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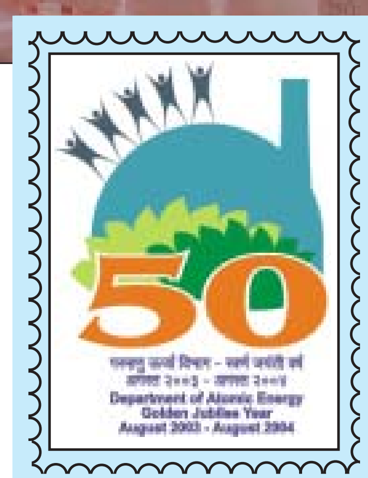
Three Decades of ISOMED



ISOMED, the gamma radiation sterilization plant for healthcare products, set up at Trombay in the year 1974 by DAE with assistance from the United Nations Development Programme (UNDP) and International Atomic Energy Agency (IAEA), has pioneered the radiation sterilization technology in India. The facility, aimed at improving the quality of locally made healthcare products and devices and practical demonstration of sterilization of large volumes of healthcare supplies, on an industrial scale, has firmly established this technology in India.

Users of ISOMED services, which were around 12 in the year 1974, have increased to well over 1600 now.

ISOMED- The Success Story of Three Decades

P. Madhusoodanan
General Manager, Gamma Radiation Processing Services
Board of Radiation & Isotope Technology

Sterilization, the destruction of microorganisms, can be conveniently carried out by exposing the material to ionizing radiation such as gamma ray from radioisotopic sources. This method of sterilization offers many advantages over conventional methods based on heat or ethylene oxide. Since materials can be effectively sterilized by radiation in their final packages, this method provides considerable flexibility in packaging for sterilization and allows the product to be retained in the sterile form until the package is opened or damaged.

ISOMED, the gamma radiation sterilization plant for healthcare products, set up at Trombay in the year 1974 by the Department of Atomic Energy with assistance from United Nations Development Programme (UNDP) and International Atomic Energy Agency (IAEA), ushered in "the radiation sterilization technology era" in India in the seventies.

The facility was aimed at improving the quality of locally made healthcare products and devices and practical demonstration of sterilization of large volumes of healthcare supplies, on an industrial scale. The operating experience of ISOMED, for over three decades, has demonstrated unambiguously that the intended objectives have been fully met and today radiation sterilization is firmly established as an industrial process for sterilization of healthcare products and is widely accepted in the country. Users of ISOMED services have increased from around 12 in the year 1974 to well over 1600 by the year 2003, thus demonstrating the acceptance of radiation sterilization technology by the healthcare profession and industry in India.

ISOMED was the first project under UNDP/IAEA assistance , which was completed ahead of its scheduled time. The credit for early completion of the project goes to its project director Dr. V.K. Iya, former Director, Isotope Group, BARC and the project manager, late R.G. Deshpande, former Head, Isotope Division, BARC and the first Chief Executive of Board of Radiation & Isotope Technology (BRIT).

The Plant and the Process

ISOMED project was commissioned on January 1, 1974.

The plant is designed to irradiate medical/healthcare products of bulk density ranging from 0.1 to 0.2 g/cc. The product conveyor system incorporated in the plant allows continuous processing of package and helps to achieve a high degree of uniformity of absorbed dose in the products treated.

Products to be treated are packed in a standard cardboard cartons of stipulated specifications of size 59cm long x 34 cm wide x 43 cm height, / (volume approx. 90 litres), with the gross weight not exceeding 14.5 kg.

The source rack is designed to house 90 composite source units with a maximum activity of 1 MCi (million Curies).

The product conveyor system consists of an in-cell conveyor, labyrinth conveyor and load/unload stations. Both the in-cell conveyor and the labyrinth conveyor are monorail type. These conveyors together hold 63 vertical product carriers, suspended through individual trolleys on the monorail. Forty eight of these carriers are within the cell at any point of time and arranged on the in-cell conveyor in 8 rows, on either side of the source rack, each row containing 6 carriers. Each carrier holds five standard cartons, one over the other, on five separate shelves.

The product carriers continuously move with uniform speed in the cell.

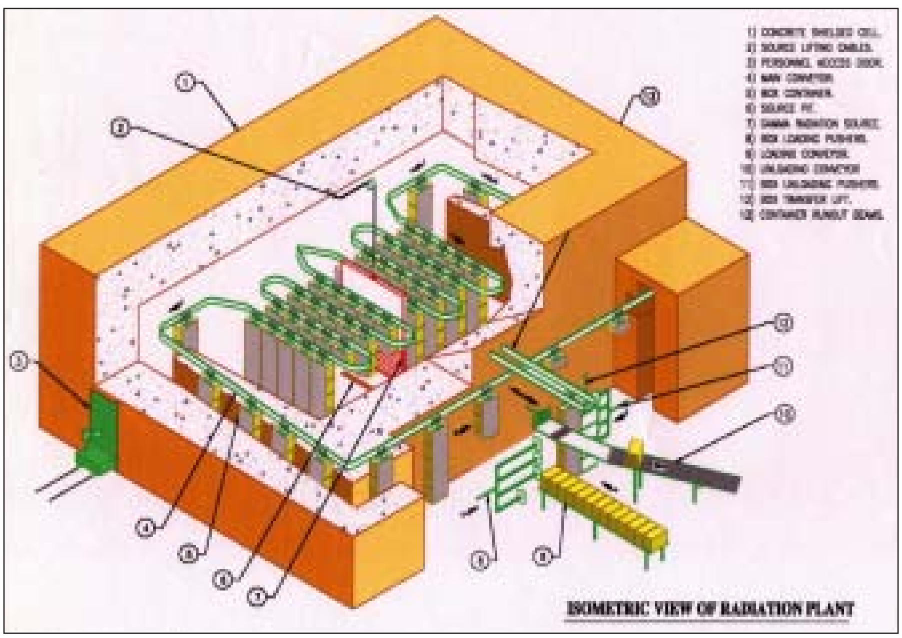
The speed of the conveyor can be controlled to a desired value with ±1% variation. Each carton with the product passes around the source five times, each time occupying different shelves of the carrier. A linear transfer mechanism located inside the radiation cell reverses the carriers through 180 degrees at the middle of its travel. The labyrinth conveyor carries the product between the loading station and the in-cell conveyor. The control and interlock systems provided in the facility are fail-proof and ensure complete safety of personnel and products. The control system is based on timer-relay logic with safety philosophy concepts of defence-in-depth redundancy, diversity etc.

The products processed are released to the customer based on product dosimetric results. Ceric-cerous dosimeters are used for ascertaining absorbed dose. These dosimeters are made in-house and are traceable to national and international standards. Periodical comparison of ISOMED dosimeters with International Atomic Energy Agency (IAEA) dosimeters under International Dose Assurance Service (IDAS) has proved undoubtedly the high precision and accuracy of the dosimetry system adopted at ISOMED. The minimum radiation dose imparted to the product for sterilization is 25 kGy (energy equivalent to 6.2 calories of heat) conforming to international standards. Such a dose offers a sterility assurance level (SAL) of the order of 10^{-6} provided the initial bioburden is not excessively high and the primary packaging of the product is adequate to maintain post-irradiation sterility of the products. Microbiological dosimeters (Biological indicators) are also employed, as additional measure, in the facility for emphasizing the efficacy of the process. Bacillus pumilus (ATCC-14884) is used for this purpose. These are also prepared in-house. Thus quality assurance of the process and products is achieved by strict adherence to Good Irradiation Practice (GIP) and Good Manufacturing Practices (GMP).

A broad classification of the products which are regularly processed at ISOMED are outlined in the table below.

