Hon’ble Prime Minister Shri. Narendra Modi during his visit to National Cancer Centre of Mongolia while gifting of Bhabhatron - II Tele-therapy equipment.
Statement by Dr. Ratan Kumar Sinha, Chairman of the Atomic Energy Commission and Leader of the Indian Delegation at the 59th General Conference, Vienna.
16 September 2015

Mr. President, Excellencies, Ladies and Gentlemen,

Mr. President, I take this opportunity to congratulate you, on your election as the President of the 59th General Conference. Under your leadership, I am sure the current General Conference will accomplish all the tasks laid before it.

India welcomes the three new Members to the IAEA, and I take this opportunity to congratulate Antigua & Barbuda, Barbados, and Turkmenistan on the occasion of their joining the IAEA family.

Mr. President,

I am happy to share some highlights of the progress achieved in the Indian nuclear programme, since the previous General Conference.

Our utility, Nuclear Power Corporation of India Ltd. (NPCIL), has achieved the highest ever generation of electricity in the financial year 2014-15, with a Capacity Factor of about 82% and Availability Factor of 88%.

The first unit of the Kudankulam Nuclear Power Plant (KKNPP 1), built in collaboration with the Russian Federation, started commercial operations from December 31, 2014, taking the country's installed nuclear power generation capacity to 5780 MWe. The second unit at Kudankulam is in an advanced stage of commissioning.

Indian nuclear power plants continue to register records of long continuous runs.

Recently, Narora Atomic Power Station Unit-2 crossed 500 days of uninterrupted operation and is continuing to operate. Till date, the Indian nuclear power reactors have recorded continuous runs exceeding one year on twenty occasions.

Following the completion of construction of the 500 MWe Prototype Fast Breeder Reactor (PFBR) its commissioning is in progress. At present the reactor is gearing up for loading its coolant – sodium.

Construction work is progressing on four indigenous 700 MWe Pressurised Heavy Water Reactors. In addition, 16 reactors of similar capacity are planned to be set up in already identified locations. Plans for further expansion of nuclear power generation capacity through imported LWRs are progressing and techno-commercial negotiations with identified vendors, including localisation of manufacture involving Indian industries, are underway.

Mr. President,

The performance of several Indian fuel cycle facilities continues to reach higher levels every year. At the Nuclear Fuel Complex (NFC) the annual production of nuclear fuel for PHWRs achieved an increase of 30% over the production figures for the previous year. Annual domestic production of uranium also recorded its highest ever figure.

In my Statement to the General Conference last year, I reported on the technology developed for the removal of Caesium-137 and its conversion to vitrified pencil sources for low-dose rate applications. During the current year, we have separated large quantity of Caesium-137 from High Level Liquid Waste (HLLW) using an indigenously developed process, and the first lot of pencils of vitrified Caesium-137 was produced at the Bhabha Atomic Research Centre (BARC) and delivered to the Board of Radiation & Isotope Technology (BRIT) for use in the indigenous blood irradiators. This technology is being used for the first time in the world in commercial domain.

India continues to attach high priority to all aspects of Thorium related reactor and fuel cycle technologies. In
the month of January this year, the newly constructed Power Reactor Thoria Reprocessing Facility (PRTRF) started the reprocessing of thorium oxide fuel bundles irradiated in our PHWRs earlier.

India is hosting the International Thorium Energy Conference (ThEC15) in Mumbai next month.

Mr. President,

Our State-owned General Insurance Corporation-Reinsurer (GIC-Re) and several other Indian insurance companies came together in June 2015 to launch an Indian Nuclear Insurance Pool (INIP). The INIP will initially launch the insurance product for NPCIL to cover the operator’s liability under the provisions of the Civil Liability for Nuclear Damage (CLND) Act 2010. A separate product will be subsequently launched to cover the risks of the suppliers under this Act. This is expected to address liability related concerns of national as well as international suppliers.

Mr. President,

In March this year, the IAEA’s Integrated Regulatory Review Services (IRRS) mission conducted the peer review of the nuclear power related regulatory activities of the Atomic Energy Regulatory Board (AERB). The IRRS team appreciated the AERB’s actions and initiatives taken as a follow-up of the Fukushima accident related reviews, and identified a number of good practices, recommendations and suggestions. We are in the process of implementing those recommendations and suggestions.

