts. The list of achievements made at our Centre during the last year is too long to narrate and, therefore, I will attempt to give only a flavour of them by selecting a few illustrative examples.

The three Research Reactors Apsara, Cirus and Dhruva continued to operate with high level of safety and availability factor of 84%, 86% and 77% respectively. The reactors were well utilized for isotope production, material testing, human resource development and neutron beam research.

Apsara reactor has completed 52 years of operation and efforts for upgrading its power to 2 MW reactor are currently under progress.

Design work on the 30 MW high flux research reactor proposed to be constructed at Vizag is under study. A scheme has been worked out for coupling an external neutron source with this reactor.

The Critical Facility, a low power research reactor of 100 W nominal power, constructed in BARC as a part of the over-all technology development programme to validate the physics design of thorium based AHWR, attained first criticality at 1900 hrs on April 7, 2008. The reactor core is currently loaded with natural uranium fuel assemblies. After necessary safety appraisals the reactor power is being raised to the rated value.

Dr. Srikumar Banerjee, Director, BARC

In conjunction with the IAEA's 52nd Annual General Conference, India organised a side event on the theme "Extending the Global reach of Nuclear Energy through Thorium". In this event it was highlighted that deployment of thorium in the present fuel cycle technologies associated with PHWRs, BWRs and PWRs could meet the objectives of large-scale disposition of plutonium and the use of proliferation resistant fuel.

Our benchmark document on PURNIMA II has been accepted by the International Criticality Safety Benchmark Project (ICSBEP). This is the second criticality benchmark from India, the first being that on KAMINI released in 2005.

Options for the design of an initial core of Advanced Heavy Water Reactor (AHWR) with low plutonium requirement were developed. It was possible to reduce the plutonium content and the large negative void reactivity by using a 42 pin cluster (a modified 54 pin cluster with inner dummy pins) and zircaloy-2 displacer.

The physics design of the equilibrium core of AHWR was further improved to enhance the average core discharge burn-up from 34,000 MWd/te to 38,000 MWd/te by using a SS displacer in top half of the fuel assembly and a Zircaloy-2 displacer in the bottom half, thereby reducing the SS loading in the cluster.

The metallic seal made of thin sheet of Inconel-750 has been indigenously developed, fabricated and successfully tested for its ability to maintain leak tightness between the fuelling machine and the coolant channel during the online refuelling operation of AHWR.

Fuel handling components, namely radial seal plug, snout plug, ram adaptor, plug installation tool and stub end fittings, suitable for 225 mm reactor lattice pitch of AHWR have been designed, manufactured and performance tested successfully in the specially designed test rigs. These will be used during the performance testing of AHWR fuelling machine being manufactured at M/s MTAR, Hyderabad.

Design of the AHWR thermal hydraulic test facilities to be set up at R&D Centre, Tarapur for validating thermal and stability margins has been completed and further actions for its construction are progressing as planned under the MoU signed earlier.

In the design of Compact High Temperature Reactor (CHTR) the Active Control and Shutdown System is proposed in place of the earlier designed Passive Power and Regulation System (PPRS) for improving the response time. Various physics studies were carried out to establish that a new fuel configuration, namely, 2.4 kg of U-233 mixed with 5.6 kg of Th-232 with required burnable poison is sufficient to sustain for 12 to 15 effective full power years of operation.

A liquid metal loop employing lead-bismuth eutectic as the coolant has been installed and commissioned. The facility is aimed at generating thermo-hydraulic and corrosion data.

A considerable progress was made for the design of 5 MW(th) nuclear power pack meant for supplying electricity in remote areas not connected to the grid system. The core has been designed for a burn-up of 3,000 full power days.

As a part of R&D for our PHWR programme, the construction of BARC containment model (BARCOM) of 540 MWe PHWR containment has been completed at Tarapur project site. The model will be tested to arrive at its ultimate load capacity to assess the integrity of the containment of PHWRs under over-pressure accident scenario.

In a separate study, the behaviour of containment of Indian PHWR has been investigated for the aircraft impact induced fuel spillage fire accident. It is concluded that the primary containment wall will remain intact under such condition.

During refuelling of PHWRs, a seal plug at the end of coolant channel is removed by the fuelling machine and reinstalled after the refuelling work is completed. In case the seal plug develops a small leakage, this needs to be expeditiously attended to. An end fitting blanking assembly has been developed for 540 MWe PHWR that will block such leakage very quickly and help in maintaining leak tightness till more rigorous maintenance of the closure seal face is carried out during the next planned shut down of the reactor. The device enables the refuelling of the neighboring channels with reactor on power.