- Antibiotic Powders
- Ayurvedic Products
- Containers and Closures
- Eye / Ear Droppers
- Latex Gloves
- Ointments
- Orthopaedic Implants
- Perfusion Sets
- Surgical Blades, Sutures, Dressings
- Veterinary Products
- Contraceptives (Family Welfare)
- Dai Kits (Rural Healthcare Programme)
- Pharmaceutical Raw Materials (Export)
- Herbal Products (Export)
- Miscellaneous

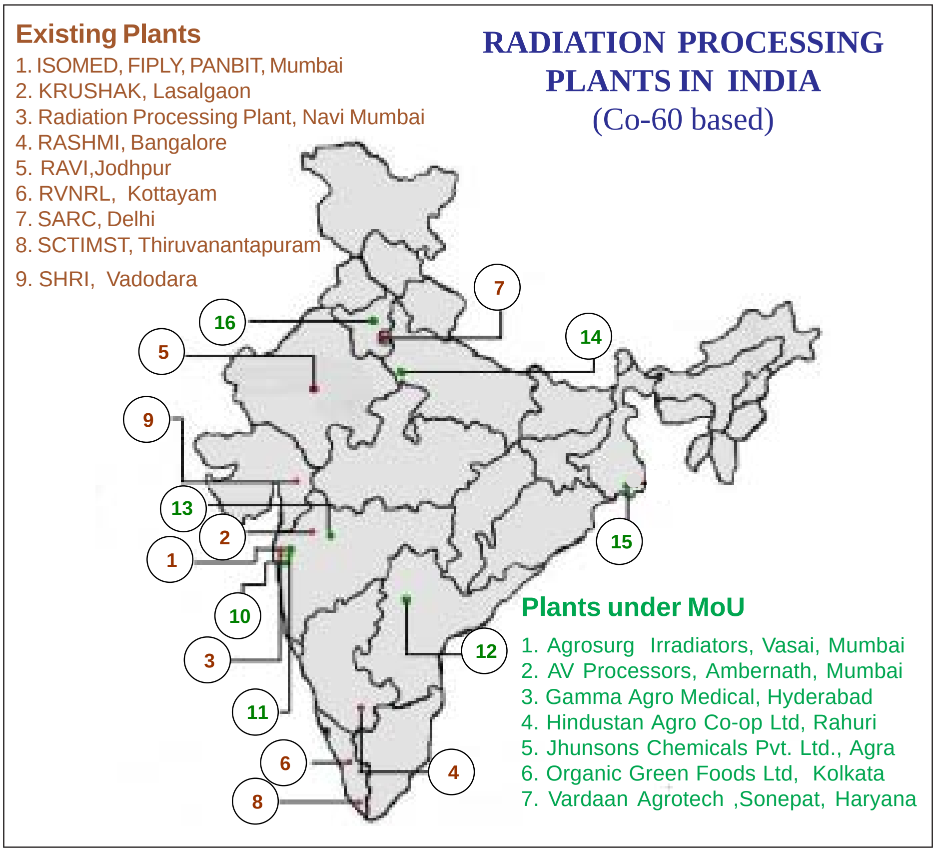
The question of economics of gamma sterilization technology is frequently debated. It is recognized that the cost of sterilization by steam is the lowest amongst all sterilization processes. However, steam sterilization does not provide the same advantage and convenience as provided by gamma radiation sterilization. Besides, it can not be used for sterilizing heat sensitive products. Turning to ETO, in many countries, it has been noticed that, cost of ETO sterilization is 50% higher than that for gamma radiation sterilization in industrial operations. What is worse, is the fact that residuals left back in products such as ethylene glycol and ethylene chlorohydrin are reported to be carcinogenic. Many overseas countries have done



Excellence in Service

ISOMED, presently under the Board of Radiation and Isotope Technology (BRIT), has been offering radiation sterilization services to the healthcare sector in the country since the past 31 years. The facility with ISO 9002 accreditation has been serving over 1600 customers spread all over the country.

Data collected from International Institute of Population studies indicate that the overall rural birth-rate in India is 30 per 1000. Accordingly the total annual rural births in India work out to be 2.15 crore. Hence the number of Dai Kits required is around 2.15 crore if we assume atleast one kit per birth.



RAVI - Raksha Anusandhan Aur Vikas Irradiator
RVNRL - Radiation Vulcanization of Natural Rubber Latex
SCTIMST - Shree Chitra Thirunal Institute of Medical Science & Technology
KRUSHAK - Krishi Utpadan Sanrakshan Kendra
SHRI - Sledge Hygienization Research Irradiator
SARC - Shriram Applied Radiation Centre
PANBIT - Panoramic Batch Irradiator
ISOMED - Irradiation Sterilization of Medical Products
FIPLY - Food Irradiation Processing Laboratory

away with ETO process for sterilization. Gamma sterilization charges constitute only a fraction of the cost of finished product (around 3%). Moreover, in the energy starved world, gamma radiation sterilization requires only one fifth of the energy input required for ETO sterilization.

Centre of Excellence

ISOMED facility is considered to be a centre of excellence in the field of gamma radiation sterilization of healthcare products, in the Asia Pacific region, by many national and international agencies. In fact, ISOMED had conducted around 10 training courses, each of 2 weeks duration, sponsored by IAEA/ Regional Co-operative Agreement (RCA), on relevant aspects of radiation sterilization. The participants for the above courses were from countries such as Bangladesh, China, Korea, Malaysia, Pakistan, Philippine, Singapore, Sri Lanka, Thailand, Vietnam etc. Also, ISOMED used to get short term trainees sponsored by IAEA from many overseas countries. ISOMED also obtained ISO-9002 accreditation in the year 2000. The other irradiation facilities in the country look forward for ISOMED expertise and guidance for their various activities.

Allografts from the TMH Tissue Bank irradiated at 1SOMED.

To be successful in a dynamic environment, it is essential to holistically optimize the entire production process chain of healthcare products. Motivated by this philosophy ISOMED strives to achieve perfection in all the dimensions of customer service such as quality, delivery schedule, reliability and flexibility. Consequently, ISOMED had been bestowed with many prestigious awards and commendations for excellence in customer service from a host of its user organizations on several occasions.

Dai Kits- In an effort to promote the use of radiation sterilization technology in the country, ISOMED has developed a number of sterile surgical and medical aids, which have played a significant role in the quality of the medical care, particularly in the rural areas, where infrastructural facilities are inadequate. One such product developed and promoted by ISOMED is the radiation sterilized Dai Kit. Dai kit is a radiation sterilized packet containing the necessary basic items such as absorbent gauze, absorbent cotton, surgical blades, umbilical tape, soap, drape sheets, antiseptic solution etc., normally required for delivery procedures in rural home. The usage of such kits is reported to have significantly reduced the infant morbidity and mortality rates in India. The successful usage of Dai kits has encouraged many small scale entrepreneurs to take up manufacturing of such kits on a larger scale.

Hydrogel - A product developed at ISOMED, jointly by BRIT & BARC, is found to be very effective for faster healing especially for burns and other wounds. The product may also find potential applications in fire-fighting areas. This product has been patented and the technology has been transferred to a few private entrepreneurs for large scale production and supply of this product, by the department.

Market Profile

The findings of a recent market survey on sterilization methods used by manufacturers of single use medical devices in India, by Indian Market Research Bureau (IMRB) revealed :

- The total 1999 sterilization market of single use medical devices in India is approximately 18.5 million cubic feet
- The market has growth rate of 15 to 20 percent per annum over the last 2-3 years
- ETO sterilization represents 16 million cubic feet, i.e.. 86 percent of the volume. Gamma sterilization contributes around 2 million cubic feet i.e. 11 percent of total volume.

Gamma sterilization technology has greatly helped to improve the quality of healthcare products and thereby the quality of healthcare in the country. The introduction of this technology in our country, three decades ago, has provided an impetus to the growth of indigenous manufacturers of many sterile medical and healthcare products and devices. With increasing awareness and the need to provide improved medical care to our large populations and with its inherent advantages, there is no doubt that gamma sterilization technology will play an important role in future in our country. Realizing the future potential of this technology, many private entrepreneurs have shown keen interest and have come forward to setup gamma radiation sterilization plants at different parts of the country.

Milestones

- Commissioned for continuous operation on 1st january 1974.
- ISO-9002 accreditation obtained in year 2000.
- List of customers availing ISOMED services close to 1600 in the year 2003 against 12 in the year 1974.
- Award for excellence in service for the continuous past five years.
- Range of products treated increased considerably.
- Plant availability factor and capacity utilization factor maintained at around 90 percent since the past two decades.
- Considered centre of excellence in the asia pacific region in the area of radiation sterilization of healthcare products
- Served as a training centre on the subject of radiation processing for participants form within the country and abroad.

Bharatiya Nabhikiya Vidyut Nigam Limited (BHAVINI)

The Government of India have approved the setting up of a Prototype Fast Breeder Reactor at Kalpakkam at an estimated completion cost of Rs. 3492 crore. The Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam being the developing agency for this technology, will act as the prime design engineering group and will be closely associated at every stage of the project. The Nuclear Power Corporation of India Ltd. (NPCIL) will be closely associated with construction, commissioning and operation of the project. NPCIL will also take a small stake in the project amounting to 5% of the equity involved in the project The authorised capital of the Company will be Rs. 5000 crore.

BHAVINI will be fully responsible for owning and executing the project. The Company will take care of construction of the project, monitor the progress and borrow funds as necessary.

The Atomic Energy Commission will evolve appropriate guidelines for the Company.

The future investment proposals of the Company will be processed through the Atomic Energy Commission which will frame suitable procedures for scrutinizing these proposals before submission to the Cabinet.