India greatly values its association with the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO). India believes that the INPRO methodology provides an important tool for the evaluation of new advanced safety features of the next generation nuclear power plants.

Mr. President,

In the opening session of this Conference, DG, IAEA made an important statement highlighting the role of nuclear in addressing the green house gas emission and associated climate change. Indeed, from this perspective, nuclear power has to be a very prominent component in the global energy-mix to meet the growing energy demands of the world. In order to facilitate assessment of a country specific optimum energy mix, it is, however, important to address the question of system-effects, in particular those arising out of grid-connected variable energy sources, along with mainly base load energy sources such as nuclear. Such system-effects may have an impact on reliability and long term economic viability of such energy systems. The IAEA may consider facilitating the development of a standard methodology to assess the aforementioned system-effects.

Mr. President,

During the last decade, Gamma-Ray Astronomy has emerged as an important tool for understanding the high energy processes in the Universe. India is setting up one of the largest gamma-ray telescopes MACE (Major Atmospheric Cherenkov Experiment) at Hanle, a high altitude (4200m above the sea level) astronomical site in the Ladakh region of North India.

The Indus-2 synchrotron radiation source at Raja Ramanna Centre for Advanced Technology at Indore has been operating round the clock. With the commissioning of a soft X-ray reflectivity beamline, the total number of operational beamlines on Indus-2 has increased to thirteen. As a result, the number of researchers and students using the Indus beamlines has doubled over the past two years.

In the field of fusion science, Steady State Superconducting Tokamak (SST-1), at Institute of Plasma Research (IPR), Gandhinagar, Gujarat, has become operational with repeatable plasma discharges up to ~ 500 ms duration and plasma currents in excess of 60 kA. SST-1 is the only tokamak in the world, where the superconducting Toroidal Field Magnets are operated in two-phase helium demonstrating reduced cold helium consumption.

Mr. President,

Nuclear applications beyond power and associated technologies, in the area of health-care, water, industry and environmental protection continue to expand, delivering important benefits to our society.
India appreciates the Director General of IAEA for choosing the theme of ‘Atoms in Industry: Radiation Technology for Development’ for the Scientific Forum this year. India has a large programme in this area, and has also been the Lead Country in the Industry sector for the IAEA Regional Cooperation Agreement (RCA) Programme for several cycles. In this context, I would like to draw your attention to the exhibition set up by India on our indigenous technological capabilities and contributions in the development of industrial applications. I cordially invite all delegations to visit our exhibition in the Rotunda.

India has been a strong advocate of the IAEA’s Programme of Action for Cancer Therapy (PACT). Tata Memorial Centre (TMC), an autonomous institution under DAE, provides the most appropriate and cost-effective technologies in implementing cancer care programmes, most suitable for developing countries consistent with their infrastructural resources.

Objective staging of cancer is crucial for deciding on effective treatment options. TMC, along with the IAEA and RCA, has developed a smart phone App for Cancer Staging. This TNM (Tumour, Node, Metastasis) App will facilitate harmonised communication approach among the multi-disciplinary team in staging of patients, and in turn, delivering better cancer care to patients. As I speak, the App is being launched in a GC side-event organised by IAEA and the Embassy of India. We thank IAEA for the opportunity given to India to contribute to this important development of high value for all countries.

Mr. President,

As part of implementation of the Arrangement with the IAEA concerning India’s voluntary contribution to the Nuclear Security Fund, the services of an Indian cost-free expert in information security are being provided to the Division of Nuclear Security of the IAEA.

In the same context, and under the auspices of the Global Centre for Nuclear Energy Partnership (GCNEP) initiative, training events were conducted covering the topics on “Natural Circulation Phenomena and Passive Safety Systems in Advanced Water Cooled Reactors”; “Vulnerability Assessment for Nuclear Material Security”; “Information and Computer Security for Nuclear Facilities” and “Physical Protection of Nuclear Material and Nuclear Facilities”.

India continues to actively participate in Regional Cooperation Agreement (RCA) Programmes of IAEA making significant contributions. In the last one year, two RCA-related events were hosted by India, in which 22 IAEA Member state delegates participated. The services of several Indian Scientists and Engineers were made available to the Agency to carry out the expert assignments.