Tritium monitor for area monitoring in presence of interfering 133Xe was developed for use at TAPS-4 on a specific request from NPCIL. This system is in operation continuously for the last three months.

With the five BARC Channel Inspection Systems (BARCIS) installed and the experience of inspection of more than 1000 coolant channels, BARCIS has established its credibility. The latest version of BARCIS was handed over to NPCIL in July, 2008.

The compact light water reactor plant at Kalpakkam has been operating satisfactorily since last two years. Performance of fuel and all systems of the plant are meeting the design specifications.

It is a matter of great pride that our commitment for design, supply and integration of compact light water plant for strategic applications has been fulfilled.

High purity special grade low alloy steel for reactor pressure vessel application is also developed successfully. A 120 ton ingot is cast in vacuum and forged, meeting the stringent quality requirement. This way, India has become one of the countries to have technologies for making the steel for reactor pressure vessel.

BARC is also providing R&D support for the PFBR related work. Two identical cell transfer machines are required to transfer new as well as the spent fuel to and from different work posts inside fuel transfer cell of PFBR. Design of these machines has been completed in BARC and technical specifications with drawings have been handed over to IGCAR for procurement action.

BARC has the responsibility of supplying fuels for the FBTR and PFBR at Kalpakkam. FBTR is now operating with a hybrid core of mixed carbide and mixed oxide fuel supplied by BARC. The new line for fabricating FBTR mixed carbide fuel commissioned last year is now fully operational and several batches of mixed carbide fuel have been processed successfully in this line.

The manufacture of MOX fuel pins for PFBR first core is continuing at our facility in Tarapur and fabrication parameters have been optimized to get a high yield of acceptable quality fuel. End plug welding of D-9 clad tubes using Nd-YaG laser has been successfully demonstrated and an ultrasonic technique has been developed for inspection of the closure weld.

BARC is also involved in R&D on metallic fuel for the advanced fast breeder reactors with high breeding ratio. The injection casting system for casting of metallic fuel is under installation inside glove box and a demoulding and slug shearing machine is undergoing trial operations. Thermophysical and thermomechanical properties of several Uranium Plutonium alloys and fuel-clad chemical compatibility studies are in progress.

As a part of the Fuel Reprocessing and Waste Management Activities Plutonium Plant (PP) at Trombay has been operated efficiently to process concurrently the spent fuel and the reject sintered DU pellets.

The repair and modification jobs at KARP have been completed, regulatory approvals have been obtained for resumption of plant operations and recommissioning work has started.

Processing of spent fuel and recovery of DDU was continued at PREFRE, Tarapur. During the period, PREFRE achieved a record production, despite some failed equipment.

Regular supply of DU and DDU has been maintained to Nuclear Fuel Complex, Hyderabad to enhance the availability of fuel to power reactors.

To enhance the reprocessing capacities for spent fuel and for management of radioactive waste, the projects at various sites are progressing well. At ROP, Tarapur, supply of all equipment and storage tanks has been completed. State-of-art spent fuel chopper for gang chopping of fuel bundles in one stroke to enhance the production rate to four times is under installation. Commissioning of various systems has also been taken up. At WIP, Kalpakkam, plant erection has been completed.

Waste Management facilities at

Trombay, Tarapur and Kalpakkam were operated safely for collection, segregation, storage and treatment of radioactive waste. The discharge of activity to the environment was kept well below the prescribed regulatory limits. At WIP, Trombay, decontamination and modification jobs have been taken up to enhance the throughput by incorporating various systems for separation of uranium, cesium, etc. At the Effluent Treatment Plant (ETP), Trombay, alkaline hydrolysis process for management of spent Tributyl Phosphate (TBP) has been modified to minimize the generation of aqueous waste. The plant has been modified for simultaneous operation of hydrolysis and incineration systems.

Advanced Vitrification System (AVS), Tarapur has provided excellent operational experience for vitrification of high level waste (HLW) and about 170 m^3 of HLW has been vitrified.

The second phase of cold crucible technology to demonstrate liquid feeding was successfully tried. An effective off gas treatment loop is being hooked to the advanced Cold Crucible Induction Melting (CCIM) for handling oxides of nitrogen for simulated waste feeds. The advanced Cold Cruicible facility is expected to generate design inputs and operational data for plant scale operation.

Process for recovery of Ru-106 from secondary waste has been established on laboratory scale and two batches, 100 ml each of Ru-106 (specific activity 300 mCi/l) have been supplied to Radio Pharmaceuticals Division for medicinal application.