Electron Beam Technology for Industrial Accelerators: BARC's Endeavour

Dr. R.C.Sethi
Head, Accelerator & Pulse Power Division, BARC

Electron beams have established themselves as potential tools both in basic as well as applied sciences. Industry also has been immensely influenced by their vast potential. Beams with varying power and energy are being extensively employed for radiation processing of materials and have totally revolutionized this field. For example electron beams are gradually replacing the old methods of curing of coatings, adhesive and paints. This not only tremendously improves the quality of the products but also gives an everlasting effect. Similarly, the electron beam processing of cables & sheets vastly improves their thermal and mechanical properties. The irradiation of semiconductor devices has brought in a total transformation in the IC and microchip industry. The sterilization of the disposable medical products is another area where electron beams have made a big impact. The usage of electron beams for food preservation have revolutionized the concept of food storage. The art of producing exotic colours in gems and stones is also getting monopolized by electron beams. These stones have a big international market. Even the pathogenic germs of the sewage & sludge are being treated by these beams. Now, on a vast scale, the organically contaminated soils are going to be processed by electron beams. The field is growing and expanding at a fast pace.

BARC had long back realized the enormous potential of electron beams and chalked out an elaborate indigenous technological development programme. Depending upon the product and the type of radiation processing, the requirements of energy and power vary, vastly. The energy may go anywhere from a few hundred keV to a few MeV and the power from a few hundred watts to a few hundred kilowatts. A single accelerator or one type of accelerator cannot meet such requirements. To cover the diverse areas of applications, it was decided to build a 500 keV, 10 kW DC accelerator, a 3 MeV, 30 kW DC accelerator and a 10 MeV, 10 kW RF Linac.

500 keV DC Accelerator

In the year 1995, this accelerator was taken up for development. It is a Cockroft Walton based DC accelerator designed to give 20 mA of electron beam at an energy of 500 keV. The accelerator is housed at BRIT complex, Vashi, Navi Mumbai. Since last year, the accelerator is in regular operation at a power level of about 3.5 kW and energy 350 keV. Its upgradation to full power level is planned in the near future. In parallel, it is being fully computerized and converted into a single push button machine. At present, the accelerator is in use for surface modification studies. Industries such as Reliance India Ltd. (RIL) are using it for cross linking of plastic sheets & granules. Hindustan Lever Ltd. (HLL) is plan-

Trial assembly of 10 MeV, 10 kW RF Electron Linac ning to irradiate its brand of wheat flour by utilising this facility. BARC and IIT-Madras, Chennai are pursuing radiation damage studies of materials including electrical & electronics circuits.

This is the only indigenously developed accelerator in the country which is operating at such a high power level.

3 MeV, 30 kW DC Accelerator

This accelerator is designed to deliver 30 kW of beam at an energy of 3 MeV. The 5 keV beam from the electron gun is accelerated to 3 MeV in the acceleration tube. The beam, after passing through the scan magnet chamber is let out in the air through the scan horn and is used for processing of the materials. The high voltage system comprising corona guard rings is connected through rectifier chains, each of which generates an effective voltage of about 50 kV. In all, there are 70 such chains giving rise to a voltage of more than 3 MV. The accelerator tank having a diameter of 2 m and a length of 7 m, is pressurized with sulphur hexa fluoride (SF6) at a pressure of 6 atmosphere. SF6 helps in holding the high voltage without any serious breakdown.

This machine is full of technological challenges. The 45 kW, 120 kHz oscillator is being designed and built for the first time in the country. The corona guard, RF electrodes and HV dome, that have highly complicated configurations, are being addressed for the first time. All these subassemblies have to be maintained with a mirror finish. The fabrication of the accelerator tank encapsulating the cooling of SF6 gas, is another major task.

10 MeV, 10 kW RF Electron Linac

It is a coupled cavity Linac, capable of giving 10 MeV beam with a power of 10 kW.

Electron Beam Centre for Material processing, Kharghar, Navi Mumbai

The 50 keV electron beam from the gun is accelerated to 10 MeV in the Linac cavity having a length of about 1 m. After the energy analysis, the beam is passed to the scan horn through the sweep scanner. The cavity is powered through a wave guide plumbing line consisting of a circulator, directional coupler, power divider, ceramic window etc. The line is fed by a klystron based microwave source which can deliver a peak power of about 6 MW at a microwave frequency of 2856 MHz. This source is being designed and built by SAMEER, Mumbai. The rest of the systems are similar to the 3 MeV machine.

The Linac technology is the most sophisticated one. Primarily, the cavity and the microwave source are one of the most intricate subsystems. The cavity should exhibit highest possible Q, the field uniformity and proper dispersion at the operating frequency. The geometrical deviations have to be confined within a few tens of microns. Similarly the microwave source ought to show highest possible stability at the maximum power level. All the microwave components of this accelerator will be handling very high average power, a task being attempted for the first time in the country.

To exploit the benefits of electron beam technology fully, BARC is setting up an Electron Beam Centre (EBC) at Kharghar, Navi Mumbai. SAMEER is also a participant in this programme. EBC will house both, 3 MeV and 10 MeV machines. Apart from housing the two accelerators, the centre is being equipped with labs which will cater to the future developments and advancements to be carried out in the subsystems such as electron guns, cavities, microwave sources, beam handling devices, computer controls, chemical processing, quality controls etc. For taking care of the high-voltage components, a clean room is being set up. Apart from that, a small workshop, a library and a seminar hall is also being planned. With the incorporation of all these features, EBC will be a novel and unique facility in the country, for carrying out R & D in the area of industrial accelerators and their applications.

The building is functional along with all its utilities and the labs. On the accelerators front, quite a few subsystems such as electron guns, gun modulator, prototype Linac cavity, vacuum pumps, control consoles, power supplies, microwave power source, are being assembled and tested in their respective labs., at the EBC site. These are going through the usual phase of debugging and perfection. The remaining subsystems are in the advanced stage of fabrication at BARC and outside.

Conclusions

The accelerators with such high powers are being designed and built for the first time in the country. They are a big technological challenge, more so, because of the nonavailability of many of the components such as klystrons, thyratrons, circulators, ceramic windows, acceleration tubes etc., in the country. To put this technology on a strong footing, these will also have to be developed within the country. Here, DAE-BRNS is playing a laudable role. It is roping in many institutions like CEERI Pilani, SAMEER and others, to develop such devices. BARC is going ahead with full force in this endeavour.

Indo-Bulgarian Workshop on Electron Beam Technology and Applications

An Indo-Bulgarian joint workshop on applications of electron beam technology for material processing was held at Trombay, Mumbai during November 19-21, 2003. The workshop, funded and sponsored by Department of Science & Technology, provided a meeting ground for scientists, academicians and industrialists from both the countries and helped them understand each others capabilities and needs.

Electron Beam technology finds wide applications not only in nuclear, aerospace and defence related industries but also in conventional engineering industry. Major subjects covered in this workshop were :

- Overview of Electron Beam Technology in Bulgaria and India
- Design aspects of EB systems for thermal processing
- Physical and thermal processes during Electron Beam welding
- Electron Beam melting and evaporation
- Beam characterization
- Evaluation of EB melts and welds
- Electron Beam and Ion Beam Lithography
- Electron Beam irradiation for polymers
- Beam and processing modelling
- Maintenance and trouble shooting of EB equipment
- Industrial standards and quality control
- Evolution of joint Indo-Bulgarian projects

Dr. N. Venkatramani, Director, Beam Technology Development Group, BARC was the coordinator from India while Prof. G. Mladenov of Institute of Electronics, Bulgarian Academy of Sciences was the coordinator from Bulgaria. The workshop was inaugurated by Shri B Bhattacharjee, Director, BARC.

"Observer Status" for India at the Council of the European Organisation for Nuclear Research (CERN), Geneva

India has been conferred with "Observer Status" at the Council of the European Organisation for Nuclear Research (CERN), Geneva. This is a matter of great prestige and significance to the scientific community in the country. The Department of Atomic Energy had entered into a Cooperation Agreement with CERN, Geneva, in March 1991 with the objective of enabling scientists from India to avail of advanced research facilities of CERN in high energy physics. In pursuance of this Cooperation Agreement, a protocol was signed in March 1996 for Indian physicists and engineers to collaborate in the fundamental research activities undertaken at CERN in the Large Hadron Collider (LHC) experiment and initially to contribute to the construction of the Collider. India is also collaborating in the setting up of two of the detectors in the Collider, namely, the Compact Muon Solenoid (CMS) and A Large Ion Collider Experiment (ALICE) and the contribution made by the Indian scientists has been greatly appreciated at CERN. India had so far been one of the several non-Member countries contributing to the setting up of the Large Hadron Collider. However, in view of India's significant contribution and the mutual benefits to CERN and the Indian particle physics community, India has been given the status of Observer to the CERN Council. Other countries who enjoy Observer status at the CERN Council are USA, Japan, Russia, Turkey and Israel.

