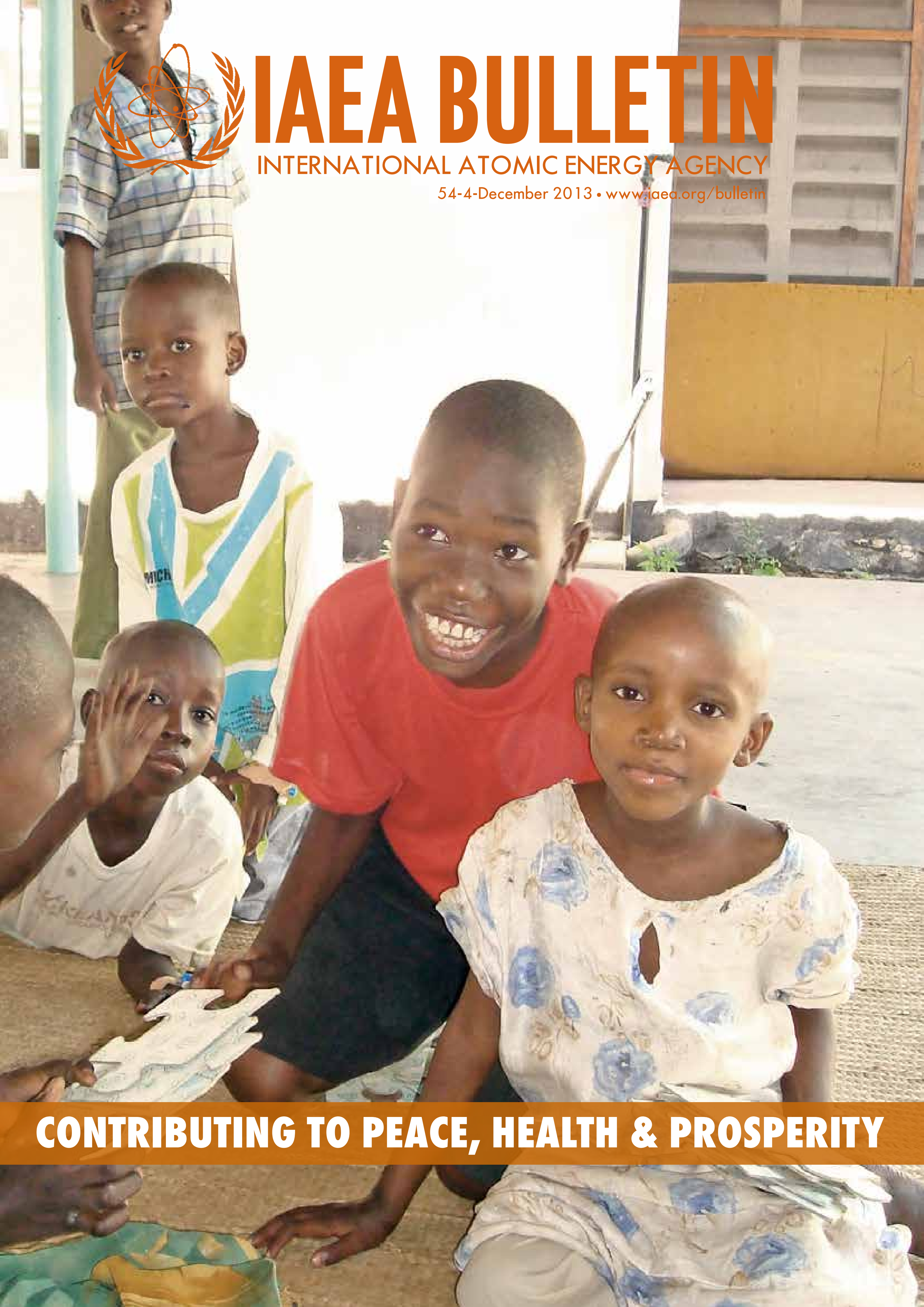
IAEA BULLETIN

INTERNATIONAL ATOMIC ENERGY AGENCY

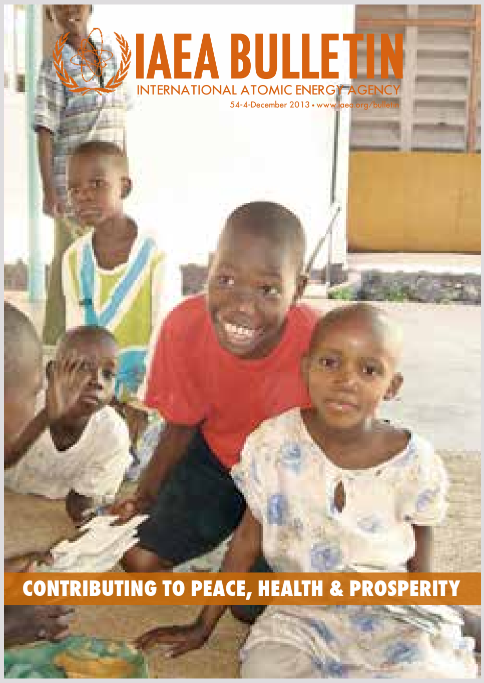
54-4-December 2013 • www.iaea.org/bulletin



CONTRIBUTING TO PEACE, HEALTH & PROSPERITY

CONTENTS

IAEA Bulletin 54-4-December 2013



IAEA BULLETIN
is produced by the
Division of Public Information
International Atomic Energy Agency
PO Box 100, 1400 Vienna, Austria
Phone: (43-1) 2600-21270
Fax: (43-1) 2600-29610
iaeabulletin@iaea.org

Editor-in-Chief: Peter Kaiser
Editor: Aabha Dixit
Design & Production: Ritu Kenn

IAEA BULLETIN is available
› online at **www.iaea.org/bulletin**
› as an App at **www.iaea.org/bulletinapp**

Cover Photo:
Paediatric patients in an oncology ward of a hospital in eastern Africa.
(Photo: E. Rosenblatt, IAEA)

CONTRIBUTING TO PEACE, HEALTH & PROSPERITY

This issue of the IAEA Bulletin edition considers the ideas and innovations that led to the IAEA's formation and influenced its evolution.

December 8 2013 is the 60th anniversary of President Eisenhower's historic Atoms for Peace speech to the United Nations General Assembly. He called for the establishment of an international atomic energy agency to put nuclear material to use to "serve the peaceful pursuits of mankind."

The world has changed enormously, but the Atoms for Peace mission has lost none of its relevance.

Four years later, in 1957, the IAEA began work in Vienna. Since then, the IAEA has worked hard to bring the benefits of peaceful nuclear technology to all parts of the globe and to prevent the spread of nuclear weapons. The world has changed enormously in that time. But the Atoms for Peace mission has lost none of its relevance. The IAEA has successfully adapted to changing times and the evolving needs of Member States.

In this issue of the IAEA Bulletin, you will learn more about how countries use nuclear technology to improve health and prosperity and protect the environment through the technical cooperation programme. Together, the Member States and the IAEA are making a lasting contribution to achieving the Millennium Development Goals that challenge us to significantly reduce hunger, poverty and disease.

To take one example: cancer is reaching epidemic proportions in developing countries, but many countries lack the resources to deal with it. The IAEA, together with the World Health Organisation, is helping to make radiotherapy, medical physics, nuclear medicine, and imaging services available to developing countries. Our Programme of Action for Cancer Therapy (PACT) has been recognized by Member States as a flagship IAEA programme.

The IAEA also helps to improve food security and to manage precious water resources in areas suffering from drought. Through its energy planning services, the IAEA helps countries to assess their current and future energy needs.

Civil nuclear power is also marking its 60th anniversary: the first such plant became operational in Obninsk, in what was then the Soviet Union and is today the Russian Federation, on 26 June 1954. This innovation has been followed by decades of continuing development to provide safe, low-carbon, baseload power and other applications.

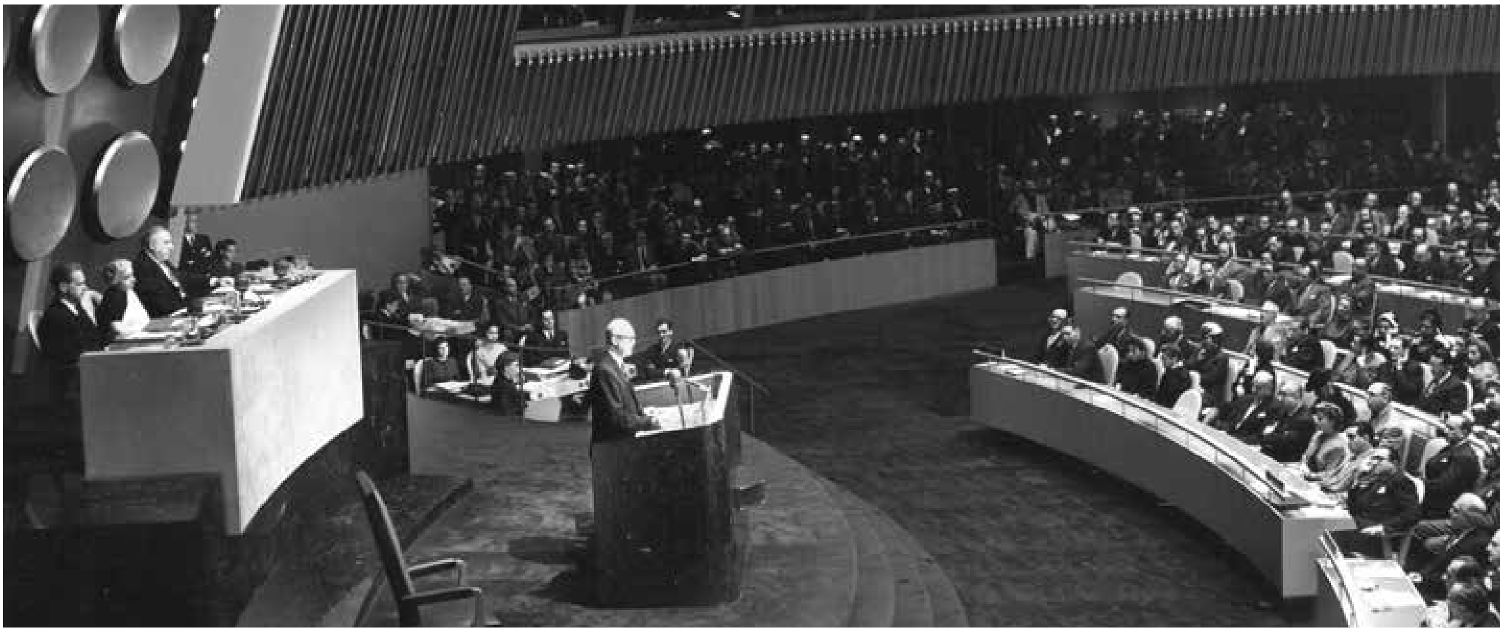
Nuclear safety is a never ending pursuit for improvement. In this year, the Agency marked the 30th anniversary of the Operational Safety Review Team (OSART) programme, through which the IAEA coordinates internationally-based teams of experts who conduct reviews of operational safety performance at nuclear power plants.