In the area of Electronics & Instrumentation, BARC in association with ECIL was responsible for the 32 meter solid parabolic dish antenna for the Indian Deep Space Network (IDSN32) Antenna System located near Bangalore. This antenna will provide telemetry and tele-command support for ISRO's moon mission satellite, "Chandrayaan-1" and for further deep space missions in the future. ISDN 32 has been picking up the signals from Chandrayaan-1 and continuing to track the satellite. BARC's involvement in this program included analysis of structural design, design and fabrication of sub-reflector and design of the servo system.

The development of the full scope "Main Power Plant Simulator" for training operators and other personnel of LWR was completed ahead of time and installed at site.

1100 numbers of silicon strip detector modules were supplied for the Compact Muon Solenoid at Large Hadron Collider, CERN.

Silicon charged particle detectors with energy resolution better than 20 keV for 5.48 MeV alpha from Am-241 have been developed for use in physics experiments.

Cardiac Output Monitor technology has been transferred to M/s. Opto Circuits (India) Ltd.

A hand held Tele-ECG Machine capable of sending ECG waveforms through a mobile phone has been developed for rural telemedicine applications.

Components of high Tc superconductor 123 compound have been fabricated for rotor assemblies of prototype superconducting motor. The motor has successfully achieved synchronous speed at 77 K at no load.

In Remote Handling & Robotics Area, BARC has developed a state-of-the-art DNA Microarrayer for mutation detection and gene expression analysis. It has a positional repeatability of one micron and throughput of 75 slides per batch with 7000 genes per slide.

Based on BARC technology, nine units of cobalt tele-therapy machine "Bhabhatron" are installed at various Hospitals in the country as on date.

In the area of Computer Science, the "Gridview" software, developed by Computer Division under DAE-CERN Collaboration, for monitoring large data-grid-centres has been deployed in production environment in LHC Computing Grid (LCG) of CERN. DAE participated in the LHC GridFEST on October 03, 2008 when the LHC Grid was formally inaugurated through worldwide video conferencing.

The Programmes & Resources linkage system, PARINAY, and on-line work reporting system, OCR, have become fully operational in BARC. Secure access to BARC Email using two factor authentication has been provided from outside BARC.

Construction of Multi-Stage Flash (MSF) Desalination Plant as part of Nuclear Desalination Demonstration Project at Kalpakkam has been completed. This is the world's largest nuclear desalination plant which can produce 4.5 million litres per day (MLD) of distilled quality water from sea water.

A Barge Mounted Desalination Plant based on membrane based pre-treatment and Reverse Osmosis (RO) technology has been designed, developed and built to produce 50,000 litres per day of safe drinking water from sea water. It can be towed along the coast to provide drinking water to the people on shore.

A new photocatalytic disinfection set up for drinking water using solar light has been developed. The cost effective set up has the potential to be used for purifying water from usual resources of rural areas.

In the field of Insrument Development, a femtosecond transient absorption Spectrometer with 200 fs time resolution has been successfully commissioned.

A state-of-the-art Molecular Beam (M) Resonance-Enhanced Multiphoton Ionization (REMPI)-Time-of-Flight (TOF) system has been developed to widen the scope of studies on reaction dynamics in the gas phase.

Two more Oncology Centers have collaborated with Radiopharmaceuticals Division, BARC in multi-centric clinical trials for the treatment of eye cancer patients by using Iodine-125 brachytherapy sources produced at

BARC and thus far, the benefit has been passed on to nearly 35 patients suffering from ocular cancer.

Lutetium-177, a radionuclide with high therapeutic potential was radiolabelled to two bio-active molecules for treatment of cancer patients, a phosphonate was aimed at treating patients with bone metastasis and a peptide was aimed at treating patients with neuro-endocrine tumours. Both these products are undergoing preliminary clinical evaluation at AIIMS, New Delhi with very encouraging results.

In our work on developments of beamlines for the utilization of synchrotron radiation from Indus-2, Energy Dispersive X-ray Diffraction beamline has been completed and commissioned on the Bending magnet Port 11

Great strides have been made in development of advanced gas centrifuges for uranium enrichment program. The latest fourth generation design, with output 10 times the early design, has been successfully developed and an experimental cascade is in operation at BARC. These would soon be ready for induction at RMP. Third generation design, with 5 times output of early designs, are presently being inducted at RMP.

An important milestone in development of carbon fibre composit tubes for high speed rotor system, has achieved a surface speed of 600 m/sec. These rotors have the potential to provide greatly enhanced centrifuge output. These rotor systems are presently undergoing various trials.