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(Sd.)
R K Bhatnagar

TATA MEMORIAL HOSPITAL TISSUE BANK

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Officer-in-charge, Tissue Bank

The banking of tissues for surgical use is one of the recent advances in patient care. Today, tissues such as bone, cartilage, ligaments and others are being acquired, banked and transplanted with considerable clinical success. They are used in almost every field of medicine benefiting thousands of patients crippled by congenital defects or disfigured and disabled by burns, accidents or disease.

While the use of a patient's own tissues (autografts) remains the gold standard, the use of tissues taken from another individuals (allografts) has its own advantages. Allografts eliminate the additional incision necessary for acquiring an autograft and consequently reduce operating time, blood loss as well as costs. They also avoid creation of a permanent defect in the tissue recovery site. Further, since allografts do not damage normal structures, they provide the surgeon with a variety and quantity of tissue which otherwise might not be available especially in patients who are already medically compromised. Children, in particular, depend on banked allografts because they frequently possess insufficient stocks of tissues for their own use.

Tissue Banking

The quality and safety of tissues transplanted are of the utmost importance. Thus in addition to being clinically effective, the allografts require to be sterile and non-immunogenic.

The Tissue Bank at the Tata Memorial Hospital (TMH) is a pioneering effort in the country to provide safe and reliable tissue allografts. It was set up in collaboration with the International Atomic Energy Agency (IAEA) in 1988 to promote the use of radiation for the sterilisation of biological tissues. At the Tissue Bank, tissues from suitably screened donors, are processed, lyophilised (freeze-dried), and terminally sterilised by gamma irradiation of the packaged grafts.

Radiation sterilisation is a simple and safe process involving the exposure of the tissues to gamma radiation from a Cobalt-60 source, for a predetermined time, so as to receive a prescribed dose. It has been established as an efficient and convenient technique for achieving a high level of sterility in medical supplies, medicinal products and in vital diagnostic products, and its use has been extended to the sterilisation of grafts. Tissues sterilised in this way do not become radioactive and are completely safe.

Tissue grafts being irradiated in the Gamma Chamber 1200 in the TMH Tissue Bank.

Radiation sterilisation has a number of advantages:

- The high penetration power of radiation enables the tissues to be sterilised in the fully packaged form and places no restriction on the shape, size and density of tissue that can be effectively sterilised.
- Since sterilisation is effected after final packaging, the sterility of the tissue is limited only by the integrity of the packaging.
- Being a "cold" process, heat sensitive tissues remain unaffected. Further, if the recommended dose is used, no significant physical and chemical changes are induced which influence the required function of tissues.
- The effect of radiation is instantaneous and simultaneous for the whole target.
- Since radiation sterilisation is a continuous, fully automated process with a single parameter to be controlled, namely time of exposure, it can be precisely controlled to accurately achieve a sterility assurance level of 10^{-6}. This is in contrast to steam and chemical (Ethylene Oxide) sterilisation, which apart from being batch processes, requires more than one parameter (temperature, pressure and humidity) to be controlled.
- Radiated products require no quarantine period as there is no residual toxicity.
- Radiation is believed to reduce the antigenicity of the grafts.

Lyophilised gratis from the TMH Tissue Bank are gamma irradiated at the ISO 9002:1994 certified 1SOMED, the radiation sterilization plant for medical products set up at Trombay by the Board of Radiation & Isotope Technology (BRIT) of DAE. Alternatively they are irradiated in the Gamma Chamber 1200 manufactured by BRIT and housed in the TMH Tissue Bank.

Clinical Uses of Irradiated Allografts

The availability of indigenous allografts sterilised by irradiation has enabled innovative approaches to sur-

Irradiated amnion from the TMH Tissue Bank being used in a patient with burns

gery. These have helped save patients' lives or limbs, or made their rehabilitation quicker and less painful. The preserved tissues from the TMH Tissue Bank are being used by surgeons in more than 150 hospitals and nursing homes in Mumbai and other parts of India.

Skin grafts have served successfully as biological dressings in the treatment of burns. Amnion is another excellent biological dressing which mimics skin. Although in plentiful supply, fresh amnion, carries the risk of disease transmission and is not always available on demand. Its cumbersome retrieval and the need for cleansing and sterilisation, deter its use by surgeons. Radiation permits the supply of sterile amnion off-the-shelf. These have been used as temporary wound covers in the treatment of ulcers, burns, wounds, unresponsive bedsores and abscesses.

At the TMH, banked amnion has proved to be particularly valuable in the management of moist skin ulceration in radiation therapy patients. Such ulcers are often difficult to treat in areas like groin. Amnion adheres easily to the irregular contours, does not require to be changed frequently, reduces pain and enhances healing. It has proved to be more efficacious and cost effective than routine dressings.

For the first time in India, freeze-dried, irradiated amnion has been used in orbital and ocular surface reconstruction. It has also been used successfully as a graft for limbal stem cell transplantation. Its biggest advantage lies in its availability as ready-to-use packs that may be conveniently stored for long periods at room temperature. Processing amnion also closes the sero-diagnostic window for HIV.

A defect following tumour resection reconstructed at TMH with irradiated bone allograft

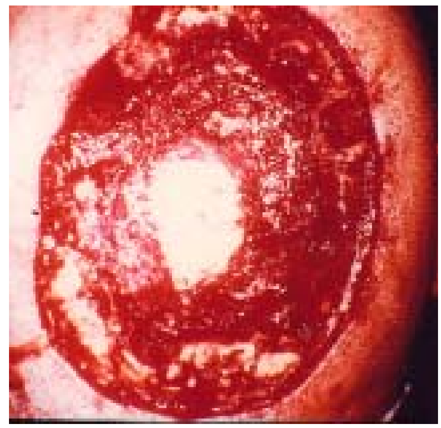
Irradiated bone powder from the TMH Tissue Bank being used in a periodontal osseous defect.

Dura mater grafts have been used in duraplasty and in abdominal wall reconstruction following tumour surgery. In oral surgery they have found use as gingival grafts and as barrier membranes in periodontal guided tissue regeneration proving to be cost effective alternatives to imported membranes.

Bone powder is being used effectively in the treatment of periodontal osseous detects. Bone grafts have found use in reconstructing skeletal detects, fusing joints, and augmenting fracture healing and joint reconstruction procedures. At the TMH they have enabled reconstruction of massive defects and limb salvage following tumour resection.

Code of Practice for Radiation Sterilisation of Allografts

As a participant in the IAEA project, the TMH Tissue Bank has contributed towards the development of the first multi-media distance learning package on Tissue Banking which forms the basis of the curriculum for the IAEA Diploma Course in Tissue Banking. It is currently engaged in the process for implementing the IAEA Code of Practice for the Radiation Sterilisation of Tissue Allografts.



Irradiated dura mater from the TMH Tissue Bank being used as a dural patch

RADIOPHARMACEUTICALS

Radiopharmaceuticals are drug formulations containing radioisotopes and are suitable for administration in humans for diagnosis and therapy of various diseased states. Radiopharmaceuticals have revolutionized the medical field by their ability to provide static as well as dynamic images of internal organs in a noninvasive manner as well as by offering efficacious therapy of certain diseases.

Radiopharmaceutical production facility at BRIT

Diagnosticradiopharmaceuticals are used to derive detailed description of the morphology and dynamic functioning of the various internal organs of the body. The radiopharmaceutical accumulated in an organ of interest emit gamma radiation which

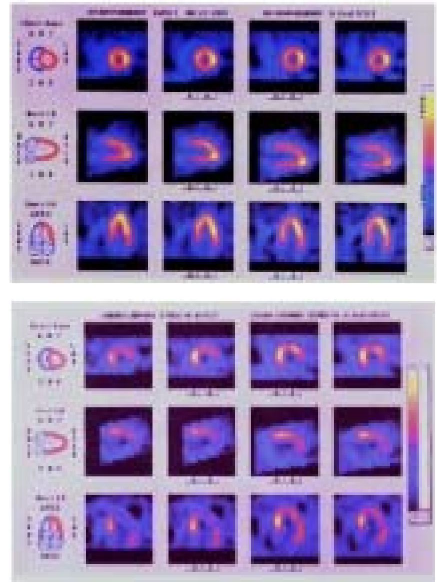
A shielded facility for the production of Iodine-131 capsules for therapeutic applications

are used for imaging of the organs with the help of an external imaging device called gamma camera. A typical example is the imaging of a neuroendocrine-tumour using ^{131}I-metaiodobenzyl guanidine (mIBG).