The IAEA looks forward to continuing to support its 160 Member States in the peaceful use of nuclear technology in the coming decades.

Yukiya Amano, IAEA Director General

EISENHOWER'S ATOMS FOR PEACE

The Speech that Inspired the Creation of the IAEA



President Eisenhower gives his famous Atoms for Peace Speech to the United Nations General Assembly (8 December 1953). (Photo: UN)

Sixty years ago, on 8 December 1953, US President Eisenhower delivered his historic "Atoms for Peace" address to the United Nations General Assembly in New York. The Cold War and the nuclear arms race were the background for the President's speech. However, instead of solely focusing on the perils of atomic war, Eisenhower lauded the civilian nuclear applications in agriculture, medicine, and power generation. He proposed the establishment of an "international atomic energy agency" that would promote the peaceful uses of nuclear energy "for the benefit of all mankind."

In October 1957, Eisenhower's vision became reality. From today's perspective, it is striking that during a tense period of the Cold War international agreement on nuclear matters was reached within only four years.

The Genesis of Eisenhower's Speech

When President Eisenhower decided in 1953 to deliver a major speech on nuclear issues, he initially planned to talk about nuclear fears rather than about nuclear hopes. The speech's original concept traced back to the report of the "Oppenheimer Panel", a committee formed by Eisenhower's predecessor, Harry S. Truman, and named after its most distinguished member, Robert Oppenheimer. In view of the nuclear arms race, the panel recommended that the American public receive a fuller picture of the threat and about national defence plans. The proposal resulted in a public information campaign, "Operation Candor," that foresaw a major presidential speech.

However, during the several months of drafting, the speech's emphasis slowly changed from the initial idea of "candor" to the later "Atoms for Peace" concept. As historian Ira Chernus explains, "the focus shifted steadily away from the American-Soviet rivalry to this new perspective of humanity versus weaponry."* The specific proposal to establish an International Atomic Energy Agency appeared late in the drafting phase and was Eisenhower's own initiative.

Eisenhower specifically addressed the developing countries. Nuclear energy was presented as a means to advance progress and welfare throughout the world.

While the President's proposal met approval and scepticism alike, his speech laid the foundation for an international nuclear order that still shapes our world today.

Difficult Beginnings: the Early Negotiations

In his speech, Eisenhower expressed his desire to open a new channel for peaceful

---

Ira Chernus, Eisenhower's Atoms for Peace (Texas A&M University Press: College Station, 2002).

discussion between the superpowers and called for the Soviet Union's involvement in the establishment of the new atomic energy organization. To underline the earnestness of this aim, Charles E. Bohlen, the American Ambassador to Moscow, briefed Foreign Minister Vyacheslav Molotov about the President's UN speech a day in advance.

In the months following the speech, the two governments exchanged views on the Agency's creation on a bilateral basis. But the Soviet Union initially remained sceptical vis-à-vis the American proposal. The United States pursued discussions on the IAEA's creation with Canada and the United Kingdom as well as Australia, Belgium, France, Portugal, and South Africa. During the discussion, a first draft of the new agency's statute was produced, using Eisenhower's Atoms for Peace speech as a guideline.

A Global Endeavour: the Group of Negotiators Expands

Although the actual negotiations did not take place within a United Nations framework, the UN General Assembly of 1954 welcomed and endorsed the work of the negotiating states. It also called for an international conference on the peaceful uses of nuclear energy. In August 1955, this conference took place at the United Nations Headquarters in Geneva, the largest meeting of scientists the world had seen to that date. For the first time after the end of the Second World War the veil of nuclear secrecy was partially lifted and physicists from East and West began to re-establish scientific exchange.

After the conference, the IAEA negotiating group expanded to include Brazil, Czechoslovakia, India, and the Soviet Union. With the exception of Czechoslovakia, scientists from these countries had already been members of the Geneva Conference's organizational committee. In early 1956, the twelve-nation group met in Washington, DC to revise the draft of the agency's statute. The other UN member states had been given the opportunity to send their comments.

As archival evidence tells us, an outstanding feature of the meetings was the atmosphere of cooperation. In fact, the meetings foreshadowed much of the "spirit of Vienna," which later became proverbial. In October 1956, the twelve-nation group presented the draft statute to 82 nations at a conference at the United Nations Headquarters in New York. As American delegate James J. Wadsworth recalled, it was "the largest international gathering in history up to that time." *

The Conference of the Statute ended on 26 October 1956 and the statute was opened for signature. A Preparatory Commission took up its work to arrange the first general conference of the new organization. On 29 July 1957, the statute came into force.

Vienna Becomes "the World's Centre of the Atom"

The negotiations also dealt with the site of the IAEA's headquarters. Suggested locations included, amongst others, Copenhagen, New York, Rio de Janeiro, Stockholm, and Vienna. Given the prevailing Cold War tensions, the suggestion to host the IAEA in a neutral state found support from several states. The Austrian government was thrilled by the suggestion to establish the new organization in Vienna. The country regained its independence in 1955, after ten years of four-power occupation. Eisenhower's Atoms for Peace speech had referred to Austria as a crucial example for Cold War conflicts. In the eyes of the Austrian government, to host an important international organization could provide opportunities to find a new role in international relations. One of the early supporters of an Austrian location was also India, whose prominent nuclear physicist Homi Bhabha admired the city's cultural and musical life.

In October 1957, the first IAEA General Conference took place in Vienna, and the city was chosen as the location of the new organization's permanent headquarters. When the first IAEA General Conference convened, the renowned Austrian journalist Hugo Portisch declared that Vienna had become "the world's centre of the atom."** With the IAEA's establishment, the way was paved for Vienna's role as a centre of international organizations.

Elisabeth Röhrlich, Department of Contemporary History, University of Vienna.

*James J. Wadsworth, "Modern Diplomacy: Atoms for Peace," in John G. Stoessinger and Alan F. Westin, eds., Power and Order: 6 Cases in World Politics (New York: Harcourt, Brace & World, Inc. 1964), pp. 33-65, here: p. 48.

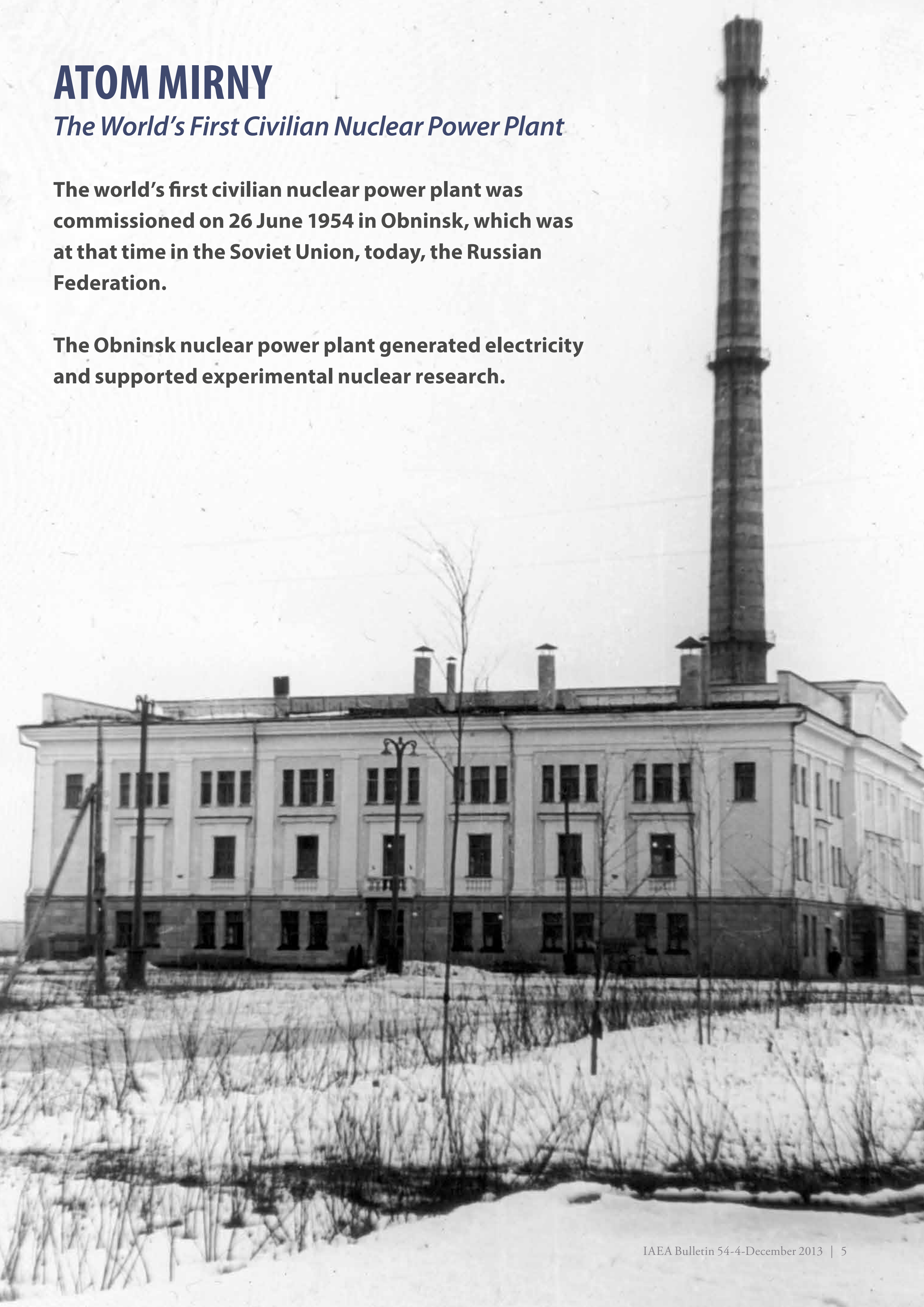
**Hugo Portisch, "In den Mauern unserer Stadt," *Kurier*, 1.10.1957.