Closed Cycle Thermal Systems (CCTS) technology for under water propulsion, involving key components viz., compact boiler reactor, submerged gas injection & trigger system with power density of about 20 kW/lit of reactor volume, has been successfully demonstrated for specified power level. The development was done under an MoU between BARC, Mumbai & Naval Science & Technology Laboratory, DRDO, Visakhapatnam. The technology is ready for further development required for integration with other sub-systems, packaging and deployment.

As a part of Micro / Nano technology Development Program, MEMS based pressure sensors with ranges from 0 - 10 bar to 0 - 600 bar have been developed for various DAE applications. Work on developing robust sensors for deployment is in hand.

With the commissioning of Ultra Nano Indentation Facility, it is now possible to carry out mechanical properties measurement on different length scales. While the facilities for testing large samples upto component level were established earlier, with the availability of new facility we can now measure mechanical properties in samples of 1-5 mm size and on coatings as thin as 200 nm.

The 10 MeV electron accelerator located at Electron Beam Centre, Kharghar, Navi Mumbai designed for providing electron beam irradiation service to industries, namely, food processing, polymer processing and medical sterilization industries has started operating with 10 MeV electron energy and 3 to 10 kW power.

The indigenous development of this accelerator which consists of an electron source, a high power microwave generator and a linear accelerating structure has been possible due to close collaboration of scientists from BARC and of SAMEER.

A microwave Electron Cyclotron Resonance (ECR) based proton source using three electrode configuration for application in the Low Energy High Intensity Proton Accelerator (LEHIPA) has been developed.

A 10 MeV RF Linac for demonstration of cargo scanning application has been integrated at ECIL, Hyderabad. The indigenous Linac which is being jointly developed by BARC and ECIL, consists of LaB6 cathode base, 50 keV electron source, OFHC copper Linac structure and 2.856 GHz microwave source.

As a part of development of dense, corrosion resistant and thermal barrier coatings in AVLIS process, Y_2O_3 coating on tantalum and Yttria Stabilized Zirconia (YSZ) coatings on silicon substrates have been produced using metallo organic precursors in low pressure microwave plasma CVD chamber. The metallo-organic compounds were developed in collaboration with UICT Mumbai. The insulating nature of the coatings was tested by thermal cycling.

Switch-less operation of Transversely Excited (TE) Gas lasers has been achieved through a novel scheme of using the pre-ionisation spark array in a self switching role. Adaptation of this technique would remove the operational limits being posed by the spark gap or thyratrons on the life of a TE gas laser.

In Nuclear Agriculture and Biotechnology, the success story of crop improvement continued with the release and notification of three more varieties, viz., TPM-1 (Tromnbay-Phule-Mustard-I), TAS-82 (Trombay-Akola-Sunflower-82) and TT-401 (Trombay-Tr-401). With these, the total number of Trombay varieties released and notified for commercial cultivation has reached an enviable number of 35.

A genetic linkage map of blackgram with 428 marker loci has been developed.

Ten Nisargruna biogas plants at Nanded, Pandharpur, Pali, Chiplun, Anjangaon (Amravati), Jaysingpur and two units each at Pune and Nagpur have become operational for processing biodegradable.

On this occasion of the Founder's Day, I call upon our younger colleagues to take the lead in fulfilling some of our cherished dreams. As a premier R&D centre of the country, it is our responsibility to rise up to the occasion to develop nuclear energy systems and play a dominant role in providing long term energy security to the country. At the same time, we continue to advance our activities towards non-power applications of nuclear energy for a variety of societal needs.

The achievements we made so far have been possible only because of the dedication and hard work from all of you. I would like to mention that the contribution made by every segment of our scientific, technical, administrative and auxiliary personnel are equally important in maintaining the overall excellence. The synergy of activities of BARC personnel is the key to our success.

Today, we are at the threshold of a large scale growth of nuclear power in the country. As you are all aware, the doors of international cooperation are opening up for nuclear power production. In this environment, it is imperative for us to maintain competitiveness both in technological and in commercial sense. The technology of Pressurised Heavy Water Reactors which has been built bit by bit over nearly four decades is now being challenged by other competing nuclear power technologies. We are aware that our own PHWRs in terms of capital investment is by far the most attractive and our colleagues in NPCIL have proved that a record of capacity utilization can be achieved in this system. We have plans for upgrading the PHWRs to a level of 700 MWe capacity and I have full confidence that we will be able to maintain economic competitiveness in this 700 Mwe PHWRs as well. India can emerge as a supplier of medium and small size reactors to countries which are new entrants in the nuclear energy field against global competition. To maintain this technological superiority, we must continue providing the back-up R&D to our colleagues in NPCIL.