India also continues to participate in a large way in the IAEA’s Co-ordinated Research Programmes (CRP’s). Currently, Indian institutions are engaged in 65 CRPs. India hosted a 6-day IAEA Inter-regional Training Course related to production of Molybdenum-99, and will be hosting two more events in November this year.

India appreciates the efforts of the DG of IAEA in modernising the nuclear applications labs in Seibersdorf and the progress made in the ReNuAL project.

Mr. President,

I have been keeping the General Conference informed about the Indian studies on the health effects of low dose radiation. I wish to update that the Department of Atomic Energy is continuing its extensive studies on the biological and health effects of low dose and low dose rate radiation in the High Level Natural Radiation Areas (HLNRA) of Kerala coast. The findings do not reveal any effect of this high level radiation on human population residing in this area.

Apart from epidemiology, biological studies in human peripheral blood mononuclear cells using end points such as chromosome aberration, micronuclei, telomere length and DNA strand breaks did not show any dose response. Furthermore, and most interestingly, radio-adaptive response studies revealed significant reduction of DNA strand breaks in HLNRA individuals, even with higher challenging doses. Repair kinetics showed fast and efficient repair of DNA strand breaks in HLNRA individuals, as compared to individuals from Normal Level Natural Radiation Areas (NLNRA) suggesting in-vivo adaptation. Global gene expression analysis revealed abundance of differentially expressed DNA damage response and repair genes in HLNRA individuals, in response to chronic low dose radiation exposure.
Further scientific studies on DNA damage and repair at low and high doses are underway using double strand break specific markers. Investigating the role of adaptive response and gene regulation is in progress to delineate the mechanistic effect of low dose radiation, which has important implications for radiation protection science and human health.

I once again suggest that the IAEA should take the lead in this direction, along with other international bodies, by organising scientific discussions to arrive at a consensus on the current state of understanding on the effect of low dose radiation on human health, and identify any residual gap areas that need further research.

Mr. President,

The 59th session of IAEA General Conference is taking place four and half years since the Fukushima -Daiichi nuclear accident. IAEA has commendably brought out its report on the accident describing what went wrong and the lessons one can draw for the future. It is time that we move beyond the shadows of Fukushima and work to harness the true potential of nuclear energy as a credible and affordable energy resource to lead the world to a greener growth path. We count on IAEA’s leadership to realise that vision.

Thank you Mr. President.

Launch of Cancer Staging Smartphone App

A smartphone App for cancer staging has been developed by the International Atomic Energy Agency (IAEA) and the Tata Memorial Centre (TMC), an autonomous institution under the Department of Atomic Energy, Government of India. This smartphone App was launched at an event held in Vienna on September 16, 2015 on the side lines of the IAEA General Conference. The smartphone App was conceptualised and developed by a 3-member medical team of TMC and nuclear medicine physicians at the IAEA, under an IAEA Regional Cooperative Agreement (RCA) Project. The IT development was undertaken by an Indian company.

Cancer is a leading cause of morbidity and mortality worldwide and for fighting the cancer menace, staging of cancer is a crucial approach to understand the extent, location and spread of tumour in the body. Staging helps doctors to develop an objective prognosis and design a correct treatment plan for each individual patient. Decision on use of surgery, chemotherapy or radiotherapy or combination therapy, is based on the staging of the cancer. For this purpose, TNM Cancer Staging is a system developed and updated by American Joint Committee on Cancer (AJCC) and the Union for International Cancer Control (UICC) and published as AJCC TNM staging manual to classify cancers based on the extent of its spread, on a globally recognised scale. The TNM staging system is based on the extent of the Tumour (T), the extent of the lymph Node spread (N) and presence of distance spread – Metastasis (M). The smartphone App for TNM cancer staging launched now will facilitate easy access and use of the manual. The new cancer staging smartphone app will be available for download on iOS, Android and Windows platforms free of cost.