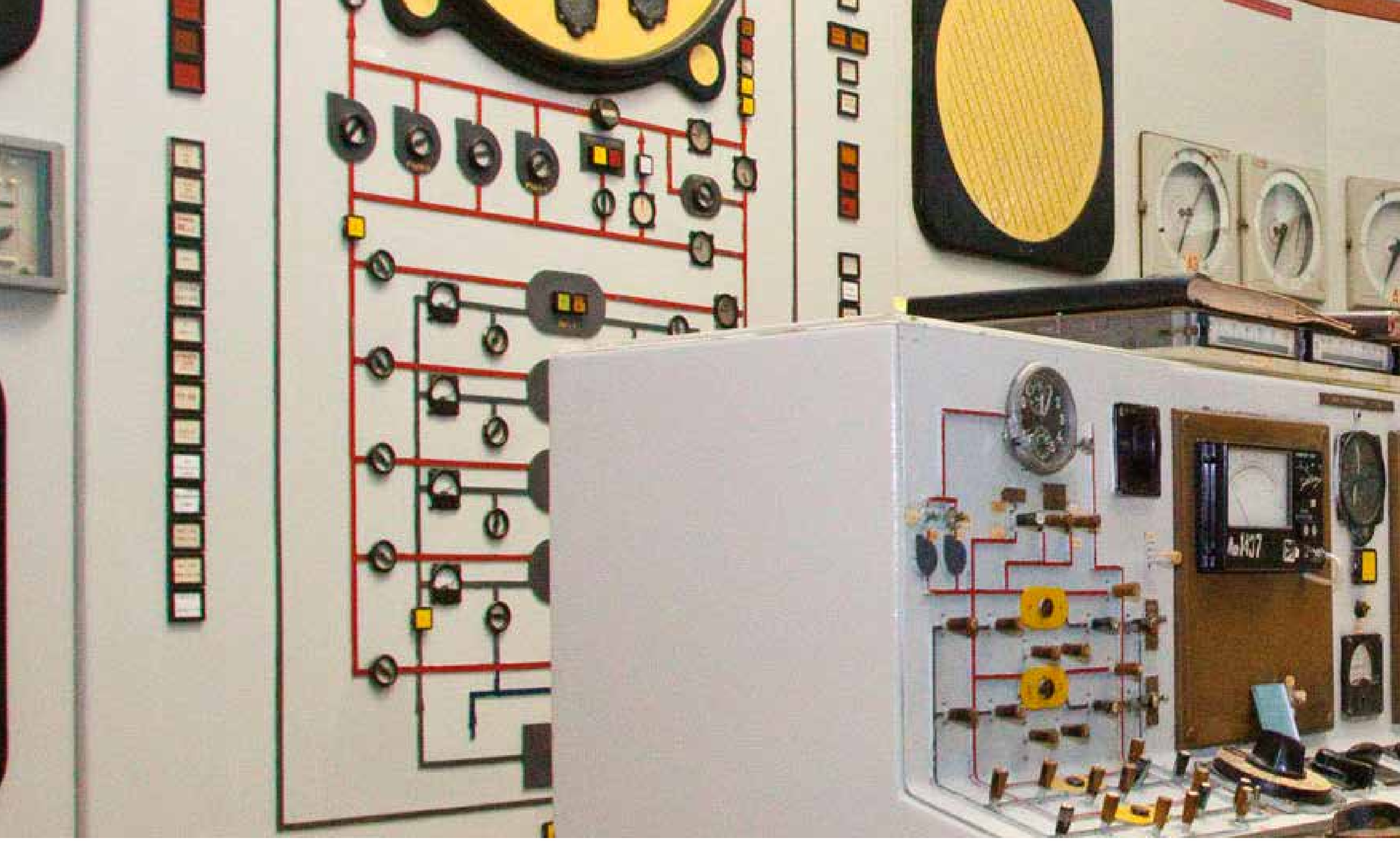
ATOM MIRNY

The World's First Civilian Nuclear Power Plant

The world's first civilian nuclear power plant was commissioned on 26 June 1954 in Obninsk, which was at that time in the Soviet Union, today, the Russian Federation.

The Obninsk nuclear power plant generated electricity and supported experimental nuclear research.





The name AM-1 is derived from the Russian phrase Атом Мирный , pronounced 'Atom Mirny'or 'Peaceful Atom'. Its reactor, which was controlled from the main control room, had a net capacity of 5 MW. In this photo, the operator is monitoring the status of the 18 fuel rods.

A celebrity in itself, the world's first civilian nuclear power plant at Obninsk received many eminent visitors, such as the cosmonaut, Yuri Alekseyevich Gagarin (left), who piloted the Vostok 1 on the world's first space flight in 1961.

The Obninsk nuclear power plant operated without incident for 48 years. In September 2002, the last fuel subassembly was unloaded, when the Obninsk nuclear power plant set another first: it became the first nuclear power plant to be decommissioned in Russia.

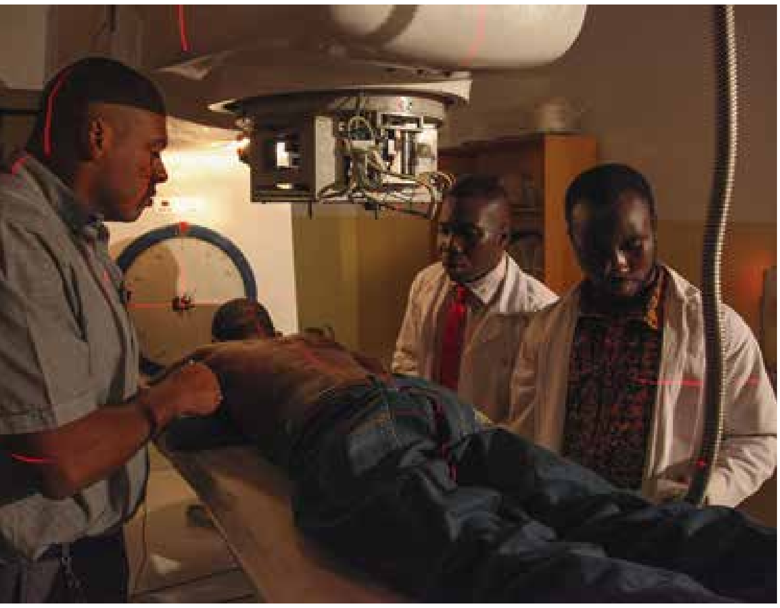
Text: Peter Kaiser & Michael Madsen, IAEA Division of Public Information; Photos: Federal State Unitary Enterprise
"State Scientific Centre of the Russian Federation – Institute for Physics and Power Engineering named after A. I. Leypunsky"

SMALL STEPS, B
THE IAEA HELPS MEMBE

1 'Unless we take urgent action, by 2030 over 13 million people will die from cancer every year. The majority of these deaths will occur in developing countries.'

— IAEA Director General Yukiya Amano

2 Over 50% of cancer patients need radiotherapy during the course of their treatment. Sadly, in the developing world, only 20% of patients who need radiotherapy have access. One radiotherapy machine can treat about 500 cancer patients every year.



3 In 2009 the IAEA challenged manufacturers to make radiotherapy more affordable by creating machines less susceptible to heat and fluctuating electricity supply. The Advisory Group on increasing Access to Radiotherapy Technology in developing countries (AGaRT) was formed to realize this goal.

4 With Africa's shortage of trained medical personnel in cancer control, the IAEA and its international partners developed the distance learning programmes – the Virtual University for Cancer Control and Regional Training Network (VUCCnet).

BIG DIFFERENCE
ER STATES FIGHT CANCER

5 VUCCnet also promotes the establishment of cancer control workforce training hubs in Africa to encourage the harmonization of regional policies regarding health care credentials.

6 Fighting cancer requires more than greater access to radiotherapy, and much more than the IAEA's efforts. It requires collaboration among local and international organisations, governments and NGOs to ensure that radiotherapy is integrated into a sustainable and effective cancer control system.

7 The IAEA's Programme of Action for Cancer Therapy (PACT) offers comprehensive assessments of Member States' cancer control capacities and needs, identifying strengths and weaknesses. Since these imPACT reviews began in 2005, 55 countries have been assessed.

8 Countries that meld good cancer control strategy, adequate funding and multi-sector collaboration are known as PACT Model Demonstration Sites (PMDS). The IAEA helps these eight countries (Albania, Ghana, Mongolia, Nicaragua, Sri Lanka, Tanzania, Vietnam, Yemen) find funding, and design, implement and evaluate national cancer control plans.

Text: Sasha Henriques / IAEA Division of Public Information; Photos: IAEA/PACT

IMAGING AND DIAGNOSIS

Using Imaging to Fight the World's Biggest Killers

Modern medicine has developed techniques and cures for many of humanity's ailments, treatments that often require early detection or frequent observations. Some of the most revolutionary advances in improving diagnosis and observation of diseases have been through the use of imaging. Radioisotope imaging techniques like SPECT, PET/CT and conventional imaging such as MRI and CT are instrumental in fighting modern diseases like cardiovascular disease and cancer, and the IAEA plays an important role in helping its Member States acquire the skills and resources for implementing these technologies.