We have made a beginning in designing and building the compact light water reactor. Time has come for us to use this experience as a stepping stone to embark upon development of the total technology of light water power reactors.

Similarly, R&D efforts in BARC have the mandate in every aspect of the nuclear fuel cycle form the exploration of fresh uranium deposits to the final immobilization and incineration of nuclear waste. As the new mines are being opened up, we are encountering different types of uranium ores which require new processing techniques. BARC is already collaborating with UCIL and AMD for working out the mineral processing schemes for these new ores. Our interactions with NFC and Heavy Water Board have further strengthened and we have several immediate developmental goals. Pyrochemical separation of zirconium and hafnium and extraction of uranium from phosphatic minerals are some of the activities where BARC will work hand-in-hand with NFC and HWB.

Enriched uranium fuel supplied by BARC for the Light Water Reactor programme at Kalpakkam has been performing quite satisfactorily and our facility in Mysore is ready to meet the demands of our current strategic programme. There has been remarkable success in improving the separating work of our centrifuges and I have the confidence that we will be in a position to enter the uranium enrichment activity in an industrial scale within a short time.

I must compliment our colleagues in the Reprocessing programme for maintaining the steady production. With KARP coming back to operation, we will be able to accelerate the production rate of fast reactor fuel, which I consider the most important mandate of BARC in the immediate future.

BARC has expanded the horizon of its R&D activities by including R&D on energy conversion in a broad sense. This area will provide challenging opportunities to many of the research groups working in basic sciences.

Coming back to the point of fresh challenges, I would like to reiterate that we must maintain a constant vigil on our performance so that the technology gain that has been achieved through years of efforts is kept well secured inspite of the threat of technology invasion. The programme on AHWR which has been conceptualized here will provide remarkable challenges to our colleagues to show to the world that our own reactor concept using proven technologies can deliver inherently safe nuclear energy system which will also pave the way for development of thorium based technologies.

Inevitable import of nuclear reactors in the near future can ride over the large scale energy shortage of today but we must not forget the huge potential of energy from thorium for our long term energy security, a concept which Homi Jehangir Bhabha first proposed. During the Homi Bhabha Birth Centenary Year, we must take the pledge of making his dream to come true.

ECIL's Antenna Tracks CHANDRAYAAN-I

Seven hours after the epochal launch of Chandrayaan-I from Sriharikota on the morning of 22nd October 2008, ECIL made 32 metre Indian Deep Space Network (IDSN) antenna at Byalalu picked-up the signals from the spacecraft as it first appeared on the horizon as predicted. It continued to track the satellite through its 2nd orbit around the earth, with clock work precision. While ushering India into the elite club of space-faring nations, this rainy day in Bangalore also marked fulfilment of three years of efforts for ECIL, BARC, ISRO and industry partners who collaborated together to build this massive, complex and precision instrument.

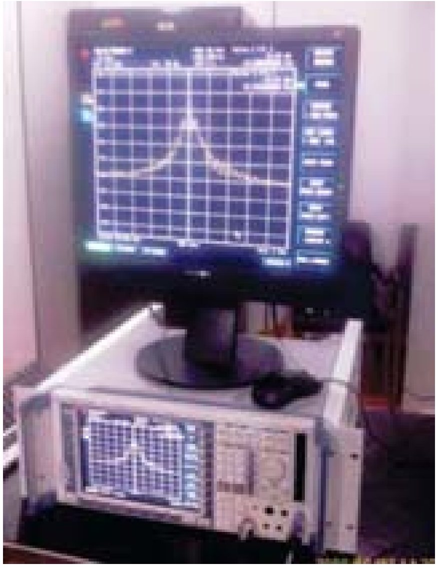
Towering over the skyline as we approach the newly established deep-space network campus at Byalalu near Bangalore, IDSN32 is designed to support Tracking, Telemetry, Command (TTC) and science data reception functions for all the future space missions of ISRO starting with Chandrayaan-I.

The design and development of this state-of-the-art equipment was jointly carried-out by ECIL, BARC, ISTRAC and ISAC. A large number of industries from the public and private sector contributed to the timely realization of this instrument leveraging expertise in mechanical engineering & fabrication, structural analysis & design, microwave, RF & communication, control systems and electronics. IDSN32 today bears testimony to the individual and collective efforts of hundreds of scientists, engineers, technicians, workmen and support staff.