Therapeutic Radiopharmaceuticals are radiolabeled molecules designed to deliver therapeutic doses of ionizing radiation to specific diseased sites. Therapeutic applications of radiopharmaceuticals have emerged from the concept that certain radionuclides possessing particulate emission such as alpha and beta radiations or low-energy low-range electrons (Auger electrons) possess the ability to destroy diseased tissues. The dual facets of these agents constitute either curative or palliative measures in treatment modalities. Some examples are :

^{131}I- Sodium iodide -	Thyrotoxicosis and thyroid cancer
^{153}Sm- EDTMP -	Palliative treament of metastatic bone pain
^{166}Ho-HA particles-	Rheumatoid arthritis

Technetium Radiopharmaceuticals are used in over 80% of the nuclear medicine studies the world over and hence aptly called the "work-horse" of diagnostic nuclear medicine. The ideal nuclear properties of ^{99m}Tc constitutes its 140 keV gamma photon with 89% abundance which is optimum for imaging with gamma cameras available in nuclear medicine centers. Its half life of 6 hours, though sufficiently long for preparation of the radiopharmaceutical, performing its quality control and injecting into the patient for imaging



Perfusion images of heart using ^{99m}Tc-MIBI. The series of pictures in the top is a normal image and the ones in the bottom show perfusion abnormalities

studies, is at the same time short enough to minimize the radiation dose. A host of technetium radiopharmaceuticals for diagnosis of a wide spectrum of diseased states are now available.

^{99m}Tc-MDP-	Bone scintigraphy
^{99m}Tc- ECD-	Brain perfusion imaging
^{99m}Tc- MIBI -	Myocardial perfusion imaging
^{99m}Tc- DTPA-	Renal function studies

The rapid growth of ^{99m}Tc radiopharmaceuticals is due to the development of ^{99}Mo/^{99m}Tc generator technology which is capable of giving the 6 h half life ^{99m}Tc at the hospital site over a period of one week. Availability of a wide variety of lyophilized cold kits for formulation of ^{99m}Tc radiopharmaceuticals have further augmented the growth of the usage of ^{99m}Tc radiopharmaceuticals. Cold-kits provide pre-packed set of sterile ingredients designed for the preparation of a specific ^{99m}Tc-radiopharmaceutical at the hospital radiopharmacy attached to the nuclear medicine department.

Radiopharmaceuticals for positron emission tomography

Radiopharmaceuticals that are prepared using radioisotopes produced in particle accelerators (particularly cyclotron), decay by electron capture and/or positron emission. Short-lived positron emitting radionuclides provide suitable alternatives to the reactor produced isotopes for diagnostic imaging. The merits of coincidence detection of annihilation photons arising from decay of a positron-emitting radioisotope within an organ of interest provide superior images in a positron emission tomography (PET). ^{18}F-FDG (fluoro-2-deoxyglucose), aptly named as the 'molecule of the millennium' is widely used over the world as a versatile PET tracer and has proven its clinical utility in oncology, neurology and cardiology.

Radiopharmaceuticals undergo stringent **quality control and quality assurance** tests to ensure pharmaceutical safety, efficacy and purity. Physicochemical, radiochemical and biological tests are carried out to ensure, radionuclidic purity, radiochemical purity, pharmaceutical efficacy, sterility, and apyrogenicity of the radiopharmaceuticals.

The medical cyclotron facility for the production of short lived positron emitting radionuclides.

Fully programmable chemistry modules and dispenser used for the synthesis and sterile dispensing of injectable PET radiopharmaceuticals

A **radiopharmacy** set-up located in a hospital is responsible for the preparation of the final dose for the administration of radiopharmaceutical and also for the formulation of ^{99m}Tc-radiopharmaceuticals. The major responsibility of a hospital radiopharmacy are dosage preparation, quality control and quality assurance of the radiopharmaceutical, safe-guarding against radiation exposure of staff as well as patients and radioactive waste management.

The **nuclear medicine department** encompasses the hospital radiopharmacy along with the scintigraphy unit. The radiopharmaceutical is administered to a patient by a physician trained in nuclear medicine and the patient is imaged under a suitable instrument such as a planar gamma camera, a single photon emission tomography (SPECT) or a positron emission tomography (PET) machine. The latter two are capable of giving three dimensional images of the organs or tissues which show uptake of the radiopharmaceutical.

The Board of Radiation and Isotope Technology (BRIT) is responsible for the production, quality control, and supply of radiopharmaceuticals in India. BRIT is routinely manufacturing about 25 radiopharmaceuticals and catering to the requirements of about 70 nuclear medicine centres in India, in addition to exporting the radiopharmaceuticals to a few neighboring countries. About 300,000 diagnostic studies and 15,000-20,000 therapies are carried out annually using the radiopharmaceuticals provided by BRIT.

Owing to the efforts of the Department of Atomic Energy in production and supply of radiopharmaceuticals as well as in human resource development both at technologist and physicians level, nuclear medicine department are currently available in all major cities in India. Major Institutions such as the All India Institute of Medical Sciences, New Delhi; Post Graduate Institute of Medical Education and Research, Chandigarh, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Christian Medical College, Vellore, Regional Cancer Centre, Tiruvanthapuram, Kidwai Memorial Institute of Oncology, Banglaore, Apollo Group of Hospitals etc. are among the major users of radiopharmaceuticals in India. From the major metros, nuclear medicine has spread into smaller cities such as Ludhiana in Punjab, Manipal in Karnataka, Simla in Himachal Pradesh, Trissur in Kerala, Agra in Uttar Pradesh, Coimbatore in Tamilnadu, to name a few.

RADIOIMMUNOASSAY

Radioimmunoassay (RIA) is a radioanalytical technique with remarkable sensitivity and a high degree of specificity that is widely used for the estimation of a variety of molecules present in complex matrices. The application of this technique spans over a wide spectra of substances such as hormones, steroids, vitamins, drugs, tumor markers and viral antigens. Radioimmunoassay is an in vitro diagnostic technique and hence does not involve administration of radioactivity to the patient.

The Department of Atomic Energy had started the RIA programme in the early seventies. Its Board of Radiation and Isotope Technology (BRIT)supplies ready to use RIA kits for many hormones. The Bhabha Atomic Research Centre (BARC) also initiated a training programmeme in the year 1980 in order to make trained manpower for RIA. Thanks to the early start of the RIA programme by BARC, currently there are over 500 RIA laboratories in India carrying out a few million RIA analysis per year.

A radioimmunoassay in progress

Radioimmunoassay is one of the fine examples of the radiotracer technique using a radioisotope. The competition of an analyte with its radioisotopically labeled counterpart for a limited amount of antibody, the specific reagent, is the underlying principle of this technique. Increasing the analyte concentration inhibits the binding of the labeled analyte to the antibody. The concentration of the unknown is thus obtained by comparing its inhibitory effect on the binding of the labeled analyte to that of a known standard.

Immunoradiometric Assay

A more sensitive and specific technique is the immunoradiometric assay (IRMA), which is an improvement of the RIA principle. In IRMA, the analyte is incubated with an excess of radiolabeled antibody. Two-site IRMA technique, a further modification of the IRMA technique, uses two antibodies for sandwiching the analyte of which one of the antibodies is labeled with Iodine-125. Two site IRMAs have better specificity than conventional radioimmunoassays.

The RIA technique has seen several refinements over the years to make it more user friendly. One of the improvements is the introduction of solid phase assays. A separation of the bound analyte and the free analyte after RIA/ IRMA is essential. In solid phase assays, the reagent antibody is immobilized on solid phase such as polystyrene tubes, and the separation is carried out by simply decanting the contents of the reaction tube.

Magnetic particle bound antibodies offer a user-friendly and manufacturer-friendly technique for solid phase assays. In the solid phase assay using magnetic particles, the antibody is coupled to cellulose incorporated in magnetic particles. At the end of the incubation, the separation of bound and free analyte is carried out by placing the test tube rack on a magnet followed by decantation of the free analyte.

The above improvements in RIA technology now enables processing large numbers of patient samples in a batch using automated equipment that are available from commercial sources. Automatic RIA counters that can quantify the radioactivity of an entire batch without intervention as well as processing the data to give the final results have made RIA much more user friendly.

Applications of Radioimmunoassay

Radioimmunoassay of thyroid hormones

An important application of radioimmunoassay is in the diagnosis of thyroid disorders. Levels of the thyroid hormones, triiodothyronine (T_3) and thyroxine (T_4) along with that of the thyroid stimulating hormone (TSH), are useful in the diagnosis of thyroid disorders. TSH levels before and after thyrotropin releasing hormone (TRH) stimulation helps in the differential diagnosis of primary, secondary and tertiary hypothyroidism. The levels of thyroxine and thyroid stimulating hormones in neonates are used as a routine screening test to diagnose neonatal hypothyroidism.