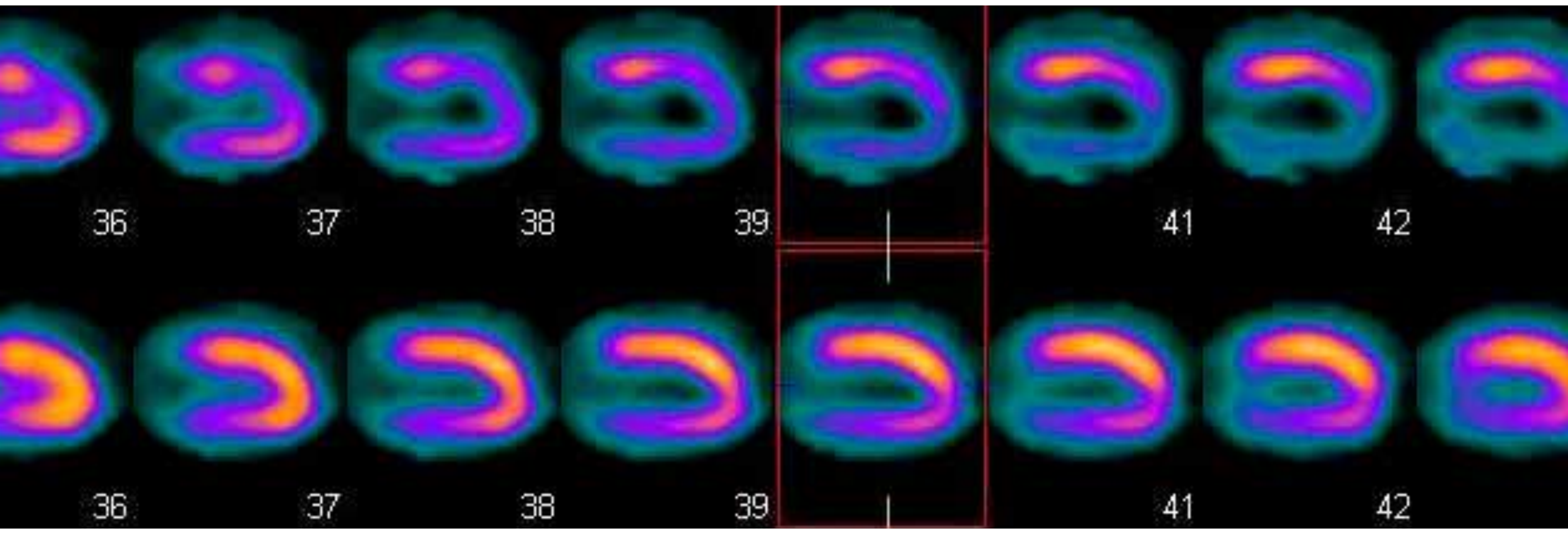
Looking at Hearts

Cardiovascular disease is the single biggest cause of death in the world. The World Health Organization has estimated that as much as 30% of all deaths in the world are due to cardiovascular disease, equating to 17.3 million deaths. Over 80% of these deaths occur in low and middle income countries, with the highest rates being in Africa and Asia. Some of the best and most precise ways of looking at the heart and evaluating its health is with nuclear imaging techniques. The IAEA works with partner organizations to help its member states train medical practitioners and enhance diagnostic capabilities; technical cooperation projects, coordinated research activities, online and on-site training courses all aim at achieving this goal.

Single photon emission computer tomography, or SPECT, is an imaging technique that generates several image 'slices' of an organ (for example, the heart, as in the photo below) by detection of gamma rays emitted by a radioactive substance given to the patient. In the photo below, a patient underwent a myocardial perfusion imaging (MPI) study during treadmill exercise and at resting condition. The upper row of SPECT images demonstrates diminished blood flow to a large area of the heart during exercise, seen as a decrease in colour intensity in comparison with the set of resting SPECT images, seen immediately below. This is a serious condition which can lead to heart infarction due to clogged arteries by fatty substances, such as cholesterol. Lifestyle choices such as high cholesterol diet, smoking, alcohol consumption and lack of physical activity can increase the chance of a heart infarction.

Curing Cancer

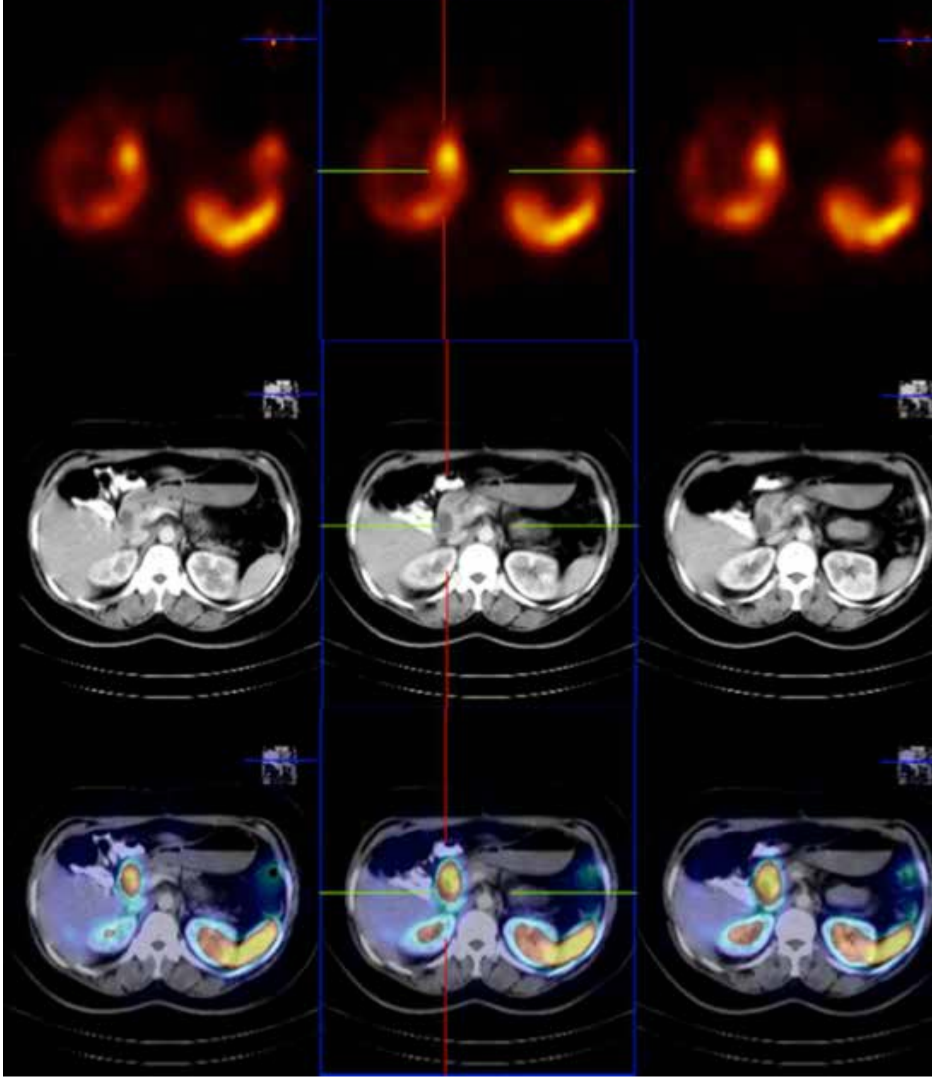
Killing 7.6 million people every year, cancer is a major cause of death worldwide. Cancer has the potential to occur in almost any part of the body and can affect people of all age groups or backgrounds. 70% of cancer deaths occur in low and middle income countries and it is estimated that 30% of cancer deaths could be prevented. The resources and tools the IAEA makes available in helping with cardiovascular diseases also play a key role in the global fight against cancer. IAEA experts help Member



States use nuclear medicine imaging to provide with a comprehensive, safe and complete set of tools and resources to save lives.

Doctors can use software to combine together images from different sources to make a composite image (fusion image) showing what is happening inside a patient. In the figure on the right, the top row of images corresponds to a set of SPECT images, demonstrating a focal area of abnormal increased radiotracer activity close to the midline and deep in the abdomen. However, it is only after obtaining the fusion with a corresponding set of X ray computed tomography (CT) images (middle row), that it is clearly realized the abnormal focal activity in the SPECT images, corresponds to a true lesion immediately adjacent to the small bowel (lower row of images). This additional piece of information not only increases the certainty of the diagnosis but also helps determine the next best course of action. Utilizing multiple imaging techniques medical practitioners are able to better diagnose and cure cancer.

By Michael Madsen, IAEA Division of Public Information



DOSIMETRY* – A SCIENCE THAT HELPS MAKE RADIATION APPLICATIONS SAFE

As the saying goes 'the dose makes the poison' and it is most apt when applied to radiotherapy. The IAEA's dosimetry and medical radiation physics experts work to insure that radiation applied in medicine is safe and effective.

› Radiation is one of medicine's most effective weapons to fight cancer, used in a process called radiotherapy. Doctors use a radiation emitting source to generate a radiation beam that can be precisely targeted to destroy a cancerous growth. Low doses of radiation are ineffective at killing cancer cells, while an overdose damages healthy cells and can cause severe recovery problems for a patient. Precision is essential. Doses that vary outside a strict range pose a risk to a patient's health.

› Dosimetry is the measurement and calculation of radiation dosages.

› The radiation beam is 'calibrated' to make sure that the dosage of radiation delivered through radiotherapy is exact. The IAEA has developed the international Code of Practice for absorbed dose determination, providing control measures that guarantee correct and safe operation of medical radiation treatment machines.

› A variety of instruments are used for absorbed dose measurements, all of which rely on detecting the physical and chemical changes caused by radiation.

› The IAEA's Dosimetry Laboratory is a Secondary Standards Laboratory, whose instruments are directly calibrated with those of the International Bureau of Weights and Measures (BIPM) and Primary Standard Dosimetry Laboratories, and in turn is used to calibrate instruments for its Member States.

› Dosimetry is not only required in radiotherapy cancer treatment, but also in clinical diagnostic radiology, radiation protection of people and the environment, and in industrial applications like food irradiation and sterilization.

By Michael Madsen, IAEA Division of Public Information

*www-naweb.iaea.org/nahu/DMRP/faq/index.html

A TOAST TO G
IAEA PROMOTES NUCLEAR TECHNIQU

1 A person's nutrition during their first two years has a profound impact on their health and mental acuity for the rest of their lives.

2 Therefore, the IAEA and its Member States take the issue of early life nutrition, and breastfeeding in particular, very seriously; working together to study nutrition's role in development and long-term health.

3 The success of national exclusive breastfeeding programmes can be evaluated with nuclear and isotopic techniques.

4 These techniques also assess whether children are growing as they should, and evaluate how their bodies absorb vital micronutrients like iron and zinc from the food they eat.

OOD HEALTH
UES TO IMPROVE NATIONAL NUTRITION

5 Also, nuclear techniques can assess muscle wasting, measure bone strength, and assess the level of physical activity in older people. In this photo, a very active 80-year-old, Habiba Aguenaou, prepares a traditional Moroccan meal.

6 Nuclear techniques make it possible to conveniently evaluate and monitor people's health and nutritional status. Causing little or no disruption to people's daily lives is ideal for researchers and participants.

7 The IAEA promotes the use of nuclear techniques to help Member States achieve the Millennium Development Goals (MDGs) by training scientists, providing experts, and helping to fund the purchase of essential equipment.

8 The Agency focuses its nutrition efforts on MDG 4 reduce child mortality, MDG 5 improve maternal health, MDG 6 combat HIV/AIDS malaria and other diseases, and MDG 8 global partnership for development.

Text: Sasha Henriques; Photos: Dean Calma, Sasha Henriques / IAEA Division of Public Information;
Eleanor Cody/IAEA Department of Technical Cooperation; Urmila Deshmukh

ISOTOPE HYDROLOGY: UNDERSTANDIN

1 Development is intricately linked to water whether concerning issues of health, food and agriculture, sanitation, the environment, industry, or energy. The IAEA, through its Water Resources Programme provides its Member States with science-based information and technical skills to improve understanding and management of their water resources.