The modified Cassegrain antenna consisting of a shaped main reflector (32 metre diameter parabolic dish) and shaped sub-reflector (3.2 metre dia hyperboloid supported on quadripods) focus RF energy on to the feed assembly via beam-wave guide optics made-up of 7 precision machined plane, convex and concave mirrors. The antenna is designed to simultaneously transmit and receive radio signals in S and X bands in dual polarization. Design accommodates future upgradability to Ka band.

Two separate feed systems operating in S and X bands have been designed, fabricated and installed in the equipment room. The feed systems employ corrugated horn

Antenna Control Unit and Antenna Drive Unit



IDSN32 picks-up signal from Chandrayaan- I

featuring symmetric radiation pattern in both principal planes, high cross polarization discrimination and low side lobes. The corrugated horns are followed by septum polarizer, ortho mode transducer and diplexers for simultaneous transmission and reception of signals. These precision components are manufactured by EDM and wire cutting process. A frequency selective surface known as dichroic mirror separates X & S band signals.

One of the primary challenge was to manufacture and assemble the huge reflector to stringent surface accuracy specifications (better than few tenths of mm). This massive structure weighing about 130 tons in EL and 250 tons in AZ is precisely steered so as to point at any direction in the sky and track targets with a large dynamic range in speed (0.1 milli-degree/sec to 400 mill-degree/sec). The AZ drive chain consists of a pair of motor-gearbox driving two of the four wheels over a 16 metre dia track. The EL drive assembly is made-up of a pair of geared motors driving a bull-gear. Errors due to gear backlash are eliminated by operating the drives in counter torque mode with torque bias. Axis positions are precisely measured by an off-axis multi-turn encoder in AZ and single turn encoder in EL. A high performance servo system controls the antenna so as to track the deep-space objects in program mode to an accuracy of few milli-degrees while compensating for the effects of gusty wind, gravity induced deflections, manufacturing and assembly errors.

Due to gravity deflections, the sub-reflector tends to move and tilt away from its design position as a function of antenna elevation angle; this causes defocusing of the beam. In order to mitigate this, sub-reflector is mounted on a 5 axis positioner which permits dynamic adjustment of sub-reflector position and tilt. Systematic pointing errors are minimized by incorporating pointing models. Tilt sensors are used to measure and compensate for pointing errors caused by the residual AZ track unevenness. A host of operating modes supported by a complement of hard and soft consoles permit unmanned and remote operation of the antenna during tracking missions.

Since 22nd of October, IDSN32 has been faithfully tracking Chandrayaan-I, receiving telemetry data, transmitting commands and playing its role in the world-wide network of Deep-space tracking stations. As the spacecraft is set to enter lunar orbit some 400,000 km away from earth and continue its perambulations around the moon for the next two years, IDSN32 will function as the eyes and ears through day and night.

...contd from page 7

and practical ideas as to how the renaissance of the nuclear industry could benefit all countries, the developing countries in particular.

Mr. President, on 30th October, 2008 we would enter the birth centenary year of the founder of atomic energy programme in India, the late Dr. Homi Jehangir Bhabha. I am also happy to inform that during this Bhabha Centenary Year, and also to mark the Silver Jubilee Celebrations of the Indian Atomic Energy Regulatory Board, we will be hosting the IAEA International Conference on Topical Issues in Nuclear Installation Safety, that is scheduled to be held in Mumbai during 17-21 November, 2008. As part of a year long Homi Bhabha Birth Centenary programme, we are planning to organize an international conference on “Peaceful Uses of Atomic Energy” and it will be our privilege if we can do this in cooperation with IAEA. As many of you are aware, Dr. Bhabha was among the early group that worked on shaping IAEA and in fact was instrumental in having its headquarters located in Vienna. Incidentally Dr. Homi Bhabha was also the President of the 1st Geneva Conference on “Peaceful Uses of Atomic Energy”

Mr. President, in the march of human civilization every age and era is defined by a significant achievement; the use of fire, the invention of the wheel, locomotion through steam, the realization of power of the atom and the internet. We have now reached the final frontier. In this age we are at the threshold of the most exciting of possibilities - the power to understand and manipulate matter in the service of mankind. But this possibility will become a reality only if the nations of the world, and in particular the scientific community, come together and join hands in a manner not seen in the past. We are hopeful that the international nuclear community working together as one family within the framework of the IAEA, will not let this opportunity pass and take giant leaps towards harnessing nuclear power for the benefit of the entire humanity.

Thank you, Mr. President.