Radioimmunoassay of Fertility Related Hormones

Estimation of human chorionic gonadotrophin (hCG) is useful in the detection of pregnancy and monitoring progress, to establish the gestational age as well as for proper management of patients with complicated pregnancies such as ectopic pregnancy, threatened abortion, foetal distress etc. RIA of luteinizing hormone

Robotic sample processor for RIA/IRMA that can process samples automatically

(LH) and follicle stimulating hormone (FSH) is used for identifying the causes of infertility and better understanding of the problems associated with child bearing and infertility. Hormonal levels estimated by RIA are of great value for the management of medically aided conception.

Estradiol determinations have proved to be very useful in many disorders such as investigations of precocious puberty in girls, differential diagnosis of amenorrhea, monitoring ovulation induction and functioning of ovaries. Levels of testosterone are useful in detecting hypogonadism, testicular tumours in males and diagnosis of hirsutism in females.

Radioimmunoassay of Other Hormones

RIA of growth hormone is useful in the early diagnosis of dwarfism in children as well as diagnosis of gigantism or acromegaly. Prolactin levels are useful for identifying pituitary adenomas. Cortisol levels are useful in diagnosing Cushings' syndrome and Addison's disease.

Tumour Markers

RIA of tumour markers such as alphafetoprotein (AFP), carcinoembrionic antigen (CEA), b-hCG for chorio-carcinoma, prostate specific antigen (PSA) for prostate cancer, are available for detection and management of cancer. They serve as valuable tools for follow-up of treatment and detection of any recurrence.

RIA of Drugs

RIA of drugs has gained importance owing to the increasing concern for the safety and toxicity of the drugs. It is important to monitor plasma levels of drugs having narrow therapeutic window (therapeutic drug monitoring, TDM). Drugs such as phenytoin, theophylline, cyclosporin, morphine, gentamycin, antidepressants etc., are estimated by RIA. From heroin in drug abusers to steroids in athletes and antibiotics in patients, RIA can estimate the concentration of drugs in blood, urine and saliva.

Non-clinical Applications

Radioimmunoassay due to its versatility has expanded its horizon from clinical to non-clinical applications such as veterinary science, food processing industry, drug industry, forensic science and environmental monitoring. Increasing awareness of the role of toxic metals has placed greater reliance on these techniques.

Aflatoxins are the secondary metabolites of the fungi Aspergillus and is a major contaminant in food articles. Aflatoxins are potentially carcinogenic and hence monitoring the levels of aflatoxin contamination is mandatory for exporting food items. Measurement of aflatoxins in food items can be done by the RIA technique for ensuring food safety.

Human Resource Development in RIA

Radioimmunoassay is best utilized in the hands of well-trained personnel. BARC has been conducting since 1980, a training course covering all the aspects of RIA and IRMA. About 400 medical doctors and about 600 technologists have been trained through this course till now. The course is conducted twice a year at BRIT as well as in leading host institutions in different parts of the country.

The HRD efforts taken by the Department has helped in propagating the RIA technique widely in India. There are over 500 RIA laboratories functioning at various parts of India. While most of these laboratories are catering to the local population, there are a few large RIA laboratories that run a network of collection centres who collect, process and courier the samples to the central laboratories. By using modern communication network, these laboratories make the results available to the referring doctors in 48-72 hours.

Over the years major competitive technologies have emerged which are capable of offering assays, which are of equal clinical use, using non-isotopic labels. However, the radioimmunoassay technique is still the preferred method for many due to its simplicity, non-interference from matrix effects and cost advantage. It is estimated that about 2-3 millions of RIAs are carried out annually in India.

Technologies Available

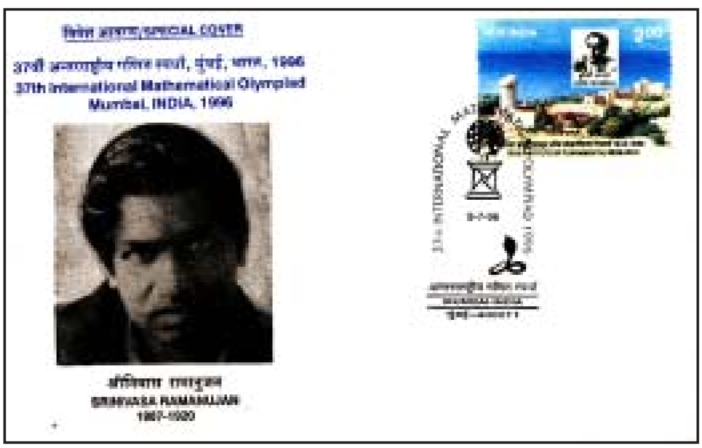
BRIT is currently the only manufacturer of radioimmunoassay kits in India. The Board has been providing RIA/IRMA kits for several hormones. Technology for the development of RIA/IRMA of any of the antigens is also now readily available in BRIT. The radioactive component in the RIA technique is very small and the non-radioactive component constitutes the major part. Hence, the RIA technology is aptly suitable for transfer into Indian manufacturer with active input of the radioactive tracer component from the Department.

SCIENCE & MATHEMATICS OLYMPIADS

There are five annual international science olympiads in which science students from across the world compete for gold, silver, and bronze medals. The International Mathematics Olympiad was introduced in 1959, followed by Chemistry (1969), Physics (1970), Biology (1990), and Astronomy (1996) olympiads. Indian students have been participating in all these events, and have won laurels.

Science Olympiads

In 1997-98, Homi Bhabha Centre for Science Education (HBCSE) (a National Centre of the Tata Institute of Fundamental Research, Mumbai) and the Indian Association of Physics Teachers (IAPT) jointly took initiative in starting the physics olympiad programme. A year later, HBCSE took initiative to extend the programme to chemistry and biology also. IAPT came forward to offer its wide network for help in the conduct of chemistry and biology examinations also. These initiatives received strong support and encouragement from the Department of Atomic Energy (DAE), Department of Science and Technology (DST) and the Ministry of Human Resource Development (MHRD) of the Govt. of India. India sent its first team to International Physics Olympiad (IPhO) in 1998, International Chemistry Olympiad (IChO) in 1999 and International Biology Olympiad in 2000. The good performances of the Indian teams right in the first few years of participation helped in the consolidation of the programme.



Commemorative special cover issued by the Indian Postal Department to mark the 37th International Mathematical Olympiad held in Mumbai in 1996

From July 6 to July 15, 2001, India hosted the 33rd International Chemistry Olympiad in Mumbai. This world event organised by Homi Bhabha Centre for Science Education (TIFR) has given a further boost to the entire science olympiad programme in India. The year also saw the best overall performance so far of the Indian teams in all the four International Olympiads.

The National Olympiad Programme in physics, chemistry and biology is overseen by an Integrated National Steering Committee constituted by DAE under its Board of Research in Nuclear Sciences (BRNS). The programme is financially supported by BRNS (DAE), DST and MHRD.

Science stream students in Class XI and XII are eligible to participate in these Olympiads. The first stage of the selection process is the National Standard Examinations (NSE) in Physics (NSEP), Chemistry (NSEC), and Biology (NSEB) held across the country at the end of November. A student may appear for any one, two or all the three subjects. The duration of NSEP, NSEC and NSEB are 180, 120, and 90 minutes, respectively. These examinations are the organizational responsibility of Indian Association of Physics Teachers (IAPT) and the Indian Association of Chemistry Teachers (IACT). About 250 students are short listed in each subject on the basis of NSE.

The next stage, the Indian National Olympiads in physics (INPhO), in chemistry (INChO), and in biology (INBO) are organized by Homi Bhabha Centre for Science Education (HBCSE) in collaboration with IAPT and IACT. They are held in the last week of January or early February.

The duration of the Olympiad examinations is 4 hours for INPhO and INChO and 2 hours for INBO. The short listed students (about 50 in each subject) join the relevant orientation-cum-selection camps of one-week duration, at the end of which 25 students from each of the disciplines are selected as Gold Medalists. Each is given a medal, a certificate, and a book.

The medalists undergo rigorous training in theory and experiment at the annual summer camps in May – June at the Homi Bhabha Centre for Science Education. Special laboratories have been developed at the HBCSE for the purpose. At the end of the training, the top 5 students in physics, the top 4 in chemistry and the top 4 in biology are selected for the international Olympiads in respective subjects. HBCSE also organizes pre departure training and orientation to the Indian teams before they depart for the International Olympiads.