2 Water consists of hydrogen and oxygen isotopes, distributed throughout the hydrological cycle. Each water drop's journey causes small, important and measurable changes in the relative abundance of the different isotopes. Water in different environments develops characteristic isotopic 'fingerprints' that allow it to be distinctly identified. It is possible to trace the source of the water or estimate its age in the hydrological system.

3 Isotope techniques can determine the origin, age and renewal rate of groundwater, and whether it is at risk of contamination. It allows rapid and reliable mapping of non-renewable groundwater resources, the majority of which are trans-boundary aquifers. Isotopes like Krypton-81 are used for dating deep and very old groundwater aquifers.

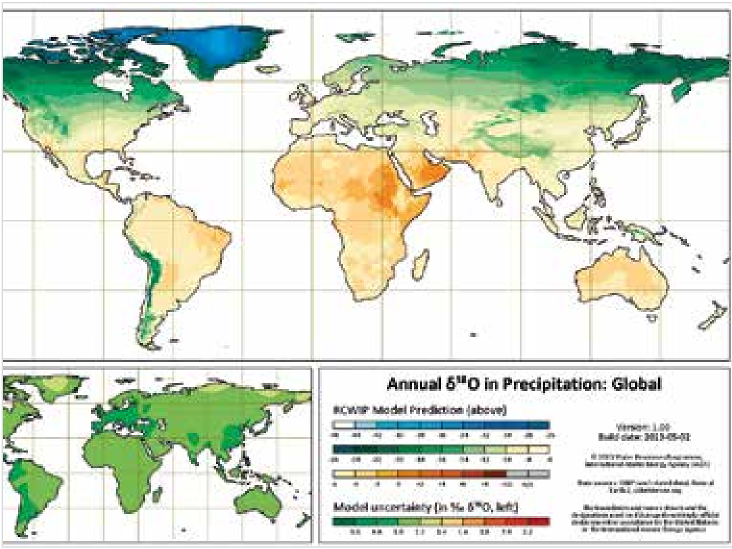
4 Isotopic techniques help understand surface water movement and inter-action with groundwater, dam leakages, and the impact of climate change on water resources development and management. Pictured is a sampling device for measuring noble gases and isotopes in groundwater.

IG AND MANAGING WATER RESOURCES

5 One of the ways scientists conduct carbon isotopic assays in water, rocks, CO_2 and dissolved carbon is through laser absorption spectrometry (LAS). As its name implies, LAS uses lasers to determine the types and concentration of isotopes it has by measuring the way it interacts with a test subject.

6 The process of taking LAS measurements of water stable isotopes is made more efficient through the use of an auto-sampler. Automating processes not only save time and effort for the scientists, but also insures greater consistency in procedure for a very sensitive technique.

7 The IAEA offers its Member States training courses in LAS for water sampling.



8 Gathered results from regions around the world are eventually compiled and turned into a global model, in this case derived from oxygen-18 data. These large predictive models reveal the patterns of global precipitation, giving greater insight for decision makers and are an invaluable tool for water management.

Text: Michael Madsen, IAEA Division of Public Information; Photos: Isotope Hydrology Section, IAEA

WATER FOR A T

1 The Sahel region stretches across the African continent between the Atlantic Ocean and the Red Sea. It is a band of land covering an area of 3 million km^2 that serves as a buffer zone between the Sahara desert to the north and the Sudanian Savanna to the south. The shaded area in the map gives an approximation of the scope and breadth of this region. Home to more than 50 million people, the Sahel is one of the poorest regions of the world. Among the challenges its people face are water scarcity and food shortages.

2 Worldwide climatic disturbances have had a deep impact on available water supply in the Sahel region. Over recent years, the transitional semi-arid eco-region has faced major and persistent challenges, including adverse climate change effects, irregular rainfall patterns, and recurrent droughts that have resulted in reduced harvests. Groundwater is the main source of water for many people in the Sahel region. Groundwater abstraction from aquifers is increasing, but is not adequately regulated. As a result, water resources are overexploited, and are declining in quantity and quality.

3 With limited potable surface water, Sahel countries tap into the groundwater of one of the five aquifers in the region: the Iullemeden Aquifer System, the Liptako-Gourma-Upper Volta System, the Senegalo-Mauritanian Basin, the Chad Basin and the Taoudeni Basin. These underground water resources cross national borders and are shared by thirteen IAEA African Member States: Algeria, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal and Togo.

THIRSTY SAHEL

4 In Africa, when you talk water, you're talking about want or plenty. A single, productive borehole can make all the difference between a living and dying village. This remote village in Ghana is now all but empty because only salty water was coming out of this borehole. The lack of a readily available supply of potable water eventually forced most of the residents to abandon the village and relocate closer to a reliable water source.

5 Limited understanding of how aquifers function and the absence of guidelines or standards for groundwater use in most Sahel countries can lead to the overuse, pollution and degradation of groundwater resources. Also, insufficient understanding can lead to boreholes being dug and then immediately abandoned because the supply of water is insufficient, as in this picture.

6 In the Sahel, fetching water is traditionally a task for women and young children, and women may walk miles to the nearest supply of potable water. Population in the region is expected to double by 2020. As more and more people tap into underground aquifers for their main source of potable water, disturbing questions arise: how much groundwater is available in these aquifers? Can they be relied upon to supply the Sahel region in the future?

7 In 2012, the IAEA launched a large scale, four-year, technical cooperation project to promote the integrated management and development of shared groundwater resources in the Sahel region. The project supports the use of isotope techniques in hydrological studies to map underground water, and to identify and understand the root causes of the main threats to the five transboundary aquifers. Isotope hydrology techniques can also provide useful information about the quality and availability of water hidden underground, and can be used to investigate the impact of climate change on water resources.

8 By tracking the isotopes in water, scientists can obtain valuable information rapidly and cost-effectively, leading to a better understanding of water resource systems. This isotope data can be used to support the formulation of improved water management strategies and climate change adaptation policies to help countries meet their current and future water demands sustainably.

9 As the demand for limited water resources grows, the transboundary management issues related to shared aquifers become more pressing. The Sahel countries recognize the importance of setting up the technical, legal and institutional frameworks necessary to manage their shared water resources in a cooperative and integrated manner.

10 Through its technical cooperation programme, the IAEA is now helping 13 African countries in the Sahel to use isotopes to monitor and assess aquifer characteristics, in order to better understand how transboundary groundwater systems work; how much water can be extracted by each country without tapping the water reserves of another; and what impact human activities have on the aquifers. This information is essential for the development of effective regional water management programmes.

11 Scientists at Ghana's Atomic Energy Agency have set up components of a tritium laboratory with the support of the IAEA's technical cooperation programme. Ghana is one of several countries in the region that have acquired modern analytical equipment through the Sahel project. Technicians are being trained, and it is expected that the laboratories will play a pivotal role in data analysis within the region.

12 Mapping and understanding priceless water resources will help to ensure that countries in the Sahel region can develop long-term strategies for allocating and managing fresh water in an equitable, sustainable manner.

Text: Rodolfo Quevenco, IAEA Division of Public Information
Photos: (unless otherwise credited) Dean Calma and Rodolfo Quevenco, IAEA Division of Public Information

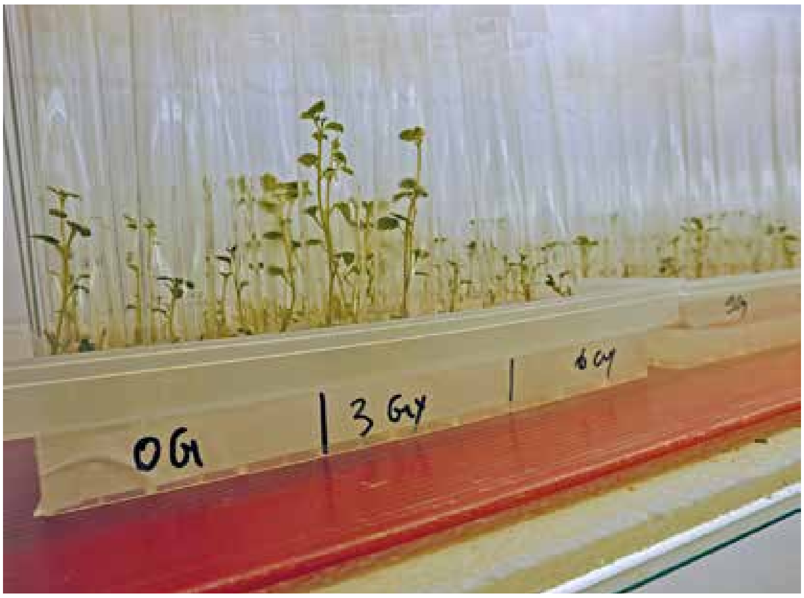
SAVING HARVESTS THROU

1 Crop diseases are one of the most challenging threats we face, affecting everyone on the planet directly or indirectly. Like so many crops, wheat — a key component for bread making — has over periods of time faced horrific destruction from diseases. One such disease, a wheat stem rust caused by a new virulent race (Ug99) can destroy whole wheat crops in a matter of days.

2 Getting into action, the international community has strived over the years to protect crops against plant diseases. Leading in the use of nuclear techniques, the Joint FAO/IAEA Laboratories at Seibersdorf, Austria, irradiate seeds to induce biological variation from which varieties with disease resistance may be developed, thereby helping farmers as well as consumers.

3 The FAO/IAEA Laboratories focus on inexpensive, quick and easy-to-use nuclear technologies to increase variation in plants that may then be used in plant breeding. Such variation can be induced by, for example, irradiating seeds with gamma- or X-rays. The resulting plants can then be selected for desired traits such as disease resistance, tolerance to environmental stress, or other desired qualities.

4 Member States regularly send their seeds to the Joint FAO/IAEA Laboratories where they are subjected to a range of irradiation dosages. These seeds are then returned to the Member State for local plant breeders to screen out the rare variants that possess the exact traits of importance to that specific country or region, such as for example diseases resistance.