Essay Contest

The Essay Contest is an annual feature of the public awareness programme of the Department of Atomic Energy that aims at spreading awareness about the benefits of atomic energy across the youth of the country. In this contest, essays are invited, in any official Indian language or in English, from regular full time students studying in India for their graduation. The contest culminates into a prize distribution function in which the participants, whose essays are adjudged as best three, are awarded prizes on the Founder's day (October 30) which is the birth anniversary of late Dr. Homi J. Bhabha.

For the year 2008, the 20th All India Essay Contest in Nuclear Science and Technology was organized by the Department, that covered the following topics :

1. Powering India - Nuclear power for Sustainable Development,
2. Nuclear Techniques in the Service of mankind - Indian Scenario, and
3. Electron Beam Technology : Journey from Cathode Rays to Large Accelerators.

In view of the "Bhabha Centenary year (October 30, 2008 October 30, 2009)" the participants of the Essay Contest were also required to write an essay on "Dr. Homi J, Bhabha : Founder and Architect of India's atomic Energy Programme."

After screening and evaluation, thirty six essays were selected. The students, who authored these essays, were invited for oral presentation of their essays, to Mumbai during the last week of October 2008. The participants, whose essays were adjudged as the best three for each of the above categories, were awarded prizes by the Chairman, Atomic Energy Commission on the Founder's Day. Consolation prizes were awarded to the remaining participants.

Chairman, AEC, and officials of Public Awareness Division, DAE, with the participants of the Essay Contest

Contest Winners 2008

POWERING INDIA - NUCLEAR POWER FOR SUSTAINABLE DEVELOPMENT

Mr. Jotimoy Das
(1st) Durgapur

Mr. Prakash Baburao Kamble
(2nd) Osmanabad

Mr. Sandeep Gupta
(3rd) Kota

NUCLEAR TECHNIQUES IN THE SERVICE OF MANKIND - INDIAN SCENARIO

Mr. Nitesh Vinodbhai Pandey
(1st) Rajkot

Ms.Prapti N Deshmukh
(2nd) Dhamangaon

Ms. Mina Badalani
(3rd) Badmer

ELECTRON BEAM TECHNOLOGY : JOURNEY FROM CATHODE RAY TO LARGE ACCELERATORS

Mr. T.B.L. Murthy
(1st) Delhi

Ms. Sathya B.
(2nd) Pottapalayam

Ms. A D Kavitha
(3rd) Chennai

Those Years... These Months...

A compilation of important events during these months in the history of DAE

Ravi Shankar, Hd AVORP, PAD, DAE

October 4, 1967
Uranium Corporation of India Limited (UCIL) is established at Jaduguda in Jharkhand (then a part of Bihar).

October 02, 1969

Tarapur Atomic Power Station commences commercial operation.

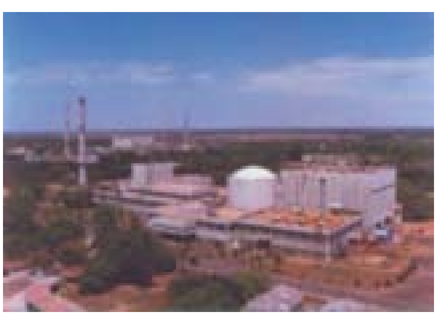
September 06, 1970
Uranium-233 is separated from irradiated Thorium.

September 1975
Surda Uranium Recovery Plant of UCIL is commissioned.

October 18, 1985
FBTR at IGCAR attains criticality.

October 1986
Bhatin Mine is commissioned by UCIL and ore is transported to Jaduguda mill for processing.

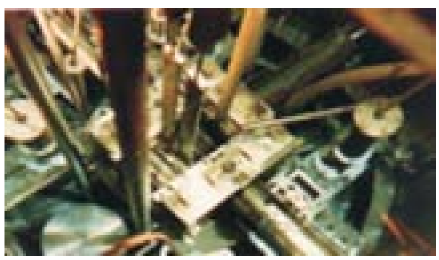
September 17, 1987



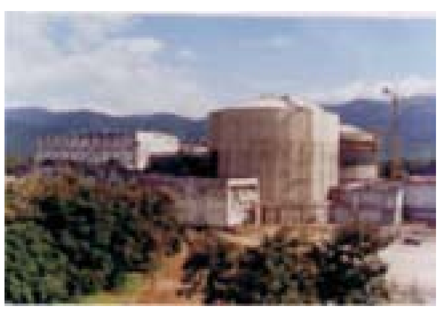
Nuclear Power Corporation of India Limited (NPCIL) is formed by converting the erstwhile Nuclear Power Board.