Astronomy Olympiad

For Olympiad in Astronomy students up to Class XI in Science stream in two age groups of 15 & 17 years are eligible.

The Astronomy Olympiad programme from the year 2003 – 2004 is implemented by HBCSE in collaboration with the National Council of Science Museums (NCSM). The selection process begins at the participating centres, such as science centres and museums and planetariums across the country. The first stage tests the knowledge of mathematics and physics. About 10 students in each age group from each centre then appear in the Indian National Astronomy Olympiad. About 20 students from each of the two age groups then participate in a 15-day national camp at the Nehru Science Museum, Mumbai. They are exposed to various aspects of observational astronomy, astrophysics and space science. Thereafter, tests are administered to select six to seven students to represent India in the International Astronomy Olympiad.

Mathematics Olympiad

The International Mathematical Olympiads has its origins in the "Etovos", a Mathematical contest started by Hungary for its High School students in 1894. Some of Hungary's neighbours followed the example and organised similar mathematical contests.

It looks more than half a century for the Olympiad activity to take on an international character. It was in 1959 that Romania hosted the first International Olympiad; it was a somewhat limited affair, participation being confined to a mere seven countries, all belonging to the then Socialist Block. The USA entered the fray in the mid-seventies. The participation has grown ten fold and more since the first IMO.

Olympiad activity was initiated in India by the Late Professor P. L. Bhatnagar of the Indian Institute of Science (IISc.) towards the end of the sixties. It was confined largely to Bangalore and nearby areas mainly due to the limited resources available to Prof. Bhatnagar both in human and financial terms. Elsewhere in the country (notably Gujrat) similar programmes emerged. In 1986, Prof. J.N. Kapur, then a member of the National Board for Higher Mathematics (NBHM) persuaded the Board to take on the responsibility of coordinating the activities going on in different regions in the country and embark on organising a National Olympiad contest. NBHM decided to enlist the assistance of various regional bodies to organise a regular annual contest for the country as a whole.

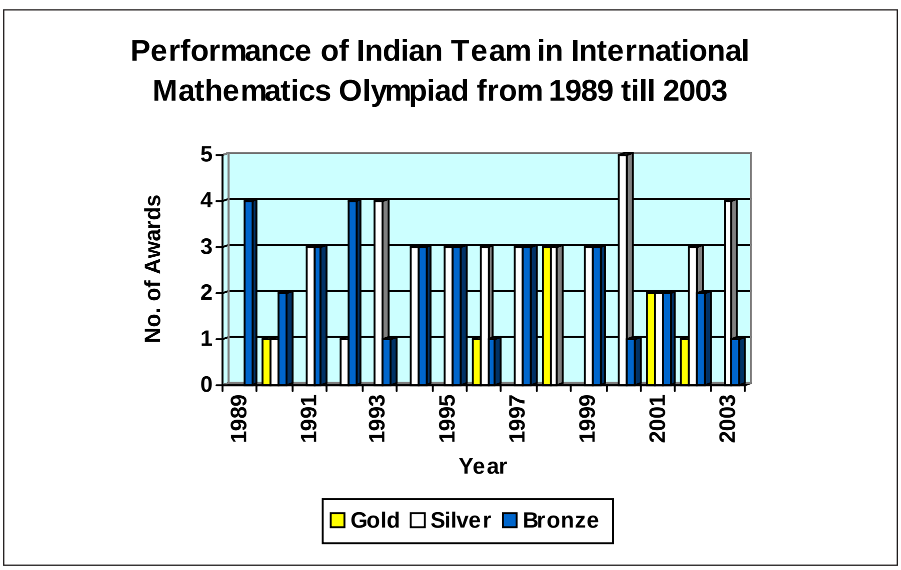
NBHM also created the 'Olympiad Cell' for looking after Olympiad activity. The cell has now become part of Homi Bhabha Centre for Science Education.

The Mathematics Olympiad Programme in India leading to participation in the International Mathematical Olympiad is organized by the National Board of Higher Mathematics (NBHM) of the Department of Atomic Energy (DAE). It consist of regional and national level olympiads, followed by training and International Olympiad.

Regional Mathematical Olympiad (RMO) is held between September and December each year at 20 different regions in the country. Students of Class XI and Class XII are eligible to appear for RMO. RMO is a 3-hour written test containing about 6 to 7 problems. The Regional Coordinator has the freedom to prepare question paper or obtain the question paper from NBHM. The regions opting for NBHM question paper hold this contest on the first Sunday of December. Certain number of students from each region is selected to appear for the national level examination.

The students selected from the Regional Mathematical Olympiads appear for the the Indian National Mathematical Olympiad (INMO). INMO is a 4-hour written test. On the basis of INMO, the top 30-35 students from all over the country become INMO awardees and receive a Certificate of Merit.

The INMO undergo a month long Training Camp during May-June at HBCSE, Mumbai. INMO awardees of the previous year who have satisfactorily gone through postal tuition throughout the year are invited again to a second round of training (Senior Batch). The senior batch participants who successfully complete the Camp receive a prize



The Medals awarded at the 37th IMO

This Logo is based on the famous work "Leelavati" of the 10th century Indian mathematician Bhaskaracharya. This Logo means: *A peacock stood on top of a pillar, nine cubits in height. At the foot of the pillar was a hole. Seeing a snake at a distance three times the height of the pillar, moving towards the hole, the peacock swooped down on it obliquely. Tell me quickly (oh, Leelavati) at what diatance from the hole, the two, moving with equal speed, clashed*

of Rs. 5,000/- in the form of books and cash. A team of the best six students is selected from the combined pool of junior and senior batch participants of the Training Camp, for participation in the International Mathematical Olympiad, that is held in July each year in a member country of IMO.

IMO consists of two 4 and 1/2-hour written tests held on two days. India has been participating in IMO since 1989. Students of the Indian team who receive gold, silver and bronze medals at the IMO receive a cash prize of Rs. 5000/-, Rs.4000/- and Rs. 3000/- respectively during the following year.

Ministry of Human Resource Development (MHRD) finances international travel of the 8-member Indian delegation, while NBHM (DAE) finances the entire in-country programme and other expenditure connected with international participation.

Nurture Programme in Mathematics

The Indian National Mathematical Olympiad (INMO) awardees choosing mathematics for their undergraduate degree course are provided with a scholarship of Rs. 1,000/- per month. They are offered a 4-year programme of training in mathematics through correspondence and periodic contact with a chosen faculty. The programme is also available to INMO awardees who do not pursue undergraduate degree in mathematics but have special interest in the subject. They are offered an annual cash prize of Rs. 9,000/- subject to satisfactory performance in the programme.

Every year the faculty of the IMO-Training Camp selects 15-20 students of Class XII from the Senior Batch for inclusion in this Nurture Programme of NBHM.

All the students of the Indian teams for International Olympiads in mathematics, physics, chemistry and biology automatically qualify for the Kishore Vaigyanik Protsahan Yojana (KVPY) Fellowship (Rs. 3,000/- per month + Rs. 6,000/- per annum contingency plus a nurture programme), provided they pursue careers in mathematics or basic sciences. In addition BARC offers pre-selection to their training school to all the students of Indian teams in physics and chemistry, provided they pursue careers in basic science and maintain consistently good academic record up to M.Sc.

Details of these Olympiads are available on the website www.hbcse.tifr.res.in or from

Member Secretary,
National Board of Higher Mathematics,
Department of Atomic Energy,
Anushakti Bhavan, CSM Marg,
Mumbai - 400 001.
Tel. : 022-2202 2533
Fax : 022-2204 8476
e-mail : nbhm@math.tifr.res.in

Director,
Homi Bhabha Center for Science Education,
Near Anushaktinagar Bus Depot,
V.N.Purav Marg, Mankhurd,
Mumbai 400 088
Tel : 2556 2132, 2556 7711,
2555 5242, 2555 4712
Fax : 022-2558 5660,
022- 2556 6803
e-mail : arvindk@hbcse.tifr.res.in

New Director for CAT

Dr. Vinod Chandra Sahni has became the Director of the Centre for Advanced Technology on November 1, 2003.

Dr.Sahni did his B.Sc. from Delhi University and joined the 8th batch of BARC Training School in August 1964. After graduating from the Training School as Physics Topper, he joined the Nuclear Physics Division of BARC in 1965. He got his Ph.D. in solid state physics from Mumbai University.

Dr. Sahni has made important contributions in lattice dynamics of complex crystals, group theoretical methods as applied to solid state physics, Raman spectroscopy, measurement of electron momentum densities, quasicrystals, magnetization studies of many superconducting and several magnetic materials using SQUID magnetometer etc.