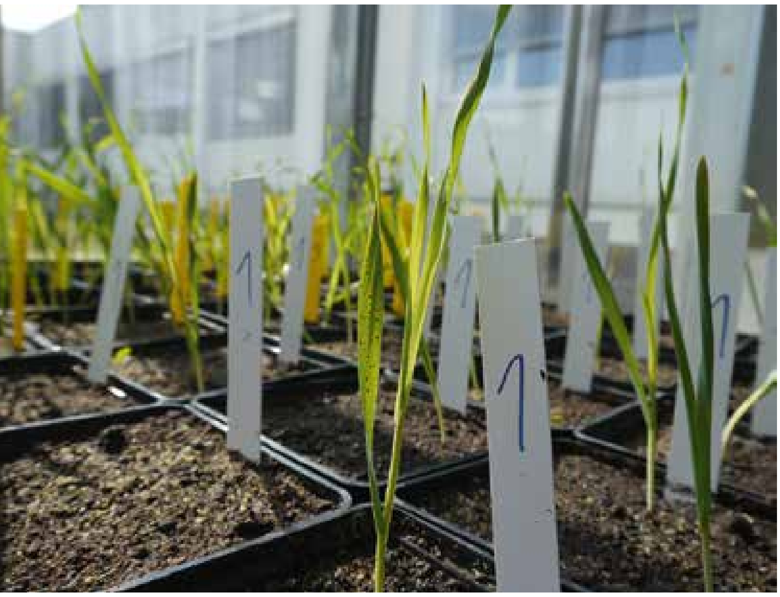


5 For the past 50 years the Joint FAO/IAEA Laboratories have been working continually to help develop plants resistant to diseases that affect important crops like wheat, rice, barley, potato and banana. In this endeavour the irradiation dose is crucial; low doses can stimulate growth, while too high a dose may stifle it. The decisive point is to dispense the optimum dose for mutagenesis, which lies somewhere in-between.

6 Dr Brian P. Forster, Head of the Joint FAO/IAEA Division's Plant Breeding and Genetics Laboratory, explains the irradiation techniques that are used to increase variation in plants: "Mutation induction takes seconds, minutes or a few hours, screening for beneficial mutants takes months or maybe even a few years. Mutation breeding is quicker than conventional breeding, generally taking 7-8 years to produce a variety as opposed to 10-15 years by conventional methods. Additional techniques are being developed to reduce the time further".

7 At the Joint FAO/IAEA Laboratories, screening of mutant plants takes place in large greenhouses. The greenhouses have carefully controlled temperature, water, lighting and humidity to imitate the conditions where the seeds will eventually be sown. In the picture rice is being grown in salty water in conditions simulating Vietnam.

8 In Vietnam, numerous villages and whole populations depend on the fate of each season's rice crop. The FAO/IAEA Laboratories have supported rice mutation breeding in Vietnam for many years. One success has been the development of new varieties of export quality rice that are also tolerant to soil salinity and can therefore now be grown in the Mekong Delta.



9 Spots are a common symptom of many crop diseases. Single gene mutations can provide resistance to such diseases.

10 Barley is used extensively as an animal feed. The barbed brittle 'whiskers' on the ears, which in nature act as a seed dispersal mechanism, cause lacerations in the mouths of feeding animals and have no nutritional value. The FAO/IAEA Laboratories have developed mutant lines without these "whiskers" to improve barley as an animal feed.

11 The FAO/IAEA Laboratories contributes to crop improvement tailored to Member States' needs. In East Africa unpredictable rainfalls play a crucial role in food security and hence in people's livelihood. Drought tolerant wheat mutants are here being screened and tested in a 'Kenyan environment' before being sent to Kenya for further trials.

12 The FAO/IAEA Laboratories is one of several international agencies that support Member States in their endeavours to enhance harvests of crops. After treatment with irradiation to increase variation, treated seeds are returned to Member States to be tested in the field. A recent success was the UG99-resistant wheat varieties, irradiated at the FAO/IAEA Laboratories and isolated and screened in Kenya. Two of these disease resistant lines have now been developed into varieties.

Text: Aabha Dixit and Michael Madsen, IAEA Division of Public Information; Photos: Michael Madsen & Greg Webb/IAEA

WHERE FOOD COMES FROM

40% of our land is used for agriculture; land threatened by desertification, salinity, and loss of nutritional content, thereby threatening the food security of millions. The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture is using nuclear science to track carbon through the plant cycle because healthy soil has more carbon, and healthy soil produces much more nutritious food.

Text: Sasha Henriques, IAEA Division of Public Information; Photo: Christian Resch/IAEA

IMPROVING AGRICULTURAL PRODUCTIVITY WITH RADIATION PROCESSED NATURAL POLYMERS

Through the power of irradiation to break and create chemical bonds, the natural polymer cassava starch is used to make super water absorbents (SWA), 1kg of which can absorb and hold 200 litres of water and release it slowly over time. Placed in the soil near plants' roots, SWA can be used where there is little rain or frequent drought. After 9 months the crystals, which resemble sugar crystals, completely disintegrate, leaving no residue.

Text and Photo: Sasha Henriques, IAEA Division of Public Information

NATURAL POLYMERS HARVESTED TO IMPROVE AGRICULTURE

With the IAEA's help, scientists use irradiated natural polymers including seaweed, shrimp shells, cassava starch, and palm oil to make products that help plants grow faster and protect them from diseases. For example, plants treated with oligoalginates (radiation-processed alginates derived from brown seaweed) grow faster and 13% to 56% bigger. Oligoalginates also stop the spread of the tobacco mosaic virus, which infects over 350 different plant species.

Text and Photo: Sasha Henriques, IAEA Division of Public Information

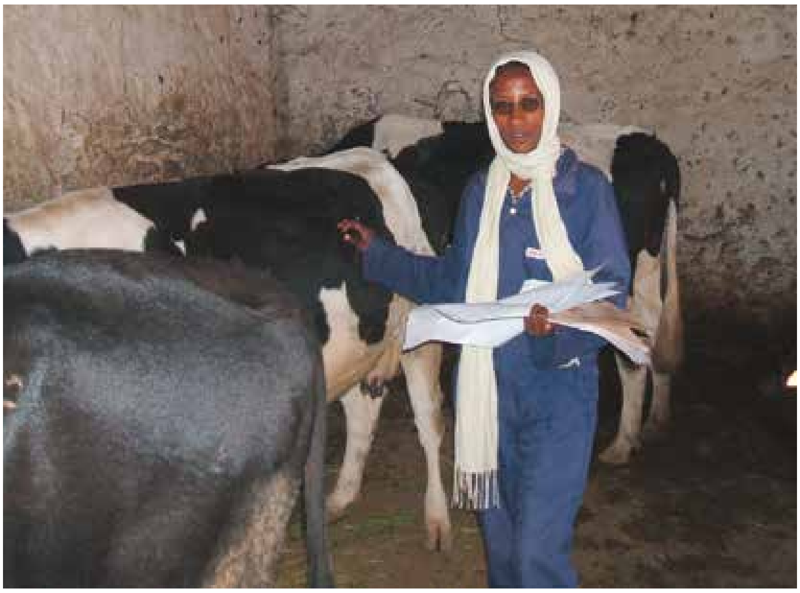
MAKING OUR FOOD SAFE

As civilization has progressed societies have strived to make food safer; from using fire to cook our food, and boiling our water to make it safe to drink, advances in technology have helped kill microorganisms that can make food unsafe. The FAO/IAEA Joint Division helps provide technical assistance to Member States that want to implement irradiation technology in making their food safer.

Food and waterborne diarrhoeal diseases are estimated to kill roughly 2.2 million people annually, of which 1.9 million are children. Irradiating some of the foods we eat can save many of these lives by reducing the risk of food poisoning and killing the organisms that cause disease. Irradiation works by treating food with a small dose of ionizing radiation, this radiation disrupts the bacteria's DNA and cell membranes structure stopping the organism from reproducing or functioning, but does not make the food radioactive. It can be applied to a variety of foods from spices and seasonings, to fruits and vegetables and is similar to pasteurization, but without the need for high temperatures that might impair food quality.

Text and Photo: Michael Madsen, IAEA Division of Public Information

IAEA PARTNERS WITH FAO TO IMPROVE LIVESTOCK PRODUCTIVITY



1 Sound animal production and health activities contribute to the enhancement of global food security through the transfer and implementation of sustainable livestock production systems using nuclear and nuclear related techniques.

2 FAO/IAEA partnered to help Member States improve their livestock productivity through the early and rapid diagnosis and control of transboundary animal diseases. Timely actions protect farmers' livelihoods and prevent the spread of diseases.

3 The development of diagnostic and control platforms, the building of human capacity and the sustainable transfer of technologies enable national veterinary services to support the farmers in the rapid identification and control of diseases.

4 The global eradication of Rinderpest was achieved in 2011, but the war was not won. The IAEA, FAO, OIE and other partners continue their fight against livestock diseases such as Peste des petits ruminants, Avian Influenza, Foot-and-Mouth disease, Capripox, Rift valley fever, Trypanosomosis, and African swine fever to enhance animal and public health.

Text: Hermann Unger, IAEA Animal Production and Health Section;
Photos: IAEA Animal Production and Health Section and Petr Pavlicek/IAEA Division of Public Information

SUPPRESSING TSETSE F
THE IAEA HELPS ETHIOPIA PRE

1 In Ethiopia's Southern Rift Valley, a man ploughs a field using oxen. For years this land was just forest. It was not possible to use it for agriculture, because tsetse flies were killing all livestock in the region.

2 The flies carry the parasites that cause nagana. This wasting disease is transmitted when they bite animals to feed on their blood. Many cattle die of the disease, others become too weak to be used for ploughing and transport and have limited milk production.

3 In 2009, the government-run Southern Tsetse Eradication Project (STEP), with the support of the IAEA, started to carry out intensive activities to suppress the fly population using insecticides. The fly population is now down by 90%.

4 The benefits of tsetse suppression can be seen all over the region. Dairy produce is now widely available at markets and healthy animals can be seen everywhere in farming and transport. In order to maintain these benefits in a sustainable way, suppression alone is not sufficient.

LIES TO IMPROVE LIVES
PARE FOR TSETSE ERADICATION

5 The STEP project is aiming to eradicate the flies over a 25,000 km^2 area. To be able to achieve this the sterile insect technique needs to be integrated. This form of pest control uses radiation to sterilise male flies which are mass-produced in special rearing facilities.

6 Thousands of sterile males are being released every week by plane into a tsetse-infested area in the Deme Basin, following suppression activities. They mate with wild females, but these produce no offspring. Over time the wild population should be eradicated.

7 In Soddo near the Deme Basin, the STEP team monitors the success of the SIT project. They trap flies in the areas where the sterile males were released. Using a range of special techniques, they can determine whether the trapped sterile males are outnumbering their wild counterparts.

8 Once the area-wide tsetse suppression activities have advanced sufficiently in the Arba Minch region and enough flies are being reared, aerial releases of sterile males will begin. Fly eradication is essential to ensure that the benefits of healthy and ample livestock for farming are sustained.

The IAEA has been supporting the STEP project since it was launched in 1997. Text and Photos: Louise Potterton, Petr Pavlicek / IAEA Division of Public Information; and Andrew Parker/Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

DELIVERING RESULTS FOR

1 Technical cooperation seeks to forge human and institutional capacity in Member States to safely utilize nuclear technologies to address local needs, global issues and contribute to national development.