Doctors across the world can make use of this application to assign an appropriate TNM Stage to the disease of their patients. It comes with a unique Interactive Search feature which acts as a stepwise guide for users by providing them with options of possible symptoms that finally lead to deriving the TNM Stage as per established standards. This initiative would be a valuable step in facilitating improvement of quality and uniformity of care for cancer worldwide and is a step towards empowering professionals about objective decision making thus improving the cancer management, which in turn will positively impact the cancer management outcome. The above contribution of TMC is in line with its philosophy of ‘Cancer Care for One and All’, and of its sustained participation in activities that positively impact accessibility, affordability and quality of cancer care. Through this development initiative, the expertise of TMC will bring benefits to cancer patients throughout the world and further strengthen its support to the medical community. India is happy to be a part of the launch of this tool and share its core competencies in the twin fields of cancer care and IT. The
project is also another good example of the fruits of South–South cooperation in the IAEA RCA Member States that will benefit the countries in other regions of the world too. Tata Memorial Centre has been continuously engaged in the development and propagation of cost-effective and efficacious methodologies and tools, as well as networking initiatives, for strengthening cancer management. An important initiative of TMC in this direction has been the National Cancer Grid (NCG) instituted by the Department of Atomic Energy (DAE). The NCG is a network of cancer hospitals across India, which share human and intellectual resources to attain uniform standards of cancer care throughout the country irrespective of the patient's financial and social status. Another important contribution of TMC, along with the Bhabha Atomic Research Centre (BARC), has been the development of indigenous radiotherapy-related equipment, tele-cobalt machine called the Bhabhatron, and the Digital Radiotherapy Simulator called the Imagin. Radiotherapy has been established as an effective and a non-invasive modality of cancer treatment. However, the therapy cannot be availed by several patients due to shortage of equipment and facilities. To improve its accessibility, TMC has installed the equipment at various locations in India and in other countries like Vietnam, Nigeria and Mongolia. TMC is also the Asia hub for the International Agency for Research on Cancer (IARC). As a part of this status, it aids the establishment of cancer registries across Asia. These registries in turn act as points of contact in development and implementation of cancer control in their respective regions. They also provide training and guidance to regional care providers from time to time. So far, the hospital has helped setting up cancer registries in ten countries across Asia. TMC organised periodic training events, consulting activities, and site visits to several countries in the Asia Pacific Region which bear testimony to the commitment of TMC to support cancer care at an international level.

Environment Monitoring around Nuclear Reactors

Today India is self-sufficient in building nuclear power stations and has gained mastery over the entire nuclear fuel cycle. In the course of operation of the various nuclear facilities, the primary safety objective is to protect the plant personnel, the people at large and the environment from radiation. Regular environmental assessment is necessary to ensure this. Measurement of radiation levels and other pollutants constitute the most important constituent of environmental assessment. For this purpose, Environmental Survey Laboratories (ESLs) have been established at each nuclear site to maintain a constant vigil on the environment in and around these facilities. These laboratories collect the base-line environmental data before an activity starts in a new location and thereafter carry out a systematic monitoring of environment for radioactivity levels during operation of the installation and ensure that there is no build up of radioactivity in the environment over and above the pre-operational natural levels.

The primary aim of the environmental monitoring programme is to demonstrate the compliance with the radiation exposure limits set by Atomic Energy Regulatory Board (AERB) for the members of the public. The ESLs collect data on the levels of external radiation dose and concentration of radioactivity due to the natural sources present in the environment. These include monitoring of Uranium, Thorium and their daughter products formed due to their radioactive decay, Potassium (K-40) etc. Radionuclides released into the environment due to weapon tests conducted by several countries over the years (also called global weapon fall-out) are also measured. These include Sr-90 and Cs-137.

The above mentioned radioactivity measurements are carried out in a number of environmental matrices such as air, water, soil, sediment, soil, vegetation, vegetables, milk, grass, crops, fruits, fish, goat thyroid, meat and other dietary items. These samples can be divided into three categories, namely:

1. Samples directly relevant for estimation of dose received by the members of the public such as drinking water, air and local dietary items.
2. Samples which are trend-indicators for build-up of radionuclides such as weeds, sediment, soil, grass etc.
3. Samples which are sensitive indicator organisms that accumulate specific radionuclides to a great extent. For example, goat thyroid is sampled for the detection of low levels of fresh radioactive Iodine-131.

About 1000-2500 samples per year are collected from terrestrial, aquatic and atmospheric environments beyond the exclusion zone (upto 30 km from the plant), as per the requirement of AERB. The samples are selected on the basis of potential pathways of exposure to humans. The number and type of samples and sampling frequency can be site-specific depending on the nature of operations, aspects related to utilisation of the local environment, existence of population clusters and related demographic data.