Besides condensed matter physics, Dr.Sahni has specialized in the imdigenous development of physics related instrumentation, particularly UHV based instruments and synchrotron radiation utilization equipment for storage ring INDUS-1 and the upcoming ring INDUS-2

Dr. Sahni is a Fellow of the National Academy of Science, India, and an INSA Young Scientist Awardee. He has also been a Visiting Fellow at the Centre for Chemical Physics UVO, Ontario, Canada during 1981-82, INSA-USSR Academy Exchange Fellow in 1987 and INSA-Royal Society (UK) Exchange Fellow in 1993. Dr.Sahni has published more than 250 research papers, coauthored the book "Dynamics of Perfect Crystals" and co-edited another book "Developments in Theoretical Physics". He has also guided several scientists in DAE for Ph.D.

Before his appointment as Director, CAT, Dr. Sahni was the Director, Physics Group at BARC, a post he continues to hold concurrently with CAT Directorship.

NPCIL participated in India International Trade Fair - 2003 (IITF-2003)

NPCIL participated in "India International Trade Fair - 2003 (IITF-2003)" organized by the India Trade Promotion Organization (A Government of India Enterprise) held at Pragati Maidan, New Delhi during 14-27 November 2003.

The Trade Fair was inaugurated by the President of India, Dr. A. P. J. Abdul Kalam.

The President of India, Dr. A P J Kalam, and Shri Arun Jaitly, Union Minister for Commerce, at he NPCIL's stall in the Technology Trade Pavilion-2003.

INS AWARDS-2002

On December 17, 2003, at IGCAR, Kalpakkam, INS Awards-2002 were given by His Excellency Shri A.P.J. Abdul Kalam, President of India. Following are the recipients:

Shri C.V.Sundaram - INS Homi Bhabha Life Time Achievement Award (Rs.1,00,000)

INS AWARDS (Rs. 50,000/- each)
Dr. S. Banerjee, BARC, Shri R. Bhiksham, NPCIL, Dr. Gursharan Singh, BARC, Shri H. S. Kamath, BARC, Shri Sekhar Basu, BARC Facilities, Kalpakkam, Shri S. K. Sharma, AERB

INS MEDALS (Rs. 10,000/- and a Medal each)
Shri Arun Kumar Bhaduri, IGCAR, Shri D. Pramanik, NFC, Dr. B. Purna Chandra Rao, IGCAR, Shri Sunil Tonpe, NFC, Shri Vivek Bhasin, BARC, Shri Vivek Sanadhya, BARC

INS SCIENCE COMMUNICATION AWARD
Indain Association of Nuclear Chemists & Allied Scientists (IANCAS), Mumbai - (Rs.50,000)

INS INDUSTRIAL EXCELLENCE AWARD
M/S Larsen & Toubro Limited, Mumbai - Plaque

NPCIL gets new CMD

Shri Shreyans Kumar Jain, Distinguished Scientist and Senior Executive Director (Light Water Reactors), took over as Chairman and Managing Director of Nuclear Power Corporation of India Ltd. (NPCIL), from Dr. V.K. Chaturvedi.

NPCIL is a public sector enterprise of the DAE.

Shri Jain, a Mechanical Engineering graduate of 1969, joined the erstwhile Power Projects Engineering Division (rechristened as Nuclear Power Corporation in 1987), after successful completion of one year training in Nuclear Engineering and Sciences at BARC Training School. During the last three decades of his service with NPCIL, he has successfully accomplished the tasks assigned to him covering the entire spectrum of activities of setting up of nuclear power plant viz. siting, engineering, construction, commissioning, project management, regulatory review, and dealing with national and international agencies as well as governmental agencies. Prior to taking up this assignment, Shri Jain was holding the charge of Senior Executive Director (Light Water Reactors) and is fully responsible for the construction of 2 x 1000 MWe light water reactors, being set up at Kudankulam in Tamil Nadu with technical co-operation of the Russian Federation.

Dr. V.K. Chaturvedi who in his capacity as CMD, has taken NPCIL to greater heights and has helped in achieving international benchmarks, be it in the area of construction or project management, budget utilization or capacity utilization of the operating plants.

NPCIL is at present operating 14 nuclear power plants aggregating 2770 MWe. NPCIL proposes to add 3960 MWe to the national grid by the year 2008 and would reach about 10,000 MWe by the end of 11th Plan, and successively to 20,000 MWe by the year 2020.

Export of TLD - badge based on BARC technology

About eight year back Technology for manufacturing of TLD Badge for Personnel Monitoring of radiation workers was transferred by BARC to M/s Renentech Laboratories Pvt. Ltd. Since then the Renentech Laboratories have been successfully supplying TLD badges to DAE units. As a BARC accredited laboratory, they are also issuing these badges to other institutions for Personnel Monitoring services. Foreign market however is successfully dominated by the western countries for a long time.

Recently, Renentech Labs received a purchase order for 2000 TLD badges from M/s PRORAD, a Brazilian Personnel Monitoring Laboratory carrying out monitoring of radiation workers of many hospitals and industries throughout Brazil. This Brazilian laboratory was using TLD discs with 2 parts of Teflon and one part of $CaSO_4$ doped with Dysprosium ($CaSO_4$:Dy) at a concentration of 0.1 mol %. Renentech Labs had sent the samples with 3 parts of Teflon and 1 part of $CaS0_4$ doped at a concentration of 0.2 mol %, which was approved and accepted by the Brazilian laboratory. The supply has been made. Renentech Labs has also made third party exports of TLD badges to Indonesia, Bangladesh, and Sri-Lanka. Renentech Labs has thus set its foot in the foreign market of TLD badges/TLD discs with the help of BARC Technology.

Radioactivity Release to the Environment at Kalpakkam is much below the safety limits

At Kalpakkam, near Chennai, Tamil Nadu, DAE has its facilities namely the Indira Gandhi Centre for Advance Research (IGCAR), Madras Atomic Power Station (MAPS), and Kalpakkam Reprocessing Plant etc.. Safety record in these facilities has been excellent.

The activity release to environment from various facilities of DAE at Kalpakkam, is well below the authorized limits. The annual dose received by members of general population residing near MAPS as well as other DAE Facilities at Kalpakkam, is 200 times less than permitted dose of 1 milli Sv/year prescribed by AERB/ International Commission on Radiological Protection (ICRP) for the public. The dose evaluation is based on the regular survey carried out by Environmental Survey Laboratory at Kalpakkam.

The occupational dose limits stipulated by AERB, (which are based on recommendations of International Commission on Radiological Protection (ICRP) are strictly followed.

R.No 9002/62

PHOSPHATIC RARE ELEMENT EXTRACTION

Dr. Anil Kakodkar, Chairman, Atomic Energy Commission & Secretary Department of Atomic Energy, inaugurated 'Phosphatic Rare Element Extraction' (PREE) Test Facility set-up by BARC at the Kochi unit of the Indian Rare Earths Ltd. on November 20, 2003. The PREE programme forms a thrust area of work at the front end of the fuel cycles. The test facility will be testing individual fertiliser acids for rare element separation using innovative processes developed by BARC. It also has a large circular mixer-settler of proven industrial design made from a corrosion-resistant non-metallic material 'KESTRA'. Graphite heat exchangers have been commissioned for pre-heating process streams. Facilities for pre-treatment by carbon adsorption and post treatment by enhanced gravity separation are integrated into the test-rig. A state of art instrumentation & control system has been installed. The installation of the facility represents a milestone in industrial development of R&D originating at BARC on rare element recovery from secondary resources.

Dr. Anil Kakodkar, Chairman Atomic Energy Commission & Secretary Department of Atomic Energy, inaugurated 'Phosphatic Rare Element Extraction' (PREE) Test Facility set-up by BARC at the Kochi unit of the Indian Rare Earths Ltd. on November 20, 2003.

SINP's Structural Genomics Laboratory inaugurated

Shri Satyabrata Mookherjee, Minister of State for Statistics & Programme Implementation, Planning, Atomic Energy & Space,inaugurating the Structural Genomics Laboratory at the Saha Institute of Nuclear Physics, Kolkata.

The objectives of the Laboratory are as follows :

- Determination of the 3D structures of key proteins involved in hematological and neurodegenrative diseases,
- Cloning and expression of those aberrant genes/ proteins in cellular systems,
- Development of cell models for the study of protein-protein and DNA-protein interactions in the disease, and
- Development of methodologies for diagnostics and therapy.

This Laboratory is engaged on -

- Proteome analysis of thalassemic blood cells and leukemic stem cells,
- Flow cytometric characterization of different blood cells,
- High throughput sequencing of candidate genes in leukogenesis and apoptosis, and
- Elucidation of 3D structure of proteins by X-ray diffraction and computer modeling techniques.

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