September 03, 1992
Unit-I of Kakrapar Atomic Power Station attains criticality. Unit-II attains criticality on January 08, 1995.

October 1, 1996
Institute for Plasma Research, Ahemdabad, Gujarat, becomes an autonomous institute of DAE.



October 20, 1996
Kalpakkam Mini Reactor (KAMINI), with Uranium-233 fuel, attains criticality at IGCAR, Tamilnadu. The reactor is taken to full power in September, 1997.



September 24, 1999
Unit-2 of Kaiga Atomic Power Station, Karnataka attains criticality. It is synchronised with the grid on December 02, 1999, and becomes commercial on March 16, 2000. On September 26, 2000, Unit-1 attains criticality. It synchronises with the grid on October 12, 2000. On November 16, 2000, Unit-1 becomes commercial.

September 18, 2002
First pour of concrete of Unit-5 of Rajasthan Atomic Power Project - 5 & 6 is done.

October 31, 2002
Waste Immobilisation Plant and Uranium-Thorium Separation Plant (both at Trombay), and Radiation Processing Plant Krushi Utpadan Sanrakshan Kendra (Krushak) at Lasalgaon, district Nasik, Maharashtra, are dedicated to the Nation.

September 2003

भाविनि
BHAVINI

Construction of Prototype Fast

Breeder Reactor gets approval of Government. For construction of the reactor, Bharatiya Nabhikiya Vidyut Nigam Limited (BHAVINI) is set up at Kalpakkam, Tamil Nadu.

September 2007

Bhabha Atomic Research Centre (BARC) and Electronics Corporation of India Limited (ECIL) develop a 32 metre diameter Indian Deep Space Antenna System – IDSN 32 for providing steering, tracking and science data reception support for ISRO's Moon Mission – Chandrayaan – I.

Sealed Type Three Piece Master Slave Manipulator Modular Design

A three-piece master-slave manipulator (TPM) consists of three distinct and easily separable assemblies: the master arm, the through-tube and the slave arm. The unique feature of 3-piece construction is that, its slave arm can be remotely replaced in the hot cell. This modularity reduces installation and maintenance time. Unlike other Master Slave Manipulators (MSMs), TPM uses parallel rotating shafts for power transmission, along the through-tube. This feature is effectively used in indigenous TPM to provide sealing and shielding across the cell wall.

A through tube passes through a thick concrete wall shielding, separating hot cell and the operating area. It connects the master and slave arms. Lead glass shielding window is used for viewing the hot cell from outside. From the operating area, operator moves the handgrip of the master and the motion is reproduced on the tong of the slave in the remote area. Sealed Type Three-Piece Manipulator is an advanced version of MSM.

Salient Features

TPM is modular in design such that its slave arm can be remotely assembled and disassembled in the hot cell. Because of its sealed construction, it provides total isolation of the cell atmosphere from the outside atmosphere. The master arm and the slave arm can be removed or installed on the through tube without breaking integrity of the cell. Three electrically powered motions are provided on the major joints of the manipulator to enhance the range of the equipment. Another unique feature of TPM is extended balancing, which will balance its joints in their extended positions also.

Manipulator Motions

The manipulator can perform seven manual motions namely X, Y, Z, Azimuth Rotation, Twist Rotation, Elevation Rotation, Squeeze and three electrically driven motions. X motion is the left-right swing motion of the arms about the axis of the through tube in a plane parallel to the cell wall. Y motion is the rotation of arm about the shoulder joint of the manipulator. Z motion is the up and down motion of the telescopic boom tubes. Wrist joint of the manipulator gives the Twist rotation and Elevation rotation to the end effector. The wrists on both master and slave sides are identical and detachable. Azimuth motion is achieved by rotating the master boom and transmitting the same rotary motion to the slave boom. Squeeze motion is affected by the pistol grip on the master side which remotely operates Tong on the slave side.

Motion Transmission

Within the master and slave arms, cables are used for motion transmission. Any motion on the master is converted to rotary motion with the help of cables, pulleys and rope drums. The motions are then transmitted from the master to the slave side with the help of rotary shafts in the Through Tube.

Specifications

The manipulator is designed for 20 kg load carrying capacity. The slave arm has a reach of 3.3 m from its shoulder joint.

Application

Remote handling in radioactive cells

For details contact :

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Edited and Published by S K Malhotra, Head, Public Awareness Division, DAE and printed by him at M/s Rush Arts, Ghatkopar, Mumbai.