All the ESLs are equipped with sophisticated nuclear instruments to detect extremely low-levels of radioactivity in the environmental matrices. These instruments include Gamma Spectrometers, Tritium counting units and whole body radioactivity counters. In addition to carrying out radioactivity measurements, the ESLs also carry out assessment of drinking water quality and sewage effluent monitoring as per the requirements of the pollution control board. To ensure the quality of data generated, the ESLs routinely participate in various quality assurance programmes conducted by international bodies such as International Atomic Energy Agency (IAEA). Inter-comparison exercises for measurements pertaining to various instruments are also carried out at the national level.

Experience of extensive environmental monitoring in the vicinity of nuclear power plants for the last several years (as seen in the figure below) has shown that the doses to the members of the public are far below the AERB limit of 1000 mSv/yr and negligible compared to dose received from natural sources which is about 2400 micro Sv/yr. In view of this, no concern from the point of view of health risks to the general public arises.
Radiation Technology developed in BARC for Value Addition to Food & Agro Commodities

Appropriate post-harvest processing, handling, storage and distribution practices are as important as the efforts to increase productivity for sustained food security, food safety and international trade in agricultural commodities. Nuclear energy can play a significant role in the preservation and hygienization of agricultural produce.

Preservation of food by ionizing radiation

Preservation of food by ionizing radiation involves controlled application of energy of ionizing radiation such as gamma rays, X-rays and accelerated electrons to agricultural commodities, food products and ingredients, for improving their storage life, hygiene and safety. The process employs either gamma rays emitted by radioisotopes such as Cobalt-60 or high-energy electrons or X-rays generated from machine sources mentioned below.

<table>
<thead>
<tr>
<th>Radiation</th>
<th>Sources</th>
<th>Energy (MeV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamma</td>
<td>Cobalt-60</td>
<td>1.33, 1.17</td>
</tr>
<tr>
<td></td>
<td>Cesium-137</td>
<td>0.66</td>
</tr>
<tr>
<td>Accelerated Electrons</td>
<td>Electron Accelerators</td>
<td>10 MeV</td>
</tr>
<tr>
<td>X-rays</td>
<td>Electrons Accelerators with X-ray converters</td>
<td>5 MeV</td>
</tr>
</tbody>
</table>

Technological benefits

The applications of radiation technology can be divided into three categories based on applied dose.

<table>
<thead>
<tr>
<th>Low dose applications (&lt;1 kGy)</th>
<th>Medium dose applications (1-10 kGy)</th>
<th>High dose applications (above 10 kGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Inhibition of sprouting in tubers, bulbs or rhizomes</td>
<td>• Elimination of spoilage microbes in fresh fruits, meat and poultry</td>
<td>• Sterilization of food for special requirements</td>
</tr>
<tr>
<td>• Insect disinfestation in stored grain, pulses and products</td>
<td>• Elimination of food pathogens in meat and poultry</td>
<td>• Shelf-stable foods without refrigeration</td>
</tr>
<tr>
<td>• Destruction of parasites in meat and meat products</td>
<td>• Hygienization of spices and herbs</td>
<td></td>
</tr>
</tbody>
</table>

Gray is the unit of radiation absorbed dose = 1 Joule/kg

Major technological benefits that can be achieved by radiation processing of agricultural commodities and food include:

• Disinfestation of insect pests in stored products
• Disinfestation of quarantine pests in fresh produce
• Delay in ripening and senescence in fruits and vegetables
• Inhibition of sprouting in tubers, bulbs and rhizomes
• Destruction of microbes responsible for food spoilage
• Elimination of parasites and pathogens of public health importance in food

Advantages of radiation processing of food:

• Preservation of food by ionizing radiations offers several advantages. These advantages accrue from the high penetration power of the ionizing radiation and the cold nature of the processing.
• Radiation processing is a physical and non-additive process
• It is highly effective and causes minimal changes in food
• The process is safe to workers and eco-friendly
• It leaves no harmful residue on material
• The treatment can be applied to pre-packed commodities
• It is a cold process
• Does not change fresh-like nature and heat-labile aroma constituents of food

Wholesomeness and safety aspects

No other method of food processing has been subjected to such a thorough assessment of safety as the radiation processing. At the energies of gamma rays from Cobalt-60 and those recommended for X-rays and accelerated electrons, no induction of radioactivity is possible in atoms constituting food. The microbiological, nutritional and chemical aspects of radiation-processed foods have been studied in detail around the world. None of these studies have indicated any adverse effects of irradiation on food quality.