2 The IAEA's technical cooperation programme is the primary mechanism for delivering the IAEA's capacity-building services to its Member States. The programme supports the safe and secure application of nuclear technology for sustainable socioeconomic development in Member States.

3 The overall strategic framework of the TC programme is determined by pertinent provisions laid down in key documents of the IAEA. Strategic direction for the multi-annual TC programme is provided by the Agency's Members States and, more specifically, by relevant advisory and governance entities.

4 The programme concentrates on: improving human health; supporting agriculture, rural development and food security; advancing water resource management; addressing environmental challenges; helping sustainable energy development, including the use of nuclear power for electricity; and promoting safety and security.

PEACE AND DEVELOPMENT

5 Human health projects carried out through the technical cooperation programme aim to provide the capacity and infrastructure to prevent, detect and cure major illnesses. Projects also support the planning and evaluation of nutrition programmes, as well as helping to establish quality assurance programmes for radiation dosimetry and the treatment of cancer.

6 The IAEA, in partnership with the Food and Agriculture Organization of the United Nations (FAO), helps Member States to produce more, better and safer food using nuclear technology, while promoting the sustainable use of agricultural resources.

7 Through the technical cooperation programme, the IAEA provides Member States with information and skills in nuclear technologies such as isotope hydrology that will help them to better understand and manage water resources.

8 The TC programme also supports many projects that concentrate on environmental issues and activities, such as managing air pollutants, identifying harmful algal blooms in the ocean, monitoring agricultural pollutants and reducing pesticide residues.

9 The TC programme is developed through a consultative process with Member States to identify the priority development needs using a results-based management approach.

10 National TC programmes are usually prepared to address priority areas identified in the Country Programme Framework (CPF), which is a programming tool that provides a frame of reference for technical cooperation between the IAEA and its Member States.

Photo: H.E. Dr Colin Scicluna, Ambassador and Permanent Representative to the IAEA, and Kwaku Aning, IAEA Deputy Director General and Head of the Department of Technical Cooperation sign Malta's Country Programme Framework (CPF).

11 Collaborative work through partnerships with Member States, United Nations agencies, research organizations and with civil society ensures the coordination and optimization of complementary activities and allows a more streamlined international response to current development issues magnifying the end results and ensuring the best possible socioeconomic impact of the technical cooperation programme.

12 Implementation is primarily delivered through human resource capacity building activities and procurement. Capacity building is supported by expert missions and meetings, through the provision of fellowships and scientific visits, and via special training courses.

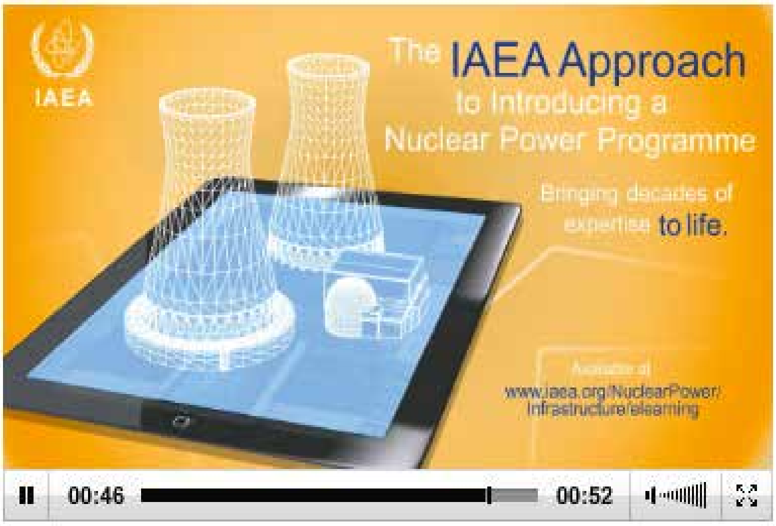
In 2012, over 1600 people benefitted from the fellowship and scientific visitor programme, and over 3000 people enhanced their knowledge through training courses.

Text: Hazel Pattison, IAEA Department of Technical Cooperation; Photos: IAEA

PROGRESS AND DEVELOPMENT THROUGH THE IAEA PEACEFUL USES INITIATIVE

1 A participant of the Eastern European Research Reactor Initiative (EERRI) Group Fellowship Training learns how to start up the TRIGA MARK II research reactor at the Atominstitut, Vienna University of Technology, October 2013. To date, 53 students have been trained through this fellowship programme. The EERRI coalition and the course were developed within a regional IAEA Technical Cooperation (TC) project and fellowships are supported using both TC and Peaceful Uses Initiative (PUI) funding. PUI funds are also being used to expand the fellowship and coalition concept to other regions. (Photo: Atominstitut)

2 Through the Peaceful Uses Initiative (PUI), the IAEA has been assisting Member States in developing the necessary infrastructure to support safe, secure and sustainable nuclear power programmes. IAEA's technical assistance includes technical and expert meetings covering the 19 infrastructure issues, as well as Integrated Nuclear Infrastructure Review (INIR) Missions.



3 An e-learning series based on the IAEA Milestones approach help newcomer countries understand the issues related to developing a national nuclear infrastructure. The first five modules, produced with financial support from the Republic of Korea under the Peaceful Uses Initiative, focus on management, human resource development, stakeholder involvement, and construction management.
The modules are available at: www.iaea.org/NuclearPower/Infrastructure/elearning/index.html

4 PUI funds are also being used to support research on the very long term storage performance of spent nuclear fuel and related storage system components. This also includes research into the long term integrity of dry storage concrete systems. Using an experimental setup of LaBr3 and NaI(Tl) gamma detectors, experts check the confinement integrity of the spent fuel and the structural integrity of the reinforced concrete silos at Embalse NPP's dry storage, Argentina. (Photo: CNEA/NA-SA)

Text: Bruna Lecossois and Elisabeth Dyck, IAEA Department of Nuclear Energy; Photos: IAEA

EXPLORE PEACEFUL NUCLEAR SCIENCE
HELPING PEOPLE AROUND THE WORLD

THE PEACEFUL USES APP

The IAEA Peaceful Uses Initiative benefits over 120 developing countries by helping these countries use nuclear technologies to help improve agricultural production; to diagnose, control, and eradicate diseases that threaten livestock, reduce yields and revenue and hinder trade; and to manage animal nutrition, improve livestock reproduction, breeding, and health. Soil erosion and land degradation problems are addressed with these versatile technologies. Strategies for the sustainable use of trans-boundary water sources are developed using data derived through isotopic and nuclear applications. Nuclear medicine and imaging techniques save lives, restore health, and alleviate suffering.

The United States is one of many IAEA Member States that supports the IAEA's Peaceful Uses Initiative that works with national authorities to implement the projects. The U.S. Mission to International Organizations in Vienna developed the free "Amazing Atoms" App to highlight IAEA PUI activities.

The App is now available from the Apple Store and the Google Play Store. Please visit:

- **"Amazing Atoms" video**: www.youtube.com/watch?v=74qiRcb0mZA
- **"Amazing Atoms" on Google Play:** http://goo.gl/GbQtUI
- **"Amazing Atoms" on iTunes:** http://goo.gl/j8hNaJ

THE IAEA BULLETIN APP

The IAEA Bulletin is the IAEA's flagship publication and is now issued quarterly in six languages.

It provides insights into how the IAEA is helping countries use nuclear technology to improve health, prosperity and environmental sustainability.

READ THE IAEA BULLETIN AS **AN IPAD APP** OR AN **ONLINE MAGAZINE**

SUBSCRIBE to our mailing list to receive email notification whenever a new edition is available.
SIGN UP AT: www.iaea.org/bulletin

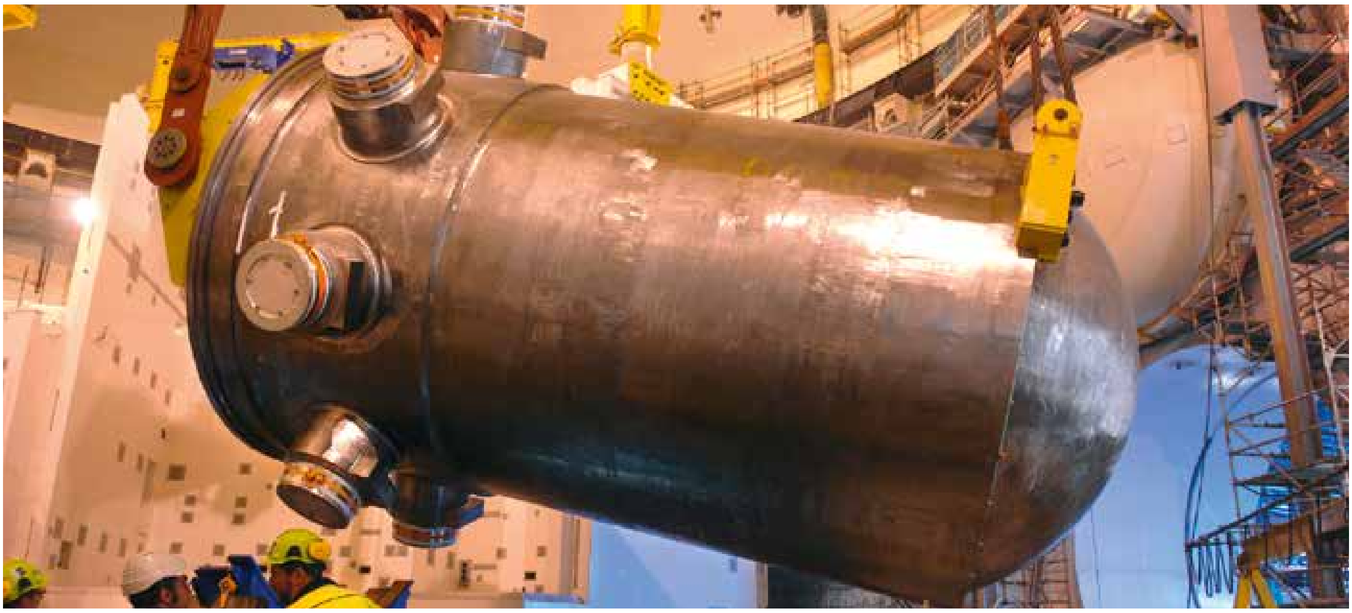
OSART WORKS TO HELP MEMBER STATES

Nuclear safety is a never ending pursuit for improvement, and one of the more prominent IAEA efforts that help Member States achieve higher levels of safety is the Operational Safety Review Team (OSART) programme. In OSART missions, the IAEA coordinates internationally-based teams of experts who conduct reviews of operational safety performance at nuclear power plants. The IAEA on 14 June 2013 marked the 30th anniversary of OSART.