International Approval

In 1980, a joint FAO/IAEA/WHO Expert Committee on Food Irradiation (JECDI) reviewed the extensive data on wholesomeness of irradiated foods collected up to that time and concluded that irradiation of any commodity up to an overall dose of 10 kGy presents no toxicological hazards and introduces no special nutritional or microbiological problems. Soon after, in 1983 Codex Alimentarius Commission, a body under FAO that sets standards for food worldwide, approved use of radiation for food processing bringing out Codex General Standard for Irradiated Foods. In 2003 Codex Alimentarius Commission revised its Codex General Standard for Irradiated Foods to include application of doses higher than 10 kGy. In 2003, International Plant Protection Convention (IPPC) included irradiation as a plant quarantine measure. The technology is also endorsed by the World Trade Organization (WTO).

Approval of radiation processing of food in India

In 1991 the Atomic Energy Act was amended and Atomic Energy (Control of Irradiation of Food) rules were notified. In 1994, Government of India amended Prevention of Food Adulteration Act (1954) Rules and approved irradiation of onion, potato and spices for domestic market. Additional items were approved by notifications published in 1998 and 2001.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of food</th>
<th>Dose of Irradiation (kGy)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>1</td>
<td>Onion</td>
<td>0.03</td>
<td>0.09</td>
</tr>
<tr>
<td>2</td>
<td>Potato</td>
<td>0.06</td>
<td>0.15</td>
</tr>
<tr>
<td>3</td>
<td>Shallots (small onion) Garlic, ginger</td>
<td>0.03</td>
<td>0.15</td>
</tr>
<tr>
<td>4</td>
<td>Rice</td>
<td>0.25</td>
<td>1.0</td>
</tr>
<tr>
<td>5</td>
<td>Semolina (Sooji or Rawa), Wheat atta and Maida</td>
<td>0.25</td>
<td>1.0</td>
</tr>
<tr>
<td>6</td>
<td>Pulses</td>
<td>0.25</td>
<td>1.0</td>
</tr>
<tr>
<td>7</td>
<td>Dried sea-food</td>
<td>0.25</td>
<td>1.0</td>
</tr>
<tr>
<td>8</td>
<td>Raisins, figs and dried dates</td>
<td>0.25</td>
<td>0.75</td>
</tr>
<tr>
<td>9</td>
<td>Mango</td>
<td>0.25</td>
<td>0.75</td>
</tr>
<tr>
<td>10</td>
<td>Meat and meat products including chicken</td>
<td>2.5</td>
<td>4.0</td>
</tr>
<tr>
<td>11</td>
<td>Fresh sea-food</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>12</td>
<td>Frozen sea-food</td>
<td>4.0</td>
<td>6.0</td>
</tr>
<tr>
<td>13</td>
<td>Spices</td>
<td>6.0</td>
<td>14.0</td>
</tr>
</tbody>
</table>
In 2004, at the request of BARC, Ministry of Agriculture & Co-operation, Government of India, amended the plant quarantine regulations to include irradiation as a phyto-sanitary treatment. This enabled export of Indian mangoes to USA in 2007.

**Technology Demonstration Units**

In India commercial food irradiation could be carried out in a facility licensed by the Atomic Energy Regulatory Board (AERB). The Department of Atomic Energy has set up two technology demonstration units in India. The Radiation Processing Plant at Vashi, Navi Mumbai, mainly meant for treatment of spices, dry vegetable seasonings like onion flakes and pet foods, is being operated by the Board of Radiation & Isotope Technology (BRIT).

KRUSHAK (Krushi Utpadan Sanrakshan Kendra), Lasalgaon, was set up in 2002 by BARC, to demonstrate low dose applications of radiation such as control of sprouting, insect disinfection and quarantine treatment. KRUSHAK became the first cobalt-60 gamma irradiation facility in the world, outside US to be certified by USDA-APHIS for phyto-sanitary treatment enabling export of mango from India to the US after a gap of 18 years in 2007. Till 2012, around 1000 tons of mangoes have been exported to USA.

**Commercial prospects in India**

In India, radiation processing of food can be undertaken both for export and domestic markets. For export food could be processed for shelf-life extension, hygienization and for overcoming quarantine barriers. Huge quantities of cereals, pulses, their products, fruits and vegetables, seafood and spices are procured, stored and distributed throughout the length and breadth of the country. During storage and distribution, grains worth thousands of crores of rupees are wasted due to insect infestation and related problems. Radiation processing can be used for storage of bulk and consumer packed commodities for retail distribution and stocking.

**Other Technologies Developed by Food Technology Division**

Litchi fruit is relished for its delicious taste, unique aroma and juiciness but its marketing is difficult due to its highly perishable nature, localized cultivation and seasonal availability. The fruit turns brown soon after harvest and spoils due to physiological and microbiological changes. Bhabha Atomic Research Centre, Mumbai has developed a sequential GRAS (Generally Recognized as Safe) chemical dip technology for increasing the shelf life of litchi fruit up to 60 days at 4°C, and maintaining its attractive pinkish-red color.
Winners in World Children’s Winners Games - 2015

World Children’s Winners Games is a unique international event, organized annually since 2010 by the non-profit organization “Gift of Life”. These sports competitions are for children who are cured of childhood cancers. In 2015, 501 children participated in the Games representing 15 different countries.

This year, seven children represented India for the “World Children Winners Games -2015”. This included children who had been cured of diseases like Wilms tumor, rhabdomyosarcoma, acute lymphoblastic leukemia, brain tumor and other cancers. The participation was facilitated by the Gift of Life foundation, MedInd Corporation, IMPACCT foundation of Tata Memorial Centre, Brain Tumour Foundation India and Nike Corp in addition to many individual donors and well wishers. These children enthusiastically practiced for over two months under expert guidance from trained professionals to represent their country in this international event. Dr Tushar Vora, paediatric oncologist at TMH led the team along with one social worker (Ms. Ameeta Bhatia) and a parent/attendant of each child.

Winners games is not just an athletic event. It is a celebration of victory for these children - A victory over the dreaded disease as well as the fear. Having been deprived of freedom of active sports during their long treatments, it was very important for them to feel free and be able to achieve. The Indian Team’s slogan was “MINDS without FEAR”. After having been cured of cancer, these children need to be reintegrated into society and this requires rebuilding of self-confidence. The international platform provided by the World Children’s Winners Games is just such an opportunity.

Adish Jakkani, a 13 year old survivor of childhood acute lymphoblastic leukemia, though a very choosy vegetarian, is full of bubbling enthusiasm and sporting spirit. Defeating his Russian counterpart to win a Silver Medal in the chess competition was the highlight of his journey and a memory he will treasure for life. Sprahish Shukla, though only 7 years old, won two medals in Running and Football and aptly defines these games as a fun and learning experience. His parents say “We can see a visible and palpable difference in Spharish’s attitude post the games. In this short span of time during the games, he has come a far way from being an introverted shy kid to someone with confidence who is not afraid to make friends”. It is this incredible feeling that these games have helped infuse in these children.

“We understand that participation in itself is an achievement worth celebrating. These children are “star kids” and an inspiration for other children battling cancer today”, Dr Rakesh Jalali, Neuro Oncologist at Tata Memorial Hospital & In-charge of the Brain Tumor Foundation India, who were originally invited to send an Indian delegation.

The Indian delegation was supported and encouraged by none other than Sachin Tendulkar – the living legend of Indian Cricket world. Before the children left for the Moscow Games, Mr. Sachin Tendulkar invited them to a one-to-one meet, spent a lot of time with them, discussing strategies and principles of sports. He gave personalized gifts to each child and wished them luck.

The efforts of the team were appreciated by the respected Ambassador of India in Russia – Mr. P.S. Raghavan. He invited the delegation on a tour to the Indian Embassy in Moscow and interacted with children and parents about their experiences. He also gave guidance to the delegation on how to improve upon the joint venture.
All the goodwill and blessings for these children helped them bag a total of 10 medals (3 Gold, 4 Silver and 3 Bronze). But as Dr. Jalali has eloquently said – “the participation in such an international event in itself is a prize that each child will savor for life.”

**The list of participants of Team India are as follows**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Age</th>
<th>Disease cured of</th>
<th>Games Participated</th>
<th>Medals won</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Priyanka Zala</td>
<td>8</td>
<td>Anaplastic Ependymoma</td>
<td>Football, Running</td>
<td>Gold - Football</td>
</tr>
<tr>
<td>2</td>
<td>Sprahish Shukla</td>
<td>7</td>
<td>Acute Lymphoblastic Leukemia</td>
<td>Football, Running, Chess</td>
<td>Silver - Running Bronze - Football</td>
</tr>
<tr>
<td>3</td>
<td>Swastik Guru</td>
<td>12</td>
<td>Rhabdomyosarcoma</td>
<td>Football, Running, Chess</td>
<td>Bronze - Football</td>
</tr>
<tr>
<td>4</td>
<td>Adhish Jakkani</td>
<td>13</td>
<td>Acute Lymphoblastic Leukemia</td>
<td>Running, Football, Chess, Rifle Shooting</td>
<td>Silver - Chess</td>
</tr>
<tr>
<td>5</td>
<td>Gujan Jotkar</td>
<td>14</td>
<td>Wilms tumor</td>
<td>Running, Football, Rifle Shooting</td>
<td>Gold - Running Silver - Football</td>
</tr>
<tr>
<td>6</td>
<td>Mansi Mehra</td>
<td>15</td>
<td>Acute Lymphoblastic Leukemia</td>
<td>Running, Chess, Football, Rifle Shooting</td>
<td>Gold - Chess Silver - Football</td>
</tr>
<tr>
<td>7</td>
<td>Tapjoyoti Sarkar</td>
<td>15</td>
<td>Chronic Myeloid Leukemia</td>
<td>Running, Swimming, Football, Table Tennis</td>
<td>Bronze - Football</td>
</tr>
</tbody>
</table>

(Contributed by Dr Tushar Vora and Dr Rakesh Jalali, Tata Memorial Hospital, India.)
Hon’ble Prime Minister Shri. Narendra Modi during his visit to National Cancer Centre of Mongolia while gifting of Bhabhatron - II Tele-therapy equipment.
PUBLIC AWARENESS ACTIVITIES

The 19th National Exhibition with the theme, “Make in India – Our Commitment to the Nation” was held at Netaji Maidan, Baranagar, Kolkata, West Bengal during September 9 - 13, 2015. DAE participated in this event and exhibited all the peaceful uses of atomic energy. Variable Energy Cyclotron Centre, Kolkata also participated and exhibited their R&D activities.

“Indian Technology Congress 2015”, a two day exhibition with focal theme “Transforming India as a Global Engineering & Technology Hub – Prospects and Pathways” was organised at NIMHANS Convention Centre, Bangaluru during July 29-30, 2015. Heavy Water Board put up an exhibition on its technologies and products developed and its role towards societal development. Members of the general public, students at the college level benefited from this event.

National Association for Application of Radioisotopes and Radiation in Industry (NAARRI) organised a two day seminar on “Applications of Radioisotopes and Radiation Technology in Agriculture, Industry & Healthcare” at AISECT University, Bhopal during July 3 – 4, 2015. DAE put up an exhibition on relevant activities.

Department of Atomic Energy participated in the “11th Food & Technology Expo & Concurrent Show – Government Achievement & Schemes Expo 2015” at New Delhi during July 29 – 31, 2015. The main focus was Application of Radiation & Isotopes in Healthcare and Gamma Radiation Processing Services. DAE exhibited its activities in the area of agriculture and food processing. Experts from BARC were also present for interaction with the public that comprised mainly farmers, agriculturists and businessmen.

The University of Mysore (in its centenary year) and the INS, Mysore chapter jointly organised a seminar on “Benefits of Nuclear and Material Sciences in day to day life” at Mysore during August 21 – 22, 2015. DAE put up an exhibition on its contributions towards nuclear power, applications of radioisotopes, water, hydrology, advanced technologies etc.

DAE took part in a National Conference on Analytical Science and Technology that was held at Munnar, Kerala during September 24 – 26, 2015. The theme of the conference was “Analytical Science for Technological Innovations and Environmental Sustainability”.