In 1983, the Agency conducted its first OSART mission to the Kori Nuclear Power Plant in the Republic of Korea, and it conducted a total of 174 OSART missions over the following 30 years. The reviews have been done in 34 nations at 103 nuclear sites.

Photo: OSART team members visit the Dukovany Nuclear Power Plant in the Czech Republic in June 2011
Text: Peter Kaiser, IAEA Division of Public Information; Photo: P.Pavlicek/IAEA

LOOKING INTO THE FUTURE:



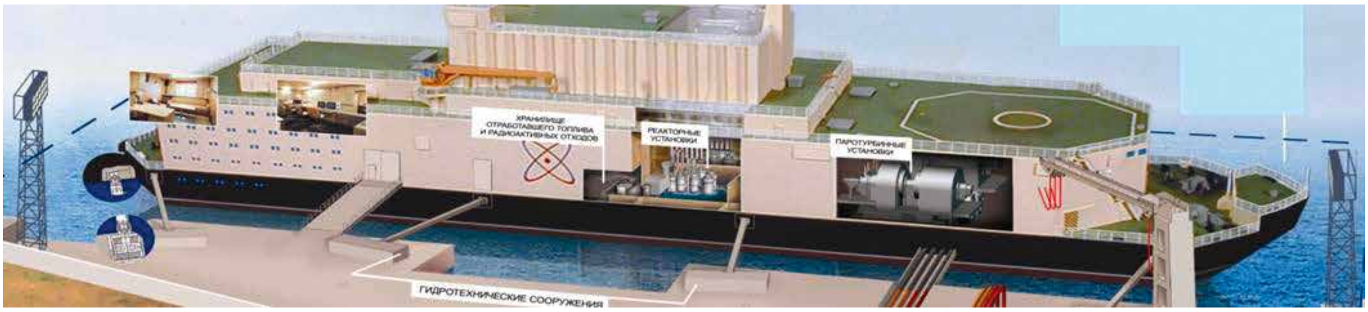
1 For nuclear energy to play a substantial role in a sustainable global energy supply, both technical and institutional innovations are needed. Through various international cooperation activities, the IAEA promotes innovation that will lead to more efficient, more affordable and more sustainable advanced reactor technologies. Over 80% of the world's operational nuclear power plants use light water moderated and cooled reactors, commonly called light water reactors (LWR). Advanced LWR designs are being developed or are under construction in several countries to help meet future energy needs.
Photo: Reactor pressure vessel installation at Olkiluoto-3 in Finland, one of the latest LWRs under construction. (TVO)

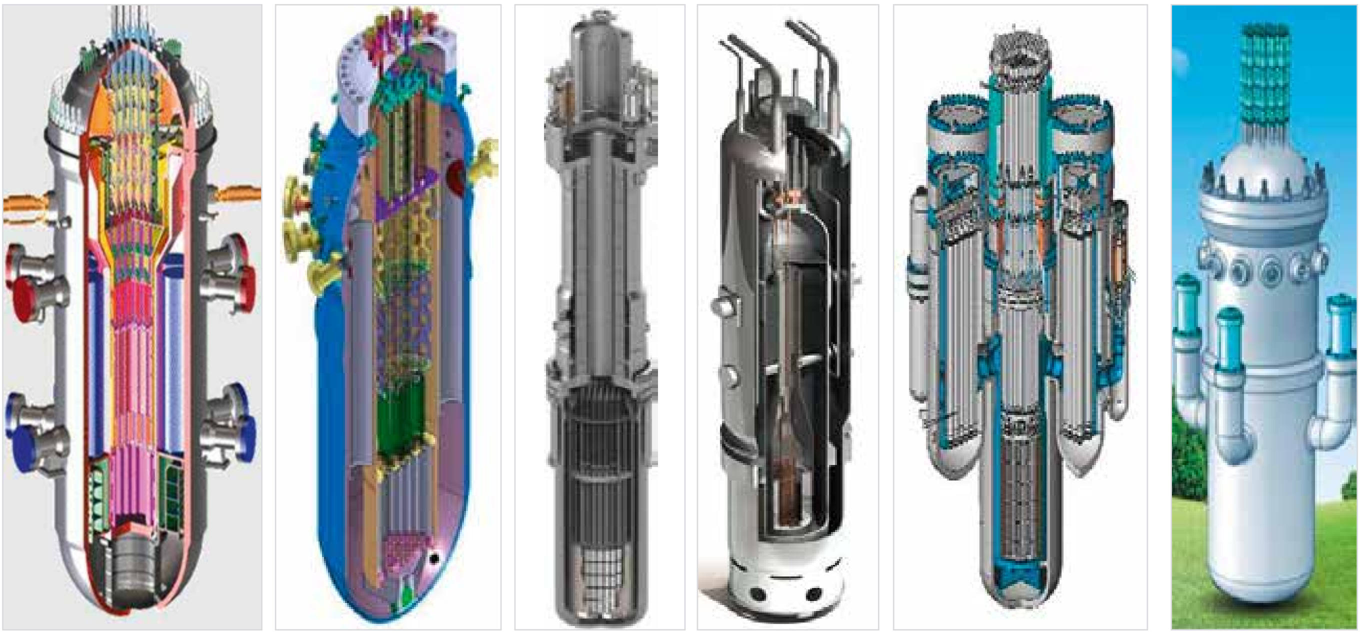
2 Fast reactors could produce over 60 to 70 times more energy per kg of uranium than with current technologies. Closing the nuclear fuel cycle by using fast reactors and by recycling used fuel could enhance the use of natural resources and reduce the amount of long lived radioactive waste. Examples of fast reactors include the China Experimental Fast Reactor (CEFR), operational since July 2011, as well as the Prototype Fast Breeder Reactor (PFBR) in India and the BN-800 in Russia, both under construction.
Photo: Construction works at the sodium cooled fast reactor BN-800 in Russia. (ROSATOM)

ADVANCED REACTORS

3 Other advanced reactor technologies, such as high temperature gas reactor (HTGR) designs, can provide high efficiency electricity generation. In the longer term, they could also provide a cost effective source of high and low-temperature process heat for nuclear hydrogen and nuclear desalination applications. Several international research and development as well as power projects are under way worldwide for advancing this technology.

Photo: Construction of the world's first prototype HTGR, Shidao Bay-1, started in China in December 2012. (INET/Tsinghua University)





4 There is growing interest in small and medium sized nuclear power reactors (SMRs), partly because they allow smaller, more flexible and incremental investment over time. 'Small' means fewer than 300 MW(e), 'medium sized' means between 300 MW(e) and 700 MW(e). There are approximately 45 innovative SMR concepts at various stages of research and development. This diagram illustrates some of the SMR concepts deployable within the next decade.

Text: Bruna Lecossois, IAEA Department of Nuclear Energy

MONITORING THE ENVIRO

Our overuse of natural resources, pollution and climate change are weakening natural systems' ability to adapt to ever more sources of stress. The varied environments of our planet are interconnected and the pollution of one has ramifications across all. It is thus important to monitor the health of our environment to ensure a sustainable future.

Water covers 70% of our planet, yet reserves of drinkable freshwater are limited and precious. The IAEA uses isotopes to 'fingerprint' freshwater and understand its unique hydrological characteristics such as its age, movement, rate of recharge, and pathways. This information allows policymakers to use these reserves responsibly. Sources of pollution can be identified, helping guide policymakers in managing this precious resource.

Earth's greatest resource is its ocean, providing oxygen, food, and livelihoods for billions of people globally. The IAEA monitors its health extensively. Using radiotracers and other isotopic techniques, scientists trace the sources and fate of marine pollutants and are able to predict their future impact.

ONMENTS WE DEPEND ON

The IAEA, through its Environment Laboratories, Water Resource Programme, and technical cooperation programme, applies unique, versatile and cost-effective isotopic and nuclear techniques to understand many of the key environmental mechanisms needed to ensure a sustainable future. These monitoring systems help Member States make ecologically-responsible and scientifically-grounded development decisions.

Our atmosphere protects us from radiation, transfers heat globally, delivers vitally needed fresh water, and its chemical composition is a major driver of global climate change. The IAEA cooperates with the World Meteorological Organization using isotopes to track the movement of water in the atmosphere. The data gathered from tracking isotopes feeds a database that supports our growing understanding of precipitation and is an invaluable planning tool for drier regions of the world.

Among the most effective tools used in environmental impact assessment are advanced analytical techniques to understand radionuclide migration and radiation's effect on both terrestrial and marine ecosystems. The IAEA coordinates an international network of Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA), which provides Member States with accurate and fast radionuclide analysis in the event of radioactive releases or discharges. Key services of the IAEA include the provision of means for quality control and calibration to hundreds of analytical laboratories worldwide, to ensure reliability of their data for responsible decision making.

Global climate change is transforming the polar regions and snow-covered mountain tops; these represent large and invaluable reserves of freshwater that hundreds of millions of people rely upon. The IAEA is contributing to global efforts by assisting its Member States in developing a project that uses isotopes to better understand permafrost loss, glacier retreat, and global mountain snow-cover reduction.

Global CO_2 emissions are currently causing the oceans to acidify, creating an enormous stress on marine life and threatening the future of marine food resources. The IAEA operates the Ocean Acidification International Coordination Centre (OA-ICC) that works to communicate, promote and facilitate global actions on ocean acidification.

Text: Michael Madsen, IAEA Division of Public Information; Photos: iStockphoto.com

CONTRIBUTORS

Yukiya Amano

Luis J. Araguás Araguás

Carl Michael Blackburn

Aabha Dixit

Elisabeth Dyck

Brian P. Forster

Jorge Hendrichs

Sasha Henriques

Rafael Argiles Herrero

Joanna Izewska

Peter Kaiser

Pierre Jean Laurent Lagoda

Bruna Lecossois

Michael Amdi Madsen

Victor Mezapov

Najat Mokhtar.

Andrew Parker

Thomas Pascual

Hazel Pattison

Louise Potterton

Rodolfo Quevenco

Elisabeth Röhrlich

Christine Slater

13-4943

ISSN 0020-6067

1953

atoms for peace speech

...it is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace.

... if the fearful trend of atomic military build-up can be reversed, this greatest of destructive forces can be developed into a great boon, for the benefit of all mankind.

... peaceful power from atomic energy is no dream of the future. The capability, already proved, is here today.

...the more important responsibility of this atomic energy agency would be to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind.