

# IAEA BULLETIN

INTERNATIONAL ATOMIC ENERGY AGENCY

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# 10 YEARS

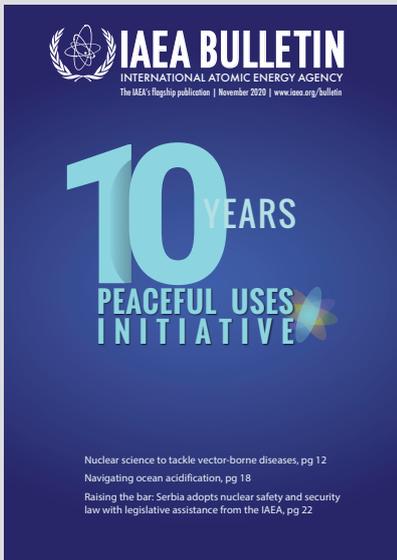
## PEACEFUL USES INITIATIVE



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The International Atomic Energy Agency's mission is to prevent the spread of nuclear weapons and to help all countries — especially in the developing world — benefit from the peaceful, safe and secure use of nuclear science and technology.

Established as an autonomous organization under the United Nations in 1957, the IAEA is the only organization within the UN system with expertise in nuclear technologies. The IAEA's unique specialist laboratories help transfer knowledge and expertise to IAEA Member States in areas such as human health, food, water, industry and the environment.

The IAEA also serves as the global platform for strengthening nuclear security. The IAEA has established the Nuclear Security Series of international consensus guidance publications on nuclear security. The IAEA's work also focuses on helping to minimize the risk of nuclear and other radioactive material falling into the hands of terrorists and criminals, or of nuclear facilities being subjected to malicious acts.

The IAEA safety standards provide a system of fundamental safety principles and reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from the harmful effects of ionizing radiation. The IAEA safety standards have been developed for all types of nuclear facilities and activities that serve peaceful purposes, as well as for protective actions to reduce existing radiation risks.

The IAEA also verifies through its inspection system that Member States comply with their commitments under the Nuclear Non-Proliferation Treaty and other non-proliferation agreements to use nuclear material and facilities only for peaceful purposes.

The IAEA's work is multi-faceted and engages a wide variety of partners at the national, regional and international levels. IAEA programmes and budgets are set through decisions of its policymaking bodies — the 35-member Board of Governors and the General Conference of all Member States.

The IAEA is headquartered at the Vienna International Centre. Field and liaison offices are located in Geneva, New York, Tokyo and Toronto. The IAEA operates scientific laboratories in Monaco, Seibersdorf and Vienna. In addition, the IAEA supports and provides funding to the Abdus Salam International Centre for Theoretical Physics, in Trieste, Italy.

# Increasing the impact of nuclear science for development through the Peaceful Uses Initiative

By Rafael Mariano Grossi, Director General, IAEA

This year marks a decade of action under the Peaceful Uses Initiative (PUI). Far reaching in scope and impact, the PUI has enabled us to expand our horizons to support developing Member States and confront some of the most pressing and — at times — unanticipated global challenges. From supporting cancer control programmes, to increasing food security and enhancing nuclear safety, projects under the PUI have been instrumental in increasing the contribution of the peaceful use of nuclear science and technology to development.

In the last ten years, the initiative has mobilized €174 million in extrabudgetary contributions from 24 countries, the European Commission and the private sector. More than 300 projects have been implemented, benefiting over 150 Member States (page 4). Several countries have made multi-year funding pledges to the PUI, making funding more reliable. This is particularly beneficial for long-term, large-scale projects where predictability is key. As the world faced unexpected challenges, such as the Zika virus disease and now COVID-19, the PUI has enabled the IAEA to respond quickly and flexibly to the evolving priorities of Member States.

I invite you to reflect not only on our accomplishments, but also on the possibilities and opportunities for greater impact on the well-being and livelihood of billions of people, as well as the protection of our planet. This edition of the *IAEA Bulletin* demonstrates how the PUI has unlocked the diverse capabilities of the IAEA and our partners, and how the use of nuclear and related techniques has made a difference for millions around the world.

But we cannot stop there. The IAEA is looking to accelerate progress in peaceful uses of nuclear applications (page 7). To this end, we are launching programmes to prevent zoonotic diseases and tackle plastic pollution, among others. Support through the PUI will be instrumental in delivering on these priorities.

In partnership with the Food and Agriculture Organization of the United Nations (FAO), the IAEA facilitates the Veterinary Diagnostic Laboratory (VETLAB) Network (page 10), which provides the foundation of our new programme on zoonotic diseases. Our work on ocean research using nuclear and isotopic techniques (page 18) will be one of the pillars of our new plastics initiative.

On the following pages, you can read about these and other projects made possible through PUI support.

We also discuss the complementarity between the PUI and the implementation of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) (page 28). It is highlighted that the goal of the PUI is not only to raise funds, but also to develop projects that will make an impact on people's lives (page 30). You will also see examples of South–South cooperation, where a country is both benefiting from the PUI and contributing to it (page 26).

The PUI epitomizes the mission of the IAEA — uniting the best of science, technology and human ingenuity from around the world for the greater good. The IAEA takes pride in reaching the ten-year milestone and will certainly — with the support of our Member States — keep fuelling the momentum to achieve even more in the years to come.



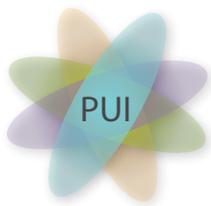
**“The IAEA is looking to accelerate progress in peaceful uses of nuclear applications.”**

— Rafael Mariano Grossi,  
Director General, IAEA



(Photos: D. Calma/IAEA)





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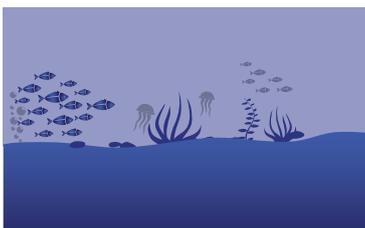
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# Ten years of the IAEA Peaceful Uses Initiative

By Shota Kamishima

This year marks the tenth anniversary of the Peaceful Uses Initiative (PUI). The inception of the PUI can be traced back to the 2010 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), where it was proposed by the delegation of the United States of America. Later that year, the PUI was established as a funding initiative to support IAEA projects on the peaceful uses of nuclear technology. It has since become instrumental in mobilizing extrabudgetary contributions to support unfunded IAEA activities, including technical cooperation projects, that further the peaceful application of nuclear technology.

Since 2010, the annual resolutions of the IAEA General Conference have encouraged all Member States in a position to do so to make additional contributions to the PUI. As of 30 September 2020, 24 countries and the European Commission have donated through the PUI and provided €174 million in financial contributions. In 2017, funding to the PUI expanded to the private sector, and Shimadzu Corporation became the first company to contribute. These contributions

have supported over 300 projects benefitting more than 150 Member States.

Several Member States have pledged multi-year funding to the PUI. Now funding can be relied upon with greater predictability, which is particularly beneficial for long-term, large-scale projects and has enabled the IAEA to respond quickly and flexibly to emergencies and the evolving and emerging priorities of Member States. This has been demonstrated by the IAEA's response to the Ebola virus disease in West Africa, to the Zika virus disease in Latin America and the Caribbean, and to natural disasters in Asia and Latin America. Most recently, funding received through the PUI has supported the IAEA in its efforts to assist Member States in combating COVID-19, delivering consignments of equipment for virus detection and diagnosis, accessories, personal protective equipment and other supplies.

PUI funding has contributed to projects in a variety of areas, including food security, water resource management, human and animal health, nuclear power infrastructure

10 YEARS  
PEACEFUL USES  
INITIATIVE

2010

The USA proposed the PUI at the Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons.

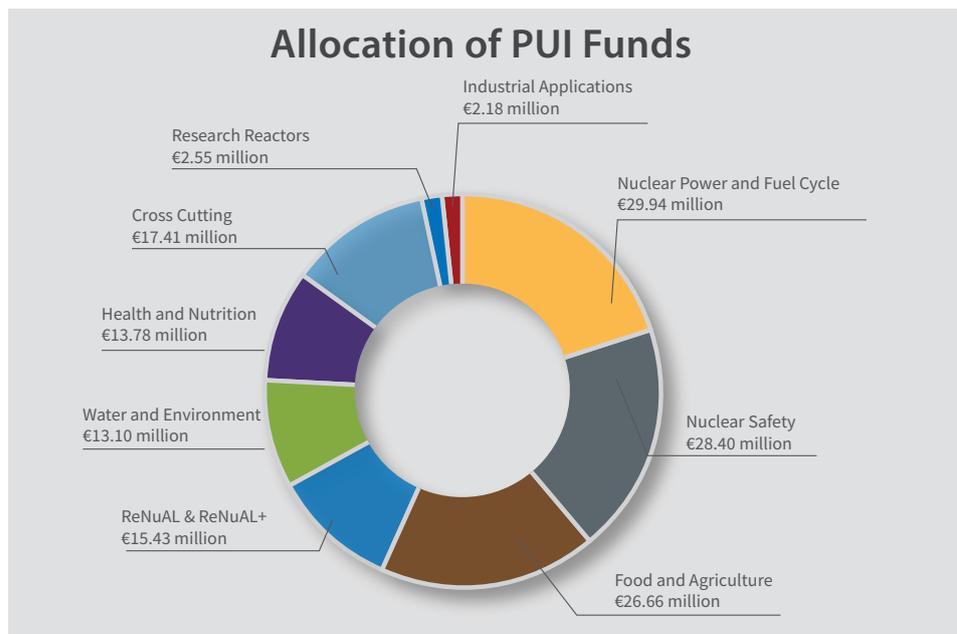


development, and nuclear and radiation safety, many of which would have remained unfunded without the PUI. The figure on the right shows the allocation of funds received through the PUI broken down by thematic area.

Those featured in this publication are just a few examples of the projects that have benefited from the PUI over the past ten years.

The area of nuclear power and fuel cycle has received more PUI funding than any other thematic area. The IAEA assists Member States considering, planning or starting the introduction of nuclear power in developing their programmes, including the establishment of the necessary safety infrastructure. Funding received through the PUI has financed a number of Integrated Nuclear Infrastructure Review (INIR) missions as well as capacity building projects. The PUI has also supported an Internet Reactor Laboratory project, giving university classrooms access to research reactor experiments via live online broadcasts. It has also supported INIR for Research Reactors (INIR-RR) missions.

The modernization of the IAEA's nuclear applications laboratories at Seibersdorf, Austria, is one of the most important projects ever undertaken by the IAEA. The services and infrastructure that the laboratories can



provide to Member States in the years to come have been significantly enhanced and expanded. As of October 2020, the PUI accounts for 35 per cent of the total amount of extrabudgetary contributions received for these projects. (For more details, see our article on page 24.)

In the area of food and agriculture, a PUI-sponsored drip irrigation project in Sudan helped women farmers, with the aid of nuclear technology, to increase food yields while optimizing the use of water and fertilizer. The PUI played an important role in establishing

**24 countries,**  
the European Commission and a private corporation have donated through the PUI.



**More than 300 projects**  
for over 150 Member States





the Veterinary Diagnostic Laboratory (VETLAB) Network, a network of animal health laboratories intended to diagnose and monitor diseases. Building on the VETLAB Network, the IAEA contributes to the global effort to eradicate peste des petits ruminants (PPR), which kills thousands of sheep and goats every year in Africa, the Middle East and Asia (see page 10). The PUI has also funded a project in Senegal to promote the use of the sterile insect technique (SIT). As a result, the tsetse fly population in target areas north-east of the capital Dakar has significantly reduced, improving farmers' livelihoods.

In the area of human health, many low- and middle-income countries have benefited from IAEA imPACT review missions that have been financed by the PUI and which assess national cancer control capacities and needs, and recommend how best to prioritize related activities and investment. The PUI has also supported a project that helps Member States in Latin America and the Caribbean to access nuclear medicine for early and accurate diagnosis of cardiovascular diseases and cancer, providing support in purchasing equipment, face-to-face training for specialized skills and carrying out expert missions to raise awareness of radiation safety among health care practitioners and decision makers of the clinical applications of nuclear medicine.

In the area of water and the environment, PUI funding has supported a project to

help 13 countries in Africa's drought-prone Sahel region use isotopic techniques to assess groundwater origin and quality, resulting in the first broad overview of the region's groundwater supplies. Thanks to the PUI, Member States in Asia and the Pacific, with the use of nuclear techniques, have strengthened their capacity to monitor harmful algal blooms and reduce their adverse impacts on seafood safety. Likewise with the help of the PUI, the Ocean Acidification International Coordination Centre (OA-ICC) was launched at the United Nations Conference on Sustainable Development (Rio+20) in 2012 and continues to collaborate with partners across the globe to further the scientific study of ocean acidification and to advance international collaboration (see page 18).

In the area of nuclear safety, the PUI has supported a project in Central Asia to enhance coordination among organizations working toward remediation and safe regulatory control of former uranium mining and processing legacy sites. The PUI has also assisted Member States in sustaining the control of radioactive sources throughout their life cycle and in enhancing capacity to manage these sources, both while in use and thereafter, according to international safety standards and best practices. The PUI also supported a project focused on assisting Member States with the development and application of safety regimes for radioactive waste and spent fuel management.



(Photos: D. Calma/IAEA)

# The future of the Peaceful Uses Initiative: Responding to global challenges and emergencies

By Rebekka Koelbl

Accelerating and enlarging the “contribution of atomic energy to peace, health and prosperity throughout the world” is a statutory objective of the IAEA. For ten years the Peaceful Uses Initiative (PUI) has contributed to this objective, proving to be effective in mobilizing extrabudgetary contributions toward peaceful applications of nuclear technology.

## What is next? How will the PUI evolve in the coming years?

The world faces complex developmental challenges, such as zoonotic outbreaks, climate change and environmental pollution, among others, to which nuclear technologies can offer solutions and for which governments are seeking the support of the IAEA. Today’s complex global challenges increasingly call for large-scale, integrated responses, programmes and initiatives that are thematically overarching and strategically designed.

Multi-year pledges of PUI funding provide flexibility to the IAEA and allow it to identify and support such projects based on the

evolving needs of Member States. Multi-year pledges will continue to play an important role, helping to mobilize predictable funding and allowing donors to flexibly allocate resources for larger initiatives or emergencies when needed.

## Early response to zoonotic outbreaks

This year, the world has witnessed an unprecedented global emergency in the COVID-19 pandemic, and reverse transcription–polymerase chain reaction (RT–PCR), a nuclear-derived technique used for detecting the virus that causes COVID-19, has been instrumental in fighting it. As part of its largest technical cooperation project, the IAEA has helped to provide over 120 countries with expertise and equipment. In addition to the immediate emergency response, it is essential that experts worldwide have the capacity to detect and characterize diseases at an early stage, before an outbreak can emerge.

Zoonotic diseases affect around 2.6 billion people every year. Nuclear

**Real time RT-PCR is the most accurate method to detect the COVID-19 virus. The IAEA has been helping countries use this technique to detect zoonotic (animal to human) diseases like COVID-19 and Ebola.**

(Photo: D. Calma/IAEA)



and nuclear-derived techniques can help scientists to investigate, prevent and contain outbreaks of zoonotic diseases. Worldwide access to spatial and temporal data on animal pathogens and diseases can help facilitate swift decision making and support veterinary and health authorities in responding in a timely manner and disseminating information to relevant stakeholders. To prepare for future outbreaks, national experts will benefit from coordinated research activities to better understand and address how zoonotic diseases impact human health.

To address this need and prevent future outbreaks, the IAEA has launched the Zoonotic Disease Integrated Action (ZODIAC) project, a comprehensive, multisectoral and multidisciplinary global initiative to enhance the surveillance, monitoring and timely detection of pathogens causing zoonotic diseases. The Veterinary Diagnostic Laboratory (VETLAB) Network, supported for years through PUI funding, will provide the basis for a new expanded laboratory network under ZODIAC. (For more on the VETLAB Network, read our article on page 10.)

### Fighting plastic pollution

Plastic pollution is increasing at an alarming rate, threatening ecosystems, jeopardizing food safety, and endangering human health

and sustainable development. In 2018, global plastics production reached almost 360 million tonnes, and every year about 8 million tonnes of plastic waste finds its way into the oceans.

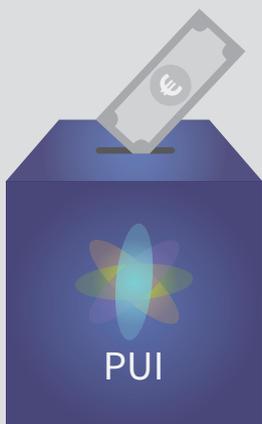
Nuclear technologies have the potential to complement conventional approaches to reduce plastic waste. Irradiation can be used to modify the structure and properties of plastic or to break it down to create feedstocks. In both cases, the modified or functionalized new material or feedstock is used to produce commercially viable plastic items, thus creating economic benefits while reducing waste volumes.

Recycling plastic into new products using radiation technologies is particularly beneficial when primary recycling of plastic waste is no longer possible, as many thermoplastics can only be recycled once or twice with conventional technology.

Furthermore, nuclear techniques can be used to characterize, monitor, trace and track microplastics to assess their prevalence and their impact on the environment, including in the oceans.

### Dealing with climate change

To comply with international agreements and keep global temperature rise below two



## How to make an extrabudgetary contribution through the Peaceful Uses Initiative

Member States initiate the process by sending a pledge letter to the IAEA, including the amount of the contribution, specific project to fund, if already identified, and an indication that the contribution is made through PUI. Member States are encouraged to closely consult with the Secretariat before they make their official pledge.

The IAEA will initiate the formal acceptance process for the contribution and respond to the pledge letter.

Private donors interested in contributing through the PUI are encouraged to contact the Secretariat to identify the appropriate modality.

For further information on PUI, please access [www.iaea.org/services/key-programmes/peaceful-uses-initiative](http://www.iaea.org/services/key-programmes/peaceful-uses-initiative)

degrees Celsius above pre-industrial levels, the energy sector must be decarbonized.

In the meantime, changing weather patterns are affecting agricultural systems, the global food supply and the livelihoods of small-scale farmers. Some of the most pressing effects of climate change already being felt are food shortages, water scarcity and biodiversity loss. The IAEA will play an increasingly important role in helping countries measure and adapt to the consequences of climate change using nuclear and isotopic techniques.

The IAEA will also continue to help mitigate climate change by assisting countries in assessing the development of their energy systems and the role nuclear power could play in generating electricity. Innovations in nuclear energy can assist countries in moving toward a clean energy transition, and nuclear power can complement renewables such as wind and solar power. Projects and programmes to help Member States operate nuclear power safely, sustainably and cost-effectively using innovative technologies will continue to be an important part of the IAEA's work supported by PUI funds.

### Modernizing research laboratories

The renovation and modernization of the IAEA's nuclear applications laboratories in

Seibersdorf, Austria, have received support from the PUI, and this is expected to continue in the years to come. Three new laboratories will be built to better serve the evolving needs of Member States, providing lab services and training in food and agriculture, human health, the environment, and the development and use of neutronic instruments (see our article, page 24).

### Safety of radioactive sources and nuclear material

The use of nuclear technology requires strong nuclear safety and security regulation and infrastructure at the national level. International cooperation through the harmonization of approaches in, for example, transport safety and security, radioactive waste management safety, and emergency preparedness and response provides tangible benefits to countries, using nuclear applications for development. PUI funding complements the Agency's programme on the safety of radioactive sources and further improves the effectiveness of national systems using these technologies.

With the support of partners from the public and private sectors, this decade can take the PUI to the next level in its capability to maximize the IAEA's impact on solving global challenges through the use of nuclear technologies.

## The Peaceful Uses Initiative website

Your portal for up-to-date information on the programme and its supported projects



The web page of the Peaceful Uses Initiative (PUI) on [iaea.org](http://iaea.org) ([www.iaea.org/services/key-programmes/peaceful-uses-initiative](http://www.iaea.org/services/key-programmes/peaceful-uses-initiative)) provides an overview of the programme, recent publications and news related to its projects. It includes information on:

- **Funding** — with information on the amount of extrabudgetary contributions, contributing Member States and other donors, including from the private sector. This information is summarized in annual presentations given to Members States, which are uploaded to the website.
- **Projects** — with a list of all ongoing projects and concept notes for unfunded projects in the areas of nuclear applications, energy, safety and technical cooperation. The description of each project is presented in a structured format, showing objectives, activities, key technologies, duration, beneficiary countries, expected results and the total estimated budget. Information on the United Nations Sustainable Development Goals that the project contributes to is also included.
- **How to contribute to the PUI** — with a step-by-step guide on how to make an extrabudgetary contribution through the PUI.

To find out more about the PUI programme and its projects, contact information can be found on the website.

# Helping to tackle the spread of zoonotic disease: The VETLAB Network

By Elodie Broussard

The virus responsible for COVID-19, originating in animals, emerged in humans in late 2019 and upended the world as we know it. While it is the first disease in over a century to cause daily lives and economies worldwide to grind to a halt, it is not the first disease to cross from animals to people.

More than 60 per cent of diseases now affecting humans started in animals — and with improved surveillance and animal disease control, they could be stopped in their tracks. This is what underlines the importance of global initiatives like the Veterinary Diagnostic Laboratory (VETLAB) Network, through which veterinary labs exchange information, share best practices and support each other. The VETLAB Network is maintained by the IAEA, in partnership with the Food and Agriculture Organization of the United Nations (FAO), and is funded through the Peaceful Uses Initiative and the African Renaissance and International Cooperation Fund.

“Over the last eight years, the VETLAB Network has helped more than 60 countries to quickly detect and control animal and zoonotic diseases, including the Ebola virus disease, avian influenza and, most recently, COVID-19,” said Charles Lamien, an Animal Health Expert at the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. “With diseases having no regard for borders, we have to work together to control their emergence, re-emergence and spread. The VETLAB Network provides an effective way to do that.”

The VETLAB Network, created in 2012, comprises 71 laboratories in 45 African and 19 Asian countries. It is now working to expand to Central and Eastern Europe, and Latin America and the Caribbean. The laboratories work with each other as well as with experts from the Joint FAO/IAEA Division to use nuclear, nuclear-derived and other methods for monitoring, early

detection, diagnosis and control of diseases (see The Science box).

## Quick response

Central to the VETLAB Network’s mission is to enable countries to quickly respond to disease outbreaks. It played a key part in dealing with the 2017 avian influenza outbreak in Africa. The disease threatened the US \$1 billion poultry industry across the six countries it struck.

Through the Network, veterinarians at the laboratories of the affected countries rapidly received the most up-to-date procedures on how to deal with the outbreak, as well as necessary laboratory supplies, such as reagents and reference material for virus detection and characterization. By mid-2018, the outbreaks were rapidly controlled.

## Ready to test

One important step in disease detection and control is to test samples from potentially infected animals or people as early as possible. When a country does not have the trained staff and equipment to test, the samples are sent to laboratories abroad, which can be expensive and time consuming.

The VETLAB Network has helped address these issues by supporting countries to establish testing capacities. These include effective quality management systems, which have led to international accreditation for some of the more advanced laboratories.

## Fighting African swine fever

In 2018, when African swine fever began appearing in Asia, veterinarians from Africa had already shared their decades-long experience in dealing with the virus with their Asian counterparts through the VETLAB Network. This helped Asian countries set up effective detection and management strategies.

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**“Thanks to IAEA support, we were able to control the outbreak within three months.”**

— *Tserenchimed Sainnokhoi, Deputy Director, State Central Veterinary Laboratory, Mongolia*

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This preparatory work made it faster and easier for experts in Cambodia, Indonesia, the Lao People’s Democratic Republic, Mongolia, Myanmar and Viet Nam to use the emergency assistance provided by the IAEA’s technical cooperation programme. Malaysia and Thailand also received equipment for early detection and diagnosis.

In Mongolia, the outbreak affected more than 80 pig farms. As a result of the assistance provided through the VETLAB Network, only 3000 of the 28 000 pigs at risk had to be culled to control the spread of the disease. “Before the outbreak, several of our laboratory staff were trained by the IAEA, and we received equipment,” said Tserenchimed Sainnokhoi, Deputy Director of Mongolia’s State Central Veterinary Laboratory. “Thanks to IAEA support, we were able to control the outbreak within three months.”

## ZODIAC

The decades of experience and collaboration through the VETLAB Network is now set to play a key part in the IAEA’s new Zoonotic Disease Integrated Action (ZODIAC) initiative. Launched in 2020 amid the COVID-19 global outbreak, ZODIAC aims to establish an international network of laboratories, building in part on the VETLAB Network, to provide a unified



platform for pre-empting and preventing zoonotic disease outbreaks.

“It’s important to monitor what is going on in the animal kingdom — both in wildlife and livestock — and to act quickly on those findings before the pathogens jump to humans,” said Gerrit Viljoen, Head of the Animal Production and Health Section of the Joint FAO/IAEA Division.

**Veterinary scientists receive hands-on training on test verification and validation for molecular diagnostic assays at the Seibersdorf laboratory.**

(Photo: IAEA)

## THE SCIENCE

The enzyme-linked immunosorbent assay (ELISA) and the real time reverse transcription-polymerase chain reaction (real time RT-PCR) are two nuclear-derived techniques commonly used for disease diagnosis.

ELISA is easy to set up and use, which makes it suitable for any veterinary or medical laboratory. Scientists place a diluted serum sample from an animal on a microtiter plate pre-coated with a specific antigen. If the sample contains the antibodies against the disease, they will bind to the antigen and a secondary antibody labelled with an enzyme will change the liquid’s colour, confirming the presence of the disease. ELISA is often used as initial tests and is mainly (but not exclusively) used for antibody detection. The ELISA test was developed based on radio-immunoassay, in which the antibodies were initially labelled using radioactive isotopes.

Real time RT-PCR is a technique that involves more sophisticated equipment and procedures than ELISA and is highly sensitive and accurate, making it well-suited for identifying specific viral and bacterial genomes. It uses an enzyme to replicate, or amplify, a specific genetic region of a pathogen’s DNA several billion times in just half an hour. Scientists then detect and monitor this DNA amplification through either radioisotopes or by measuring fluorescence released during the process of amplification.

# Nuclear science to tackle vector-borne diseases

By Sinead Harvey

Mosquitoes are among humankind's deadliest enemies because of their ability to transmit diseases such as malaria and Zika virus disease, which can cause devastation on a global scale. However, some countries are using a nuclear-based birth control method, the sterile insect technique (SIT), to combat mosquito-borne illnesses such as dengue. One such country is Bangladesh.

“Dengue ravished Bangladesh on an unprecedented scale in 2019. There were over 100 000 reported cases, our health system was overwhelmed with people suffering from severe flu-like symptoms, and more than 150 people lost their lives,” said Mahfuza Khan, Director of the Institute of Food and Radiation Biology at the Bangladesh Atomic Energy Commission. Prolonged monsoon rains provided the ideal breeding ground for the Aedes species of mosquito, which spread dengue and other diseases such as Zika and chikungunya. “As we are fighting to save people from these diseases, our efforts to control mosquitoes should be focused on an integrated approach, including the use of the SIT.”

Bangladesh turned to the IAEA for assistance in August 2019. A four-year plan was then developed for implementing the SIT as part of an area-wide integrated pest management programme to control Aedes mosquitoes.

Several countries, including Brazil, Cuba, Germany, Greece, Indonesia, Italy, Malaysia, Mauritius, Mexico, Spain and the United States of America are developing the use of SIT for mosquito control. Bangladesh is also developing its use with support from the Peaceful Uses Initiative (PUI).

The SIT is an environment-friendly technique whereby target insects are mass-reared and then sterilized using radiation. The sterile males are packaged up and sent to the infested areas and released to mate with wild females. The mating results in no offspring, reducing the wild insect population over time. This technique has been used for over 70 years and has been successful in controlling several agricultural insect pests.

“Following the request from Bangladesh, the IAEA, in cooperation with the Food and Agriculture Organization of the United Nations (FAO), sent a multidisciplinary team to assess the outbreak and help local experts develop a plan for the use of the SIT, in combination with other methods, to suppress the mosquitoes spreading the disease,” said Rui Cardoso Pereira, Head of the Insect Pest Control Section in the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

Since 2016 the initiative has received almost €2.5 million in funding from Japan, the United Kingdom and the United States to help advance SIT-related research and development for mosquito control and overcome the challenges of using it on a wide scale for Aedes mosquitoes, as well as Anopheles mosquitoes, which spread the malaria parasite.

## Mass rearing mosquitoes

“With mosquitoes, there are certain challenges that have to be overcome before the SIT can be used on a large scale,” said Cardoso Pereira. The first of these challenges is how to feed and rear the mosquitoes that are to be irradiated for release.

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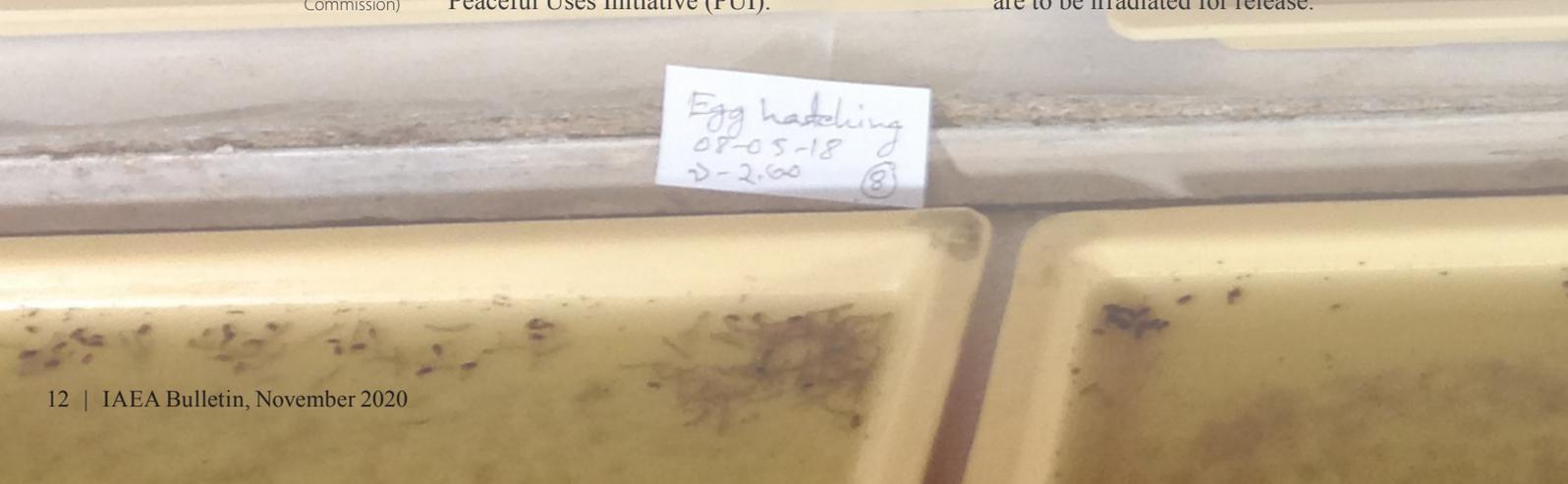
**“The Aedes mosquito is invasive to our area and is increasingly resistant to insecticides, making traditional control techniques less effective.”**

— Rachel Morreale, Manager of Applied Science and Technologies, Lee County Mosquito Control District, Florida, United States

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**Aedes aegypti mosquitos being raised in Bangladesh rearing trays with fish food as the larval diet.**

(Photo: Bangladesh Atomic Energy Commission)



Research and development efforts have improved the cost-effectiveness of mass rearing. The switch from stainless steel to cheaper aluminium and plastic in the design of racks and cages, among other improvements, allows for larger-scale implementation of mass rearing conditions.

### Separating females from males

It is female mosquitoes that bite and pass on disease, so ensuring that only the sterilized males are released is crucial.

In *Aedes* mosquitoes, males and females can be separated at the pupal stage, as female pupae are significantly larger than male pupae. This method, however, is not always precise, as pupal size is affected by conditions such as diet, rearing conditions, density of the insect population and other environmental factors. Therefore, to further optimize the separation of male and female *Aedes* mosquitoes, scientists in the Joint FAO/IAEA Division have, as part of a PUI-supported project, developed a genetic sexing strain that brings out red eye colour in females and black eye colour in males, which is expected to facilitate sex separation in SIT applications.

### Irradiating mosquitoes

Historically, gamma ray irradiators have been used for the mass sterilization of insect pests as part of SIT programmes. Recent research conducted by the IAEA and FAO has shown that X-ray irradiators are also suitable for this process. It is with X-rays that scientists at the Lee County Mosquito Control District (LCMCD) in Florida, United States, are carrying out their SIT programme on the *Aedes* mosquito in collaboration with the IAEA. “The *Aedes* mosquito is invasive to our area and is increasingly resistant to insecticides, making traditional control techniques less effective,” said Rachel Morreale, Applied Science and Technologies Manager at LCMCD. “As our programme is sterilizing via X-rays and not gamma rays, we can provide a different perspective and approach.”



The LCMCD received support from the IAEA, including assistance with the calibration of its X-ray machine. “The experiences that we have learned and the improvements that we have made can be of great assistance to other countries,” added Morreale.

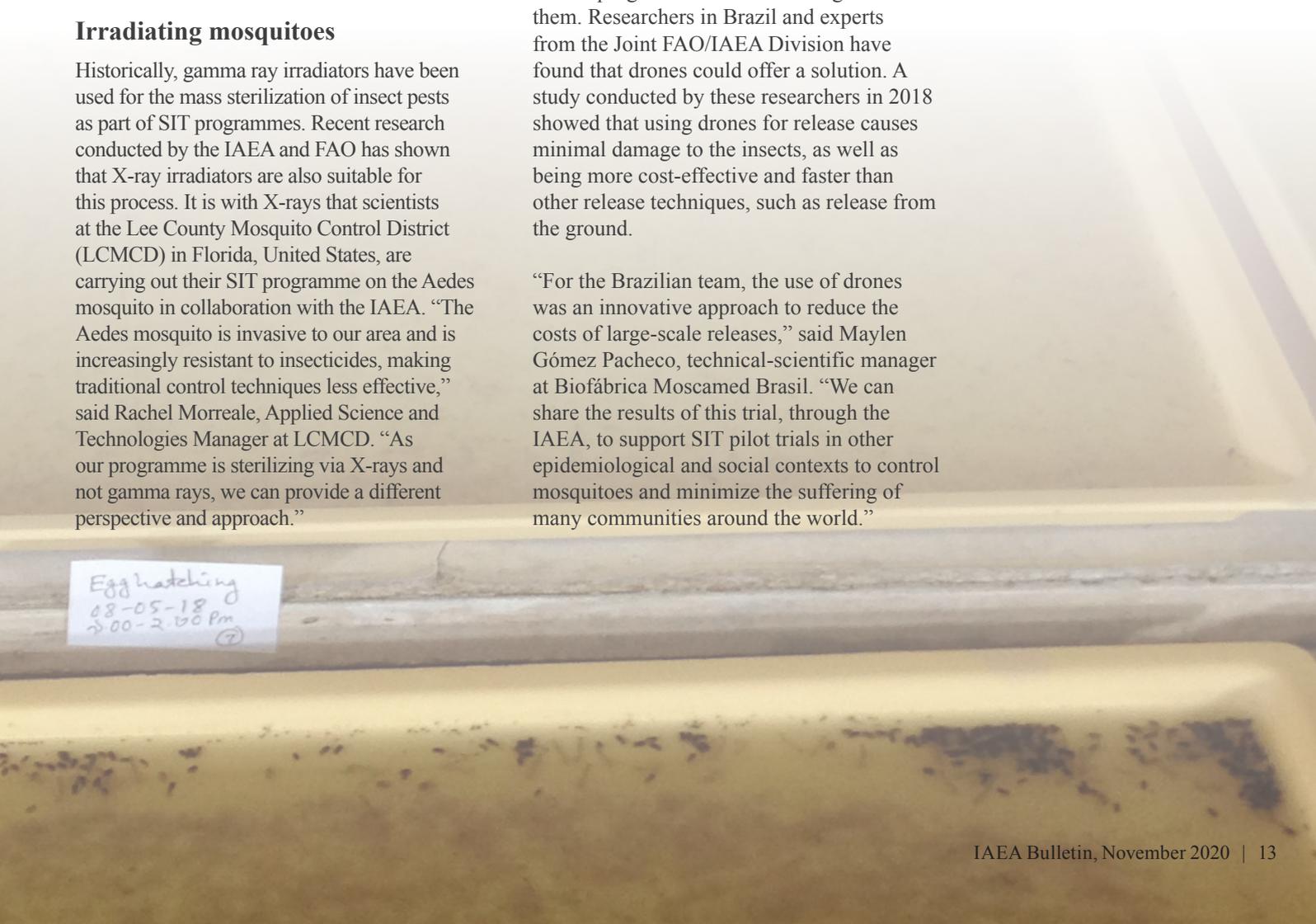
### Mosquitoes at the Insect Pest Control Laboratory.

(Photo: D. Calma/IAEA)

### Drones for release of fragile pests

Mosquitoes are fragile, and it is important that their release into the environment during an SIT programme does not damage or kill them. Researchers in Brazil and experts from the Joint FAO/IAEA Division have found that drones could offer a solution. A study conducted by these researchers in 2018 showed that using drones for release causes minimal damage to the insects, as well as being more cost-effective and faster than other release techniques, such as release from the ground.

“For the Brazilian team, the use of drones was an innovative approach to reduce the costs of large-scale releases,” said Maylen Gómez Pacheco, technical-scientific manager at Biofábrica Moscamed Brasil. “We can share the results of this trial, through the IAEA, to support SIT pilot trials in other epidemiological and social contexts to control mosquitoes and minimize the suffering of many communities around the world.”



Egg hatching  
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# Nuclear technology for cancer care

## IAEA projects provide a dose of support

By Carley Willis

*Around the world, one in six deaths is caused by cancer. Many countries are looking to the IAEA for support in comprehensive cancer care, equipment and training to address the growing cancer burden.*

*As of the end of October 2020, there are 16 projects supported through the Peaceful Uses Initiative (PUI) addressing cancer worldwide and contributing to Sustainable Development Goal 3: Good health and well-being. Some examples of IAEA projects using nuclear technology to improve cancer care around the world are provided below.*

**Strengthening National Capacities in Nuclear Medicine and Radiotherapy to Provide Quality Service to the New Cancer Center** is supporting Burkina Faso in the construction of its first radiotherapy facility. Under the project, two nuclear medicine physicians are participating in a four-year training fellowship in the Department of Nuclear Medicine of the Bab El Oued University Hospital in Algeria, while others have trained at institutions in Belgium and Morocco, gaining expertise in nuclear medicine and radiotherapy.

**Establishing National Capacity for an Integrated Approach to Early Detection, Diagnosis, Management, Prevention and Research on Cancer and Radiation Safety** is a project aimed at expanding early detection, diagnosis and treatment services for cancer in Kenya. Thanks to this project, in August 2020, the radiotherapy department of the Kenyatta National Hospital in Nairobi procured a computed tomography (CT) scanner, a device that scans the part of the body to be treated with radiation to determine the most appropriate cancer treatment plan. The project has also helped the training of experts, contributing to sustainable and accessible cancer treatment.

**Expanding Radiotherapy and Nuclear Medicine Services for the Diagnosis, Curative and Palliative Treatment of Cancer Patients and the Efficient Diagnosis and Treatment of Other Diseases** focuses on achieving comprehensive cancer care by widening the availability of related services throughout Ethiopia. By establishing radiotherapy and nuclear medicine facilities at five hospitals, advanced cancer care will be accessible outside the country's capital, Addis Ababa. In 2019, there was only one operational radiotherapy machine in the country, making the

BURKINA  
FASO

KENYA

ETHIOPIA

average waiting time for treatment one year – by which time 70 per cent of patients were in the final stages of the disease. With more equipment in Ethiopia’s hospitals and over 25 experts trained, cancer prevention and cancer care are becoming more accessible across the country.

**Providing Patients with Access to Public Nuclear Medicine Services for Early Diagnosis and Treatment** is aimed at improving the quality of life for cancer patients in Paraguay. This is achieved through efficient diagnosis and corresponding therapy, such as with the country’s first hybrid imaging system at the Health Sciences Research Institute in Asunción, the country’s capital. Additionally, nuclear medicine equipment and shielding devices to ensure the safe use of radiopharmaceuticals – drugs containing radioactive isotopes used in cancer treatment – were provided, ensuring the project’s longevity. Through the support of the PUI, an increasing number of patients now have access to brachytherapy – a form of radiation therapy used to treat cervical cancer – with new equipment available at Paraguay’s National Cancer Institute. Fellowships to train national experts, as well as expert missions to support the development of clinical protocols, took place as part of the project.

**Strengthening National Capacities for Diagnosis and Treatment of Cancer Patients** aims to reduce cancer mortality in Peru. It focuses on helping hospital staff update their knowledge of the use of ionizing radiation for effective cancer treatment, with a view to establish standardized processes, protocols and procedures. As a four-year project concluding in 2020, seven training courses have taken place on topics such as basic clinical radiobiology, quality management systems in a clinical practice and immobilization techniques for technicians. Experts travelled to Peru to assess cancer care services and provide advice and technical guidance. Fellowships enabling the participants to receive hands-on training were organized for young professionals to strengthen diagnostics and treatment capabilities using radiation medicine. Four portable digital radiographic mobile X-ray systems were installed at two hospitals in northwestern Peru, improving the infrastructure of the hospitals and the range of care they can provide.

**Strengthening Capacity for Cervical Cancer Control through Improvement of Diagnosis and Treatment** aims to reduce cervical cancer mortality by strengthening diagnosis and treatment availability in cancer control programmes. Beneficiaries of this initiative include 27 countries, such as Kyrgyzstan and Mongolia, which have both received ultrasound machines. Additionally, over 60 participants have been trained through fellowship programmes and training courses. To ensure the longevity and long term success of the project, an online learning platform was developed for professionals in the field of nuclear medicine, enabling them to keep abreast of developments, best practices and new findings in the field.



# Developing nuclear power infrastructure in newcomer countries

By Matt Fisher

While the construction of a nuclear power plant may be the most visible sign of a new nuclear power programme, major work behind the scenes is required beforehand. This includes building infrastructure in areas ranging from human resources to regulatory and legal frameworks. Thanks to significant funding through the Peaceful Uses Initiative (PUI), the IAEA can deliver a variety of programmes to help in the development the infrastructure necessary for introducing nuclear power successfully.

Around 30 countries are currently considering or embarking on nuclear power and working with the IAEA to introduce this reliable, low carbon energy source in a safe, secure and sustainable way. The IAEA supports these nuclear newcomers with advice and capacity building under the Milestones Approach, a three-phase method that enables countries to develop a national infrastructure for a nuclear power programme.

“Newcomers to nuclear have varying levels of infrastructural readiness, and our support programmes help countries with their unique situations on an as-needed basis,” said Milko Kovachev, Head of the IAEA’s Nuclear Infrastructure Development Section. “Funding from the PUI has allowed us to expand and tailor our assistance to several countries interested in developing nuclear power.”

Nuclear power programmes require a diverse mix of specialized, well-trained professionals in fields such as engineering, project management, nuclear safety and security

and non-proliferation. To assist interested countries with planning and developing their human resources, the IAEA uses the Nuclear Power Human Resources (NPHR) modelling tool, which analyses human resource development plans for new nuclear power programmes.

Initially made available to the IAEA by the United States in 2011, the tool utilizes data encompassing all areas of a nuclear power programme and allows users to select various staffing approaches according to their country’s specific needs. The NPHR model is designed to help countries assess gaps in their human resources plans and project both the number and type of personnel that they will need for their nuclear power programme.

The IAEA provides free access to the tool, as well as conducts weeklong training courses on how to use it. To date, the IAEA has conducted NPHR training for more than 15 countries.

In April 2019, a training course on the NPHR tool was conducted in Vienna with experts from Niger, a country which is considering the introduction of nuclear power. The course provided an overview of how to use the tool and incorporated data specific to Niger, including elements of their educational system and existing workforce.

In October 2019, a workshop was held in Poland to provide feedback on the country’s national workforce plan and assist in updating its country specific NPHR model. Poland plans to deploy up to 9 000 GW(e) of nuclear

**During a training course in July 2019, participants visited Zwentendorf nuclear power plant in Austria, which never went into operation and is used for training and demonstration purposes.**

(Photo: N. Kurova-Chernavina/IAEA)



power in the coming years in order to reduce its dependence on coal-fired power plants and cut carbon emissions.

“The greatest advantage provided by the training was the ability to simulate various scenarios with national baseline data according to dynamic changes in areas such as programme implementation schedule and availability of technical staff,” said Marzena Kurpinska, a specialist at the Polish Ministry of Climate and Environment’s Nuclear Energy Department. “The exercise helped us assess whether we have sufficient human resources to build and maintain nuclear power plants over the next several decades.”

### Toward integrated management systems

To ensure the safety and effectiveness of nuclear power programmes, it is crucial to implement and maintain strong leadership and management systems. The four-year Integrated Management Systems (IMS) project, launched in 2017, aims to help newcomer countries understand the essential aspects of management and leadership, with an emphasis on coalescing elements of nuclear safety with security, safeguards, quality assurance and environmental protection into a unified, dynamic management system.

Project activities include expert missions and workshops designed to address specific gaps in management systems within both operating organizations and regulatory bodies. This is in line with the guidance laid out in Leadership and Management for Safety publication (IAEA Safety Standards Series No. GSR Part 2).

The IMS project also involves assessing countries’ management plans via document reviews conducted by either IAEA staff or

external consultants and making suggestions for potential areas of improvement. Two such reviews were performed for Ghana in 2020. Ghana is advancing through the stages of nuclear power development, with Nuclear Power Ghana established in 2018 to manage the construction and operation of Ghana’s first nuclear power plant. Ghana’s Nuclear Regulatory Authority was established in 2015.

“The review missions were instrumental in helping us identify strengths and weaknesses as we move to an integrated management system for meeting safety and other requirements,” said Charles Kofi Klutse, a researcher at Ghana Atomic Energy Commission’s Nuclear Power Institute. “The review team helped us adopt a holistic approach to developing, implementing and continuously improving our management systems in line with the objectives of our nuclear power programme.”

Another tool developed with PUI funding is the Nuclear Infrastructure Competency Framework database. The database contains information on the competencies required for developing a nuclear power programme, based on the IAEA safety standards, nuclear security guidance and Nuclear Energy Series publications. Users may search the database for specific topics, such as infrastructure or implementation phase, to enhance their understanding of the competencies required at various stages of programme implementation.

Since its inception in 2010, the PUI has helped to raise more than €10 million to support infrastructure and human resource development projects. This includes interregional technical cooperation projects such as “Supporting Knowledgeable Decision-making and Building Capacities to Start and Implement Nuclear Power Programmes”, which is ongoing.

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**“The exercise helped us assess whether we have sufficient human resources to build and maintain nuclear power plants over the next several decades.”**

— Marzena Kurpinska, Ministry of Climate and Environment, Poland

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# Navigating ocean acidification

Coordination Centre advances global efforts in ocean acidification education, capacity building and science

By Joanne Liou

Playing a key role in the Earth’s climate and weather systems, as well as in the global carbon cycle, the ocean is an immeasurable force of nature. However, human activities have fundamentally altered the ocean’s chemical composition. Since the late 1980s, 95 per cent of open ocean surface water has become more acidic, a process referred to as ocean acidification. With atmospheric carbon dioxide levels 50 per cent above pre-industrial levels, the problem is getting worse.

“The ocean continuously absorbs about one quarter of the carbon dioxide that is emitted into the atmosphere every year,” said Peter Swarzenski, Head of the IAEA’s Radioecology Laboratory in Monaco. “While this is very good to lessen the deleterious impacts of sustained climate change, it also comes at a steep cost as seawater becomes more acidic.”

The IAEA supports countries around the world in utilizing nuclear and nuclear-derived techniques to develop a science-based understanding of changes in the ocean. In response to growing concerns from the scientific community and governments

regarding ocean acidification, the IAEA established the Ocean Acidification International Coordination Centre (OA-ICC) in 2012. Supported by the Peaceful Uses Initiative, it focuses on science, capacity building, outreach and communication about the status and trends of ocean acidification, promoting science-based decision making.

## Exploiting waves of scientific data

“To reduce the impact of ocean acidification on select marine organisms and the possibility of altering marine ecosystems, we need a series of data points indexed chronologically to observe trends and assess the ocean’s viability,” said Sheck Sherif of Liberia’s Environmental Protection Agency. “To understand ocean acidification, data is needed on temperature, salinity, oxygen, pressure and the carbonate system. It is essential that researchers and industry practitioners can readily access and use this information.”

In collaboration with partners such as the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World



## OA-ICC BY THE NUMBERS

2012-2019

### NEWS STREAM

-  More than 9800 posts
-  Over 250 000 visitors
-  222 countries represented

### DATABASE

-  4790 publications added
-  6116 references listed

### TRAINING

-  500 scientists participated
-  72 developing countries represented

Ocean Acidification International Coordination Centre

Meteorological Organization, the Global Ocean Observing System and the International Ocean Carbon Coordination Project, the OA-ICC supported the launch of the Global Ocean Acidification Observing Network (GOA-ON) in 2013. The GOA-ON data portal provides information on ocean acidification monitoring facilities and includes access to real-time data. GOA-ON also facilitates a global approach to prevent duplication of monitoring efforts and to define a common research strategy.

This global network is comprised of about 750 scientists from 100 countries. One of the main goals of GOA-ON is to increase monitoring in areas where data is scarce, including the coasts of Africa and the Indian Ocean. “The lack of availability of instrumentation has hampered the efforts of most developing countries, and the research organizations situated in them, to make sustained measurements. In response to global needs, the GOA-ON developed simplified methods and equipment kits for measuring water quality, pH and total alkalinity,” Sherif said. The kits, known as ‘GOA-ON in a Box’, have been distributed to scientists in 16 countries in Africa, the Pacific and Latin America.

### **Increasing capacity across the seas of Asia**

More than 30 experts from Bangladesh, India, Malaysia, Myanmar, the Philippines, Sri Lanka and Thailand convened in Kolkata, India, in January 2020, to strengthen scientific research capacity in South and South East Asia. The OA-ICC supported the workshop, hosted by the Centre for Climate and Environmental Studies (CCES) and Integrative Taxonomy and Microbial Ecology Research Group at the Indian Institute of Science Education and Research Kolkata.

Lectures and training focused on carbonate chemistry, biological effects, experimental setup, monitoring approaches, modelling and socioecology. A field trip to a wildlife sanctuary allowed for on-site discussions on sampling approaches. “The Sajnekhali Wildlife Sanctuary and surrounding areas of the Indian Sundarbans mangrove forest provided the participants with an understanding of the challenges of undertaking ocean acidification measurements in dynamic coastal ecosystems,” said Punyasloke Bhadury, Head of CCES.

Participants also discussed closer cooperation and coordination in ocean acidification research. “There is an ongoing discussion between scientists and policy makers to develop another regional hub and mechanisms for funding support, capacity building programmes and instrumentation support,” Bhadury said. “The establishment of a regional hub is critical to monitoring the seas and oceans, which are reeling from ocean acidification, and the resulting implications for vulnerable ecosystems, as well as the socioeconomic effects.”

### **Streaming information to raise awareness**

The OA-ICC is an active voice in the international sphere, elevating the topic of ocean acidification to the forefront of discussions at the United Nations Climate Change Conferences and on the Sustainable Development Goals. In collaboration with the Intergovernmental Oceanographic Commission of UNESCO, the OA-ICC hosted an event as part of the United Nations High-Level Political Forum on Sustainable Development in July 2020 to highlight success stories and ways to advance capacity building to address ocean acidification. At the virtual meeting, more than 90 participants heard from a panel of experts that called for more integrated, science-based management to minimize the impacts of ocean acidification on wildlife. “As a United Nations agency, we seek to empower Member States to start ocean acidification monitoring, contribute to the reporting process of Sustainable Development Goal 14.3 on ocean acidification and, ultimately, to inspire mitigation and adaptation actions,” Swarzenski said.

The OA-ICC also manages a dedicated, open-access website that offers a steady stream of scientific reports, media coverage, policy briefs and other material pertaining to ocean acidification. The news stream centralizes information to raise awareness about ocean acidification and to amplify efforts addressing the issue and its implications. “One of the key objectives of the OA-ICC is to facilitate the exchange of information on ocean acidification and make resources available to stakeholders and policy makers around the world,” Swarzenski said. “We work with research programmes and organizations worldwide to effectively communicate on ocean acidification to a larger audience.”

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**“The establishment of a regional hub is critical to monitoring the seas and oceans, which are reeling from ocean acidification, and the resulting implications for vulnerable ecosystems.”**

— Punyasloke Bhadury,  
Head, Centre for Climate and  
Environmental Studies, India

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# Virtual school helps standardize drafting safety regulations

By Carley Willis

**I**AEA training on drafting nuclear and radiation safety regulations now has a virtual twist — in line with the times. The IAEA recently launched a new programme, funded through the Peaceful Uses Initiative (PUI), which combines face-to-face sessions with online learning to help experts worldwide build skills and competence in drafting safety regulations in order to harmonize regulatory requirements.

The Virtual School on Drafting Safety Regulations is based on the IAEA’s traditional, in-person School, which was launched in 2010. Since then, 19 in-person courses have been held, with 60 experts involved in training more than 350 participants from around the world.

The School provides the participants with hands-on experience in drafting regulations that are consistent with IAEA safety standards, which represent the international consensus on nuclear safety. The courses provide professional guidance and include drafting sessions facilitated by experts, peer discussions and practical exercises to prepare the participants for developing and implementing regulations in their countries.

While the IAEA safety standards serve as recommendations to ensure global safety in the nuclear field, regulating safety is each country’s national responsibility. By taking part in the School, national authorities are able to draft regulations that are in line with both country-specific needs and IAEA standards.

“This School is an excellent opportunity for the countries involved to have trained regulators ready to support their authorities in preparing legislative documents in areas related to the peaceful uses of nuclear technology,” said Sotiris Economides, course director at the Regional Training Centre in Europe of the Greek Atomic Energy Commission. “It is an efficient way to sustain the competence of the authorities at the national level, as it reinforces the in-country preparation and training of the participants before meeting the experts and peers for the face-to-face training.”

## Drafting safety standards in Seychelles

Participants in the School have the chance to submit proposals ahead of time for regulations they want help in drafting. Shawn Hunt, a radiation safety officer at the

**The Virtual School of Drafting Regulations assists countries in developing their national regulations in all areas of safety, such as the regulation of the transport of nuclear and radioactive material.**

(Photo: IAEA).



Seychelles Nuclear Safety and Radiation Protection Authority, plans to take part in the next edition of the School in 2021 in order to receive assistance in drafting follow-up legislation for addressing specific safety requirements. The regulations will mirror those outlined in the IAEA safety standards and follow current international standards, procedures and guidelines.

“This will only be the second regulation that we as an authority have drawn up,” Hunt said. “Any training involving the drafting of regulations is immensely valuable, not only for me personally but for the entire radiation sector and the country as a whole.”

Hunt’s participation in the School will build on the experiences of other officials from the Seychelles who attended in 2016. Their participation led to the amendment of the country’s first Radiation Safety and Security Act, which was adopted in 2014, bringing it in line with international standards.

“The School was a good opportunity to align our regulations with General Safety Requirements Part 3 and the model regulations of the IAEA,” said Stephanie Boniface, a senior employment officer at the Ministry of Employment, Immigration and Civil Status of Seychelles. “Additionally, we were able to share experiences with other African countries who were at different stages of drafting their regulations and with facilitators from developing countries like Seychelles, who were able to guide us on how to incorporate these provisions.”

## Widening the scope

In 2019, Schools were organized by the IAEA to assist the participants in drafting regulations for both nuclear safety and nuclear security.

The School now also offers differentiated training programmes for each of the five major safety areas: nuclear safety, radiation safety, waste and transport safety, and emergency preparedness and response.

“The School creates a harmonization in regulations and brings consistency in the measures that are put in place in a given country,” said Richard Ssegane, Head of the Nuclear Security Unit at the Atomic Energy Council of Uganda, who participated in a former edition of the school in 2019. “This helps the operators and practitioners have accountability and a legal obligation to put in place sufficient measures and regulations.”

More recently, the IAEA has introduced a training component that combines radiation safety and security of radioactive material to assist the participants in drafting regulations for facilities and activities handling radiation sources. This approach aims to foster cooperation between safety and security experts to make regulation implementation more efficient and consistent.

The Virtual School on Drafting Safety Regulations is scheduled to take place for countries in Latin America and the Caribbean in March 2021. For countries in Africa, the school will take place in 2022.

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**“Any training involving the drafting of regulations is immensely valuable, not only for me personally but for the entire radiation sector and the country as a whole.”**

— Shawn Hunt, Radiation safety officer, Nuclear Safety and Radiation Protection Authority, Seychelles

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# Raising the bar

## Serbia adopts nuclear safety and security law with legislative assistance from the IAEA

By Joanne Liou

To ensure the safe, secure and peaceful use of nuclear technology in any country, whether in the medical, agricultural or industrial fields, an effective and comprehensive national legal framework is critical. In line with its mandate, the IAEA provides legislative assistance, upon request, to help countries to create, implement and maintain this framework.

With support from the IAEA's technical cooperation programme and the Peaceful Uses Initiative, the IAEA's legislative assistance programme prepares needs assessments, provides training courses and workshops, develops reference material and offers strategic advice and assistance in drafting and reviewing national nuclear legislation. More than 100 countries have benefited from this assistance.

### Establishing nuclear safety and security in Serbia

Since Serbia became an IAEA Member State in 2001, representatives from the country have participated in regional workshops hosted by the IAEA as a part of its legislative assistance programme, including the IAEA Nuclear Law Institute (NLI). In the last 10 years, around 600 officials from around the world have participated in the NLI, which is an annual two-week training course focused on legislative drafting.

“Through our representatives’ regular participation in the NLI and bilateral meetings with the IAEA, we have managed

to get significant clarifications of issues when developing our new nuclear law,” said Branko Brajic, Assistant Director at the Serbian Radiation and Nuclear Safety and Security Directorate.

IAEA legal staff and experts contributed to the drafting of Serbia's recent nuclear safety and security law. “We assisted the country through the review of its draft Law on Radiation and Nuclear Safety and Security with the aim of ensuring the law's alignment with relevant international legal instruments, standards and guidance,” said Wolfram Tonhauser, Head of the IAEA's Nuclear and Treaty Law Section. “The new law, which was adopted in February 2019, establishes the Serbian Radiation and Nuclear Safety and Security Directorate as an independent regulatory body.” The Directorate assumed all regulatory duties in radiation and nuclear safety and security, including inspection oversight and decommissioning.

The law aims to protect the public and the environment from the effects of ionizing radiation. It regulates the use of radiation sources and the response to radiation exposure in planned, existing and emergency situations. “This law is an example of comprehensive legislation in this field, especially when it comes to countries that, like Serbia, do not have nuclear power programmes,” Brajic said. “In the future, Serbian representatives, with help from the IAEA, will continuously work on upgrading statutory provisions in line with technical and technological advances.”

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**“We have managed to get significant clarifications of issues when developing our new nuclear law.”**

— *Branko Brajic, Assistant Director, Radiation and Nuclear Safety and Security Directorate, Serbia*

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**Serbia's Hangar H3 accepts low and intermediate radioactive waste. It has been in operation since 2012.**

(Photo: Public Company Nuclear Facilities of Serbia)

## Enhancing nuclear legal frameworks in Europe and Central Asia

The IAEA is implementing a regional legislative assistance project with countries across Eastern Europe and Central Asia. Its goal is to help governments to create, implement and maintain comprehensive national nuclear legal frameworks and become party to the relevant international legal instruments. “The available legislative assistance will enable all participating countries to assess, revise and draft national legislation,” said Brajic, who serves as the lead coordinator of the regional project. “Many countries have already submitted their informal work plans identifying assistance in support of their efforts to strengthen their legal framework.” The project will enhance understanding and capabilities through training in nuclear law, while raising decision makers’ awareness of the benefits of international legal instruments and comprehensive national legal frameworks.

In the first of a series of events under this initiative, the IAEA organized a regional workshop on harmonizing national nuclear law with international and European law, hosted by the University of National and World Economy in Sofia, Bulgaria, in January 2020. “This workshop, as well as all intended activities within this project, is expected to lead to better addressing all relevant topics and common challenges concerning the national nuclear legal framework and enhanced collaboration between more experienced and less experienced countries,” Brajic said. More than 50 participants attended the workshop, which covered all branches of nuclear law: safety, security, safeguards and civil liability for nuclear damage.

However, owing to the COVID-19 pandemic, several activities had to be postponed. As an



interim measure, virtual activities are taking place.

“The launch of our Webinar Series on Nuclear Law on 5 October marks a new approach, during this current period of international travel disruptions, to engaging with our Member States in this area,” Tonhauser said. Around 480 officials participated in the first webinar, which covered the role of the IAEA.

“Due to interest in the series, we will host a webinar on nuclear law for the general public as well. It will provide an opportunity for individuals and organizations, including from industry, law firms, non-governmental organizations, civil society and academia, to engage with IAEA staff and international experts on the subject,” Tonhauser added.

**Peri Lynne Johnson, IAEA Legal Adviser and Director of the Office of Legal Affairs, and Wolfram Tonhauser, Head of the IAEA’s Nuclear and Treaty Law Section, present at the Webinar Series on Nuclear Law.**

(Photo: C. de Francia/IAEA)

# IAEA launches new phase in renovations to build labs fit for the future

By Wolfgang Picot

**“The modernization of the laboratories represents a critical investment in the IAEA’s ability to address the needs of Member States.”**

— Najat Mokhtar, Deputy Director General, IAEA

An extensive renovation project, called ReNuAL is entering a new phase to provide the IAEA Secretariat — and Member States — with state-of-the-art facilities for the remainder of its eight nuclear applications laboratories in Seibersdorf, Austria. Thanks to contributions totalling nearly €40 million, raised partially through the Peaceful Uses Initiative (PUI), for the first two stages of the project, four of the eight laboratories are now housed in new buildings and a fifth has a new linear accelerator (linac) facility.

In September 2020, IAEA Director General Rafael Mariano Grossi launched ReNuAL 2 to modernize the remaining laboratories, at an estimated cost of approximately €34.5 million.

Located near Vienna, the laboratories offer specialized support to countries around the world. “The eight IAEA nuclear applications laboratories in Seibersdorf provide unique services to all of our 172 Member States in applied research, training and specialist support in food and agriculture, human health, environmental monitoring, the use of nuclear analytical instrumentation and many other areas,” Mr Grossi said.

Examples of the laboratories’ activities include assistance in cancer care, help in developing more efficient agriculture,

including more productive and resilient crops and research on human and zoonotic diseases. Most recently, the IAEA supported more than 120 countries and territories in the use of nuclear-related reverse transcription–polymerase chain reaction (RT–PCR) technology for the detection of COVID-19 infections.

ReNuAL 2 will include the construction of a new building to house the Terrestrial Environment Laboratory, the Plant Breeding and Genetics Laboratory and the Nuclear Science and Instrumentation Laboratory. It will also replace the IAEA’s ageing greenhouses. These facilities are essential for the IAEA’s work on climate-smart agriculture, water resources management and food security. Furthermore, ReNuAL 2 will provide for the complete refurbishment of the Dosimetry Laboratory, which will stay in the building it currently occupies. Dosimetry is essential to ensure that cancer patients receive safe radiation doses.

ReNuAL reached its latest milestone in June 2020 when Director General Grossi opened The Yukiya Amano Laboratories building. The facility is named after the late former Director General Yukiya Amano, who had worked tirelessly to realize the renovation of the Seibersdorf laboratories. The building houses the Animal Production and Health

## September 2013

The General Conference calls for the modernization of the nuclear applications laboratories.



## September 2014

Symbolic groundbreaking ceremony for the ReNuAL project.



## September 2017

A new building housing the Insect Pest Control Laboratory (IPCL) inaugurated.



Laboratory, the Food and Environmental Protection Laboratory, and the Soil and Water Management and Crop Nutrition Laboratory. They help countries in agriculture, food security and natural resource management and support them in addressing zoonotic diseases such as COVID-19, avian influenza, Ebola and Zika virus disease.

Major milestones of the project included an initial upgrade of the Dosimetry Laboratory, as well as the opening of a new Insect Pest Control Laboratory (IPCL) in 2017 and a new linac facility in 2019.

The linac bolsters the IAEA’s capacity to carry out dosimetry calibration and dose audits and supports its activities in cancer control. The linac is also used for research and to train professionals from around the world.

With over 1700 square meters of laboratory space, the modernized IPCL substantially increases the IAEA’s ability to assist Member States in applying the sterile insect technique (SIT). For over five decades, the SIT has been successful in controlling several harmful insect pests. It is among the most environmentally friendly insect pest control methods developed.

The activities of the labs make them a guiding institution for the international nuclear science community and are essential to the IAEA’s work to help Member States achieve the Sustainable Development Goals (SDGs). The nuclear applications laboratories have long-standing strategic partnerships with

the World Health Organization and the World Organisation for Animal Health and work with key academic and research institutions and reference laboratories around the world. Five of the labs are managed through a partnership with the Food and Agriculture Organization of the United Nations (FAO).

When the Seibersdorf Complex opened in 1962 with fewer than 40 staff members, only a limited number of countries and sectors used nuclear technologies. Since then the world has changed. Today, nuclear and nuclear-derived techniques are used across the globe for an unprecedented range of applications touching on all aspects of human existence. The number of IAEA Member States has more than doubled since the laboratories’ inception, and their needs are evolving as new challenges emerge.

To address the rising number of requests and ensure services are of the highest quality, the labs need appropriate infrastructure. The number of staff grew to around 100 over time, but facilities and equipment had never received a comprehensive upgrade. As a result, the nuclear applications labs were increasingly struggling to meet demand.

“The modernization of the laboratories represents a critical investment in the IAEA’s ability to address the needs of Member States,” said Najat Mokhtar, IAEA Deputy Director General and Head of the Department of Nuclear Sciences and Applications. “ReNuAL 2 will further improve their ability to achieve development goals and meet new challenges in the years to come.”

**June 2019**

The new linac facility opens.



**June 2020**

The Yukiya Amano Laboratories open.



**September 2020**

IAEA Director General Rafael Mariano Grossi launches ReNuAL 2.



# From soybeans to cancer treatment

## How Indonesia has benefited from the PUI and why it has become a donor to the programme

*Indonesia has received significant support under the Peaceful Uses Initiative (PUI) during the last ten years. It has achieved important milestones such as the development of new soybean and rice varieties through projects that have been financed by the IAEA's Regular Budget and Technical Cooperation Fund, as well as the PUI. A few years ago, Indonesia became one of the first developing countries to support the PUI, both financially and with human resources — offering its experts to provide advice to and training in other countries.*

*To discuss Indonesia's roles as both a recipient and a donor, IAEA Bulletin Editor Miklos Gaspar sat down with Darmansjah Djumala, Indonesia's Ambassador in Vienna, Permanent Representative to the United Nations in Vienna and former Chair of the IAEA's Board of Governors.*



**Ambassador Darmansjah  
Djumala of Indonesia**

(Photo: L. Han/IAEA)

### **Q: How has Indonesia benefited from the PUI?**

**A:** Let me start with the philosophy of our Government and foreign policy regarding nuclear technology applications. I begin with this because the PUI is very much in line with our national development philosophy.

Our Government pursues what our President calls a 'down-to-earth' foreign policy. This means that the foreign policy of the Indonesian Government focuses on tangible results of diplomacy. While diplomacy is often seen as public discourse and negotiations, for our Government, diplomacy is something very concrete. How can foreign policy benefit people? How can we deliver concrete results to the public?

Our nuclear diplomacy is very much in line with this as well. We have to provide benefits to the people via nuclear diplomacy

and nuclear applications — directly. This is why in nuclear diplomacy we focus on nuclear technology applications — and that is exactly what the PUI helps with. So the PUI is perfectly in line with our down-to-earth foreign policy. That is why we are very happy with this programme.

The PUI provides a platform for us to extend IAEA support to Indonesia. Direct benefits are particularly notable in agriculture and food security, including plant breeding, cattle breeding and insect pest control. We have made significant progress in the development of soybean varieties. We have increased the reproductive performance of cattle, which has helped farmers in many villages. The support has been very effective. We have also benefited in the area of cancer therapy and in the environmental sector.

We have received a lot from PUI projects, and we appreciate this very much.

**Q: How has the PUI complemented the support you received from the IAEA in technical cooperation and in Indonesia's participation in coordinated research projects?**

**A:** There have been additional budgetary resources made available through the PUI to extend support on top of what is provided under the Regular Budget and the technical cooperation programme. The PUI has become an excellent platform for Member States to contribute and support other IAEA programmes in the peaceful uses of nuclear technology. We hope that more Member States will provide financial support and human resources via the PUI in the future. The benefits will therefore be even more significant in Indonesia.

**Q: Why did Indonesia choose to contribute to the PUI?**

**A:** We have used the PUI to educate and increase the capacity of our scientists with regard to nuclear application technologies. This is well known.

Indonesia sees itself as a pioneer of South–South cooperation. Our philosophy is that when we have received something from others, there will be a time to give it back, to contribute, so that others can also benefit. If we have received something that benefits us from the IAEA, we need to share this benefit with others that are less developed than us. This is why we are very keen to share these benefits with other developing countries under the framework of South–South cooperation. As a developing country, we are in a good position to understand the needs of other developing countries. We want to show solidarity with them.

**Q: In what ways is Indonesia supporting the PUI?**

**A:** There are many ways in which we contribute to the PUI. We have IAEA

Collaborating Centres, where we have offered to host training for a series of technical cooperation projects, financed by the IAEA. We invite scientists from developing countries in Africa and Asia. We also send our expert scientists to other countries, such as Papua New Guinea, to give advice on the development of regulatory infrastructure for nuclear applications there. We host fellows almost every quarter. While we are not that developed overall, we are in the middle in terms of nuclear applications — we have knowledge and expertise to share. We also supported the ReNuAI Project — the renovation of the nuclear applications laboratories — because we consider this facility very important for research and development, as well as for capacity building.

**Q: How do you see the second decade of the PUI? What should, in your view, be the areas of focus, not just for Indonesia but for developing countries in general?**

**A:** The PUI is an instrument that can help in the implementation a number of the United Nations Sustainable Development Goals (SDGs). For the next decade, it should remain in line with SDGs implementation. We have to continue initiatives to improve food security, address climate change and other environmental issues, and support programmes in health care and industry.

I strongly support Zoonotic Disease Integrated Action (ZODIAC), the IAEA's new project to combat zoonotic diseases. It is very much in line with the needs of the health sector, and it is very timely, given the COVID-19 situation. I expect and hope that donor countries and all IAEA Member States will support this new project, as well as the initiative to combat plastic pollution, so that they can be implemented quickly.

**IAEA-supported projects in Indonesia**

(Photos: M. Gaspar/IAEA)



# Why the United States is supporting the Peaceful Uses Initiative

By Jeffrey L. Eberhardt



Ambassador Jeffrey L. Eberhardt serves as the Special Representative of the President for Nuclear Nonproliferation on behalf of the Secretary of State. He is the U.S. representative to Nuclear Nonproliferation Treaty (NPT) Review Conferences and related Preparatory Committee meetings, and performs diplomatic activities representing the United States and the Secretary of State at bilateral and multilateral conferences, consultations and negotiations dealing with implementing and strengthening activities related to the international nuclear nonproliferation regime in general, and the NPT in particular.

In 1992, US scientist Edward Knipping and his colleague Raymond Bushland received the prestigious World Food Prize for their successful work in the 1950s developing the sterile insect technique (SIT), a method of controlling harmful insect pests through irradiation. In 2012, after years of study, planning and work, Senegal introduced the SIT — with support from the United States — in a coastal area of the Niayes region to eradicate the bloodsucking tsetse fly, known for killing cattle and causing human “sleeping sickness” (human African trypanosomosis). Senegal joined a growing list of countries making use of this nuclear technique.

For over four decades, the SIT has been an important joint effort between the Food and Agriculture Organization of the United Nations (FAO) and the IAEA. The SIT uses irradiation to sterilize male insects, which are then released into the wild to mate with females without producing offspring. Over time, this reduces insect populations that spread disease. The Joint FAO/IAEA Programme on Nuclear Techniques in Food and Agriculture invests in applied research to improve the technique and supports the rollout of SIT packages to IAEA Member States.

Before the campaign in Senegal, this programme successfully eradicated the tsetse fly from the island of Zanzibar in the United Republic of Tanzania and helped control the insect pest in the Southern Rift Valley of Ethiopia. In Senegal, the technique led to the eradication of 99 per cent of the targeted

tsetse population in just six months. This enabled farmers to switch to more productive, non-disease resistant varieties of cattle, leading to increased meat and dairy output and providing a more secure livelihood for farmers. This is just one example of a programme through which the IAEA makes an enormous and cost-effective contribution to peace and prosperity worldwide.

Accelerating and enlarging the contribution of nuclear energy, science and technology to peace, health and prosperity has always been the driving mission of the IAEA, as set forth in its founding Statute in 1957, and as reinforced in Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) in 1970. The peaceful uses of nuclear science and technology hold answers for key challenges in sustainable development and provide excellent return-on-investment for the countries funding and implementing peaceful uses projects. However, the areas of great need that would benefit from peaceful uses cooperation and assistance far exceed the funding available to the IAEA through Member State contributions.

For these reasons, at the 2010 NPT Review Conference, the United States helped the IAEA launch the Peaceful Uses Initiative (PUI), with the goal of raising US \$100 million in additional funding for IAEA peaceful uses activities over five years. The United States pledged an initial US \$50 million toward this goal and challenged other countries to match that

amount. The PUI got off to a strong start with contributions from Australia, the Czech Republic, France, Hungary, Indonesia, Japan, Kazakhstan, New Zealand, South Korea, Sweden and the United Kingdom.\* The United States pledged another US \$50 million at the 2015 NPT Review Conference. Between 2010 and 2020, the United States and 23 other countries, together with the European Commission, contributed close to €175 million to the PUI.

The PUI allows contributors to support projects that have been developed and prioritized by the IAEA in consultation with IAEA Member States but that remain unfunded. It provides training and equipment for the application of nuclear techniques in human health, food security and water resources management, as well as for the safe and secure operation of nuclear power. PUI support also provides the IAEA with additional flexibility to develop and implement projects in reaction to unanticipated or urgent needs, such as responding to sustained drought in the Sahel region, monitoring radioactivity in the marine environment from the Fukushima Daiichi accident and helping Member States fight the Ebola and COVID-19 outbreaks.

We recognize there is much more to do to ensure the benefits of nuclear science and technology are widespread and accessible. Support from governments and from the public is key to the successful application of nuclear science and technology. IAEA Member States play a vital role in making the PUI successful, not just by donating but also by actively planning to achieve national development goals using nuclear science and technology, and then working with the IAEA Secretariat to develop and sustain national and regional projects that the PUI can support.

Take, for example, the widespread acceptance and growing use of nuclear science and technology in cancer diagnosis and treatment. Cancer control is a critical public health priority in many countries and therefore a focus of the IAEA's work. The IAEA helps countries formulate national cancer control programmes with a holistic approach involving all relevant national authorities, including by training specialized staff and planning for the development of appropriate national infrastructure to support the safe and secure use of equipment. The United States contributed US \$1.5 million to IAEA work on cancer in 2019 through the PUI and another US \$2.2 million in 2020 to upgrade the IAEA's Dosimetry Laboratory training facility in Seibersdorf, Austria, complementing other donations to the IAEA's work on cancer.

On the 50<sup>th</sup> anniversary of the NPT, we are highlighting this treaty's significant, though often unheralded, successes. One of those successes was to provide the framework to enable States to benefit from the peaceful uses of nuclear energy, science and technology in a safe, secure and safeguarded manner. Support for the PUI demonstrates the ongoing commitment of the United States to fulfill our NPT Article IV undertaking to facilitate the fullest possible exchange of nuclear technology for peaceful purposes. We look forward to continuing to work with the IAEA and other donors under the PUI to support priority projects in coming years.

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*\*In addition, the following entities have donated to the IAEA through the PUI: Belgium, Canada, the European Commission, Germany, Ireland, Israel, Kuwait, Malaysia, Monaco, Norway, Switzerland, Thailand and Turkey and other sources.*

# Supporting the PUI to strengthen the positive global impact of nuclear energy

By Takeshi Hikihara



Takeshi Hikihara is the Ambassador and Permanent Representative of Japan to the International Organizations in Vienna. He has more than 35 years of experience in foreign affairs and diplomacy.

The growing number and evolving needs of countries joining the IAEA call for timely assistance with the peaceful use of nuclear science and technology. The Peaceful Uses Initiative (PUI) plays an invaluable role in strengthening and supporting peaceful applications of nuclear technology and in providing assistance to countries worldwide. It does so by providing resources and supplementing the IAEA's Regular Budget and Technical Cooperation Fund (TCF), which help to ensure countries can continue to get the support they need when they need it.

Japan highly appreciates all the PUI has done since its establishment in 2010. The country has steadfastly supported the initiative with contributions that amount to more than €38 million to date. This has helped to fund 86 IAEA projects in a range of areas, such as cancer diagnosis and treatment, infectious diseases, food and agriculture, water resource management, environmental protection, nuclear safety and radiation protection, and nuclear infrastructure development.

## Supporting the PUI

Japan made its first contribution to the PUI in 2011 and has consistently supported the initiative ever since. There are three major reasons behind Japan's decision to support the PUI.

The first is that the PUI plays an important role in supporting the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), an international agreement that seeks non-proliferation, disarmament and peaceful use of nuclear energy. The NPT states that any country that meets its non-proliferation obligations has the "inalienable right" to research, develop and use nuclear energy for peaceful purposes. Japan's US \$25 million pledge at the 2015 NPT Review Conference highlighted its intention as a State Party to the NPT to support and promote peaceful uses of nuclear energy in the IAEA's Member States.

The second is the impact of the PUI on efforts to achieve the United Nations Sustainable Development Goals (SDGs). Of the 17 SDGs, 9 are directly related to the IAEA's activities. When Japan considers its PUI contribution for IAEA projects, the SDGs are an important driver. This is also in line with the declaration made by IAEA Member States in November 2018 at the IAEA Ministerial Conference on Nuclear Science and Technology, which was co-chaired by Japan. The declaration underscored how nuclear science and technology can contribute to the achievement of the SDGs.

The third is how support through the PUI contributes to the IAEA's Renovation of the Nuclear Applications Laboratories (ReNuAL) projects. This multi-phase modernization

project sets out to ensure the IAEA's nuclear applications laboratories are equipped to provide countries with technical assistance to face global challenges in the areas of food and agriculture, human health, the environment, and the development and use of nuclear scientific instruments. The project's unprecedented scale and budget has been supported by almost €40 million in PUI contributions from 42 Member States, including €6.5 million from Japan.

## COVID-19 and beyond

The real-life impact of the PUI can be seen in the assistance provided to Member States in combatting the COVID-19 global pandemic. The PUI's agility and flexibility made it a critical channel for supplementing the IAEA's budget and providing support quickly. Through the PUI, Japan provided €4 million in May 2020 for the IAEA to help its Member States in the fight against COVID-19. Of the total sum, €3 million was earmarked for virus detection kits and related laboratory supplies for Member States in need. The other €1 million is to be used in line with Zoonotic Disease Integrated Action (ZODIAC), a new IAEA initiative for fighting COVID-19 and other zoonotic diseases, which are diseases that spread from animals to humans.

The PUI has also been an avenue for providing support to the IAEA Marie Skłodowska-Curie Fellowship Programme, which aims to encourage women to pursue a career in nuclear science and technology, nuclear safety and security or nuclear non-proliferation. As the programme is not part of the IAEA's Regular Budget or funded by the TCF, Japan decided to provide an additional PUI contribution of €500 000 to directly support this important initiative led by IAEA Director General Rafael Mariano Grossi.



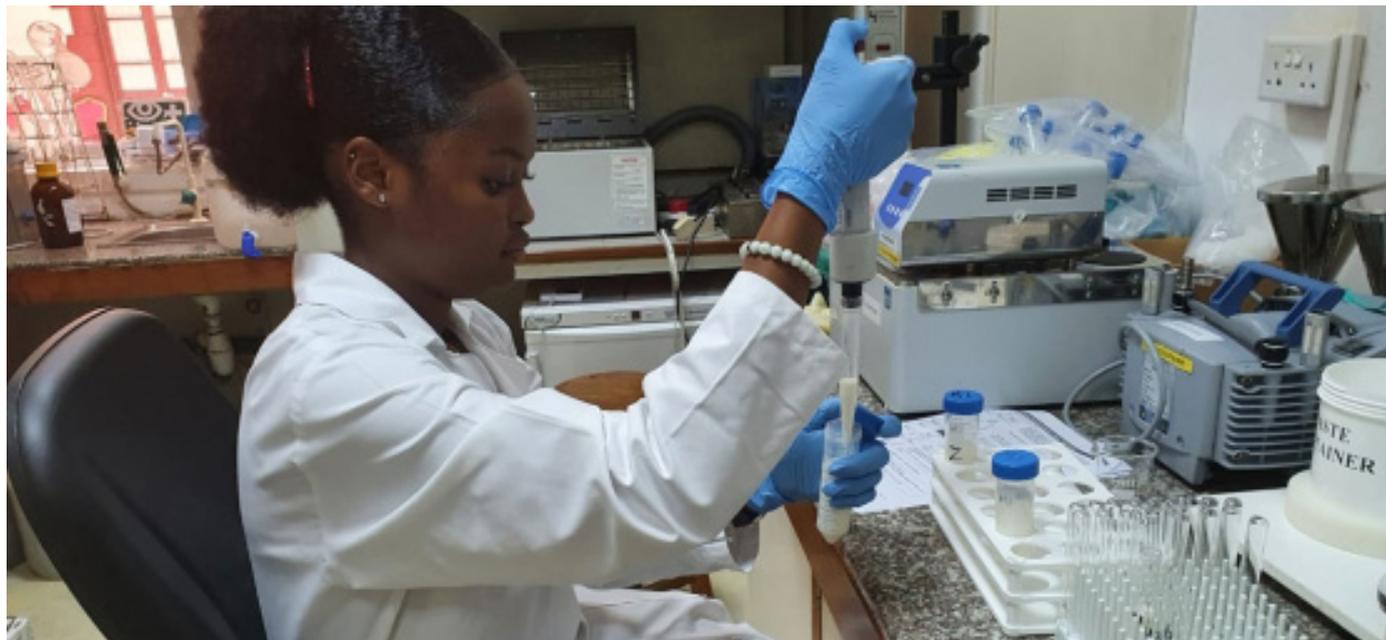
While most of the support received through the PUI comes from governments, the initiative can also be used by the private sector to make contributions. In October 2017, the Japanese manufacturer Shimadzu Corporation donated mass spectrometry equipment, and provided technical support for the development of methods for using this equipment, through the PUI. This has opened the door to in-kind contributions to the PUI.

Japan considers the PUI to be essential and intends to continue fully supporting it as an important tool to bolster the IAEA's activities and to promote the peaceful uses of nuclear energy. Further and broader support for the PUI from IAEA Member States and other relevant parties will enhance the value of this useful tool and further expand the positive impact of the peaceful applications of nuclear technology.

**Japanese Ambassador Takeshi Hikihara (right) accompanied IAEA Director General Rafael Mariano Grossi during his visit to the Shimadzu Corporation in Kyoto, Japan, in February 2020.**

(Photo: D. Calma/IAEA)

## In Seychelles, nuclear science helps safeguard consumers



**A scientist from the Seychelles Public Health Laboratory conducting milk testing.**

(Photo: S. Labrosse/Seychelles Public Health Laboratory)

The 100 000 inhabitants of Seychelles, a 115-island archipelago in the Indian Ocean, can now better trust the food products they buy thanks to the use of nuclear-based techniques.

Initiated in 2016, a four-year technical cooperation project led by the IAEA, in partnership with the Food and Agriculture Organization of the United Nations (FAO), has helped increase food safety control capacities in Seychelles. As a result, the Seychelles Public Health Laboratory can now detect aflatoxin M1, a carcinogenic substance, in milk and dairy imports. At the same time, the government has strengthened the national legal framework to better protect consumer health with respect to these contaminants.

Many small island developing states, referred to as SIDS, are unsuited to agriculture because of their small size, topography and weather. As a result, they rely on food imports. To keep consumers safe and trusting, it is crucial to monitor and control contaminants such as mycotoxins, biotoxins and toxic metals in imported food products, as well as the residues of veterinary medicines and pesticides used in food production.

“Thanks to IAEA and FAO support, we are now capable of conducting analysis for traces of a range of residues and contaminants in food, which means we have the ability to better protect consumers from potential hazards in imported products,” said Leon Biscornet, Chief Laboratory Technologist at the Seychelles Public Health Laboratory. He added that the ability to certify the safety of food products destined for export also helps to improve access to and preserve food export markets, as well as boosting agricultural exports.

### Detection of aflatoxin in milk and dairy products

Over 90 per cent of the milk and dairy products consumed in Seychelles are imported. After a year of collaboration with the IAEA and the FAO, the laboratory was able to detect unacceptable levels of aflatoxin M1 in 12 types of imported milk products. The suspected products were immediately recalled, pending confirmation of the diagnosis from an international reference laboratory, which confirmed that more than 90 per cent of the suspected samples indeed contained aflatoxin M1. This

demonstrated the reliability of the testing capabilities established at the Seychelles Public Health Laboratory.

Produced by fungi, aflatoxins are a major public health and trade concern worldwide. According to the World Health Organization (WHO), they increase the risk of cancer, especially liver cancer; they can also cause acute sickness and toxicity in humans. Therefore, according to James Sasanya, Food Safety Specialist at the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, their presence in food products should be regulated and monitored by reliable laboratories.

Before the contaminated milk incident in Seychelles, the national food regulations on contaminants and toxins in food or feed did not include any limit of aflatoxin M1 concentration in milk and milk products. This has now changed with the 2019 amendment of the national Food Safety Act. “Under the new provisions, there is now a clear legal basis for removing contaminated milk products from the market, both wholesale and retail, with immediate effect,” said Jude Gédéon, Public Health Commissioner in Seychelles.

The amendment also requires importers to provide the Public Health Authority with legitimate proof, through a health certificate, that their imported milk is free of unsafe levels of contaminants such as aflatoxin M1 and medical and pesticide residues.

### Food safety, staff and technical equipment

“Two challenges for small countries are a limited availability of specialized human resources and a lack of necessary equipment to facilitate food safety testing and operation of laboratories. Through our project, we were able to address some of these needs, contributing to enhanced consumer safety through the improvement of the national food control system,” said Sulafa Karar, the IAEA Programme Management Officer in charge of the project.

During the project, the IAEA and the FAO delivered training and equipment

and shared best practices with lab staff. Equipment included a radio receptor assay instrument, which is a state-of-the-art tool that can analyse more than ten groups of veterinary antimicrobials, mycotoxins and pesticides.

Five laboratory staff members were trained in the analysis of mycotoxins and related contaminants. Technical guidance was also provided to the laboratory on how to interpret test results, especially how to determine unacceptable levels of aflatoxins present in feed, animals and animal products. The laboratory also benefited from subsequent hands-on training on the optimum use of analytical instrumentation, as well as sample preparation for effective analysis of mycotoxins in foods — not only milk, but also nuts and spices.

This support resulted in the establishment of rapid, cost-effective and sensitive nuclear analytical capabilities that facilitate

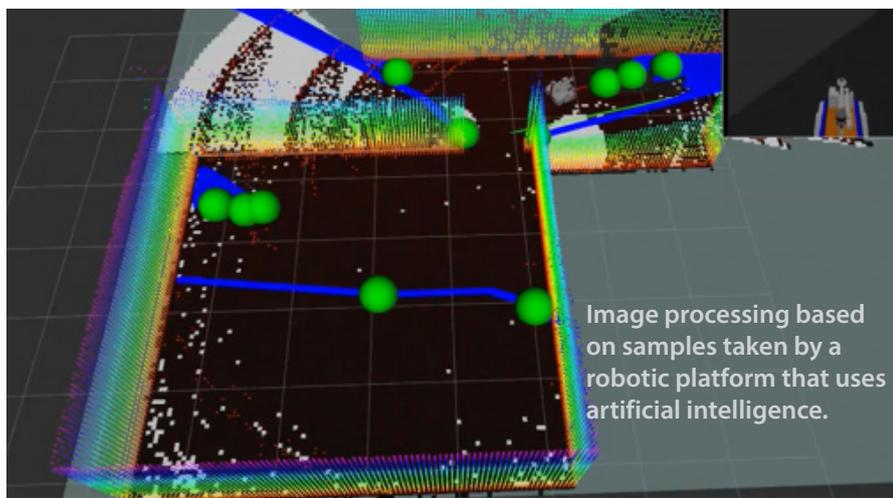
hazard testing in a broad range of foods and animal feed, which can also affect people’s health through the consumption of animal products. Aflatoxin M1 was the most recent addition to the growing list of compounds that can be screened at the laboratory.

The Seychelles Public Health Laboratory is now in the advanced stages of establishing isotopic confirmatory analytical capabilities. This means that confirmatory tests currently conducted overseas will soon be conducted domestically. This will further boost the country’s food safety control system and positively impact the quality of imported and exported food products consumed.

— *Elodie Broussard*

## Robots, drones and artificial intelligence for advanced decommissioning and environmental remediation

### Winners of the IAEA 2020 crowdsourcing challenge



The IAEA crowdsourcing challenge was aimed at encouraging innovation in design and operations to achieve cost-effective and efficient implementation of smart solutions.

The IAEA has selected the five best entries from its crowdsourcing challenge, which sought original

concepts and project outlines for advancing the decommissioning of nuclear facilities and environmental remediation of radiologically contaminated sites. Three of these entries focused on decommissioning and two on environmental remediation. The entries included characterization toolkits, instruments used for field

measurements and to collect 3D radiation data, and robots that use artificial intelligence. The young people who submitted the entries come from all over the world and share an enthusiasm for novel approaches and strategies to make work in these fields safer, faster and more cost effective.

“I have developed a device capable of imaging the radioactivity contaminating various surfaces, such as floors, walls or apparatuses encountered in facilities that are being dismantled,” said Sylvain Leblond, a research engineer at the French Alternative Energies and Atomic Energy Commission (CEA). “It will be a huge help for investigating residual contamination on site and to work toward the proper remediation of any contaminated facility.”

The effective management of decommissioning and environmental

remediation is vital to the sustainability of nuclear power, in terms of managing liability related to the protection of health and the environment.

Although many nuclear power reactors are undergoing life extensions, considerable decommissioning work is expected in the years to come, as well as the related remediation activities. This will include decommissioning of power reactors, research reactors, other fuel cycle facilities, critical assemblies, accelerators and irradiation facilities. Environmental remediation is also needed for sites used in the past for activities involving nuclear research, uranium mining and milling and the processing of naturally occurring radioactive material.

“So far, measuring of contamination has been limited to a small area and was done manually. We want to build a robot that can be used to avoid potential radiation risks to staff,” said Zeni Anggraini from Indonesia’s National Nuclear Energy Agency (BATAN), whose team came up with a concept for a robot that maps and monitors contaminated areas.

Ryo Yokoyama from the University of Tokyo, Japan, developed an approach for estimating fuel debris distribution using experiments and numerical techniques. “Due to severe environmental conditions at the Fukushima Daiichi nuclear power plant, the sampling activity or extracting a part of fuel debris from the reactor is a critical issue. Through experiments and a numerical simulation of Fukushima Daiichi, the fuel debris can be gradually

identified, which can help its retrieval,” said Yokoyama.

Both decommissioning and environmental remediation are complex undertakings that can last many years from the point when a facility is shut down and used for a different purpose.

“There is continuous improvement in both decommissioning and environmental remediation, thanks to both proven and new technologies,” said Vladimir Michal, a decommissioning team leader at the IAEA who coordinated the selection process. “However, there is also need for new ideas and fresh talent to implement them. It is important that young people are aware of the many career options in this field and are invited to education and training.” Crowdsourcing challenges like this one can help attract early career scientists and engineers to nuclear related disciplines.

As all proposals are focused on specific technical issues, they have significant potential to be used practically in decommissioning and remediation operations.

“With the nuclear industry growing, the need for new subject matter experts is in high demand. As technology increases throughout our lifetime, so does the need for experts in these fields, for example robotics,” said Daniel Martin, a research assistant at the Florida International University in the United States. His team’s proposal envisaged the use of a robotic platform that uses artificial intelligence to aid in

preventing defects before they occur in facilities to be dismantled.

“Nuclear energy is a very important part of ensuring that future energy grids are low carbon, reliable and sustainable. Nuclear robotics is a fast growing discipline, and physical demonstrations of advanced robotic systems help make nuclear decommissioning quicker and safer for human operators,” said Erin Holland, a PhD student from the University of Bristol, United Kingdom. Her team submitted a characterization toolkit to enable accelerated decommissioning activities: “We hope our work will help to improve public knowledge of and interest in nuclear energy, using advanced technologies. It is very important for cementing nuclear energy as a keystone energy technology for decades to come.”

A total of 26 submissions from 12 countries were received and evaluated against criteria such as level of innovation and creativity. The winning participants were initially invited to present their entries at the IAEA General Conference in September. However, owing to the COVID-19 travel restrictions, this was not possible.

“We are looking into other possibilities to bring the winners to a related conference in 2021 that is either organized by or in cooperation with the IAEA,” said Michal. “We also hope to repeat this challenge in 2021, focusing on economics and financing as well as knowledge management, so stay tuned.”

— *By Irena Chatzis*

## The future of atoms Artificial intelligence for nuclear applications

The first ever IAEA meeting on the use of artificial intelligence (AI) for nuclear applications was held virtually on the sidelines of the 64th regular session of the IAEA General Conference. The meeting showcased the ways in which AI-based approaches in nuclear science can

benefit human health, water resource management and nuclear fusion research. Open to the public, the event gathered over 300 people from 43 countries, launching a global dialogue on AI’s potential in nuclear science and the related implications of its use, including ethics and transparency.

AI refers to a collection of technologies that combine numerical data, process algorithms and have a continuously increasing computing power to develop systems capable of tracking complex problems in ways similar to human logic and reasoning. AI technologies can analyse large

amounts of data to “learn” how to complete a particular task. This technique is called machine learning.

“Artificial intelligence is advancing exponentially,” said Najat Mokhtar, IAEA Deputy Director General and Head of the Department of Nuclear Sciences and Applications. “AI’s ability to recognize data patterns and analyse high-resolution images from satellites, drones or medical scans can improve responses to humanitarian emergencies, help doctors identify cancer and other diseases, increase agricultural productivity, and track animal and marine migrations.”

Applied to nuclear science, AI has the potential to, for example, advance cancer staging in nuclear medicine and cancer treatment, accelerate progress toward the realization of fusion energy production and help protect global water resources from overexploitation and contamination.

During the virtual meeting, four experts delivered insights into key areas of AI applications in nuclear science and answered questions from online participants.

### AI for cancer staging and treatment

“Modern oncology, although very advanced, is still largely a one-size-fits-all endeavour,” said Jan Seuntjens, Professor and Medical Physicist at McGill University in Canada. “This means treatment prescribed for patients with a particular disease is still very much generic or, in other words, the same from one patient to another. AI gives us the opportunity to make treatment much more personalized, taking into account all the information or data that we have on that particular patient.”

Seuntjens highlighted the ways in which AI could support physicians with cancer diagnosis and treatment through improved image interpretation, more accurate treatment plans and tumour contouring, as well as adaptive radiotherapy — a radiation therapy process that adapts to internal anatomical variants of the individual patient.



### Advancing fusion research with AI

Nuclear fusion represents an opportunity to produce abundant, safe and sustainable energy.

Research in this area requires substantial experimental and theoretical activity covering plasma physics and materials sciences, among other fields. AI-based methods offer opportunities to accelerate progress towards the realization of fusion energy by maximizing the amount and applicability of information extracted from experimental and simulation data.

David Humphreys, Principal Scientist at General Atomics, United States of America, explained how AI could provide the prediction and control solutions necessary for sustained, safe and efficient operation of future fusion power plants. Among the AI and machine learning opportunities available to advance fusion research, he mentioned optimizing experimental planning, which would help to speed up progress in gaining new knowledge, as well as real-time optimization of plasma control scenarios using algorithms derived from large databases developed at experimental fusion facilities worldwide.

The Agency published the Fusion Device Information System (FusDIS), the IAEA’s first ever online fusion

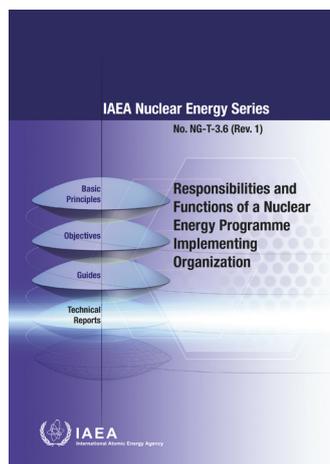
database. It contains data on more than 100 public and private fusion devices worldwide, which are currently in operation, under construction, in planning or closed down.

### Protecting water and the environment using AI

How do tap water management practices impact water losses? Do pacific salmon production sites change every year? What are the sources of moisture for hurricanes? According to Clement Bataille, Assistant Professor at the Department of Earth and Environmental Sciences at the University of Ottawa in Canada, machine learning can help us to gain insights into these questions through large-scale mapping of hydrological and environmental processes.

AI can also help manage environmental, hydrological and ecological resources through isotope geochemistry. As isotope science uses enormous amounts of data shared in global networks and repositories, including those of the IAEA, the use of AI is becoming critical to obtain interpretable results and enhance our understanding of environmental and hydrological processes, explained Bataille.

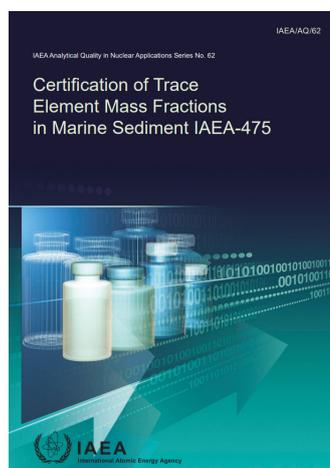
— *Elodie Broussard*



## Responsibilities and Functions of a Nuclear Energy Programme Implementing Organization

describes a set of responsibilities, functions and activities that States can use as guidance for establishing a nuclear energy programme implementing organization (NEPIO) and ensuring its effectiveness. This revision incorporates lessons learned from integrated nuclear infrastructure review missions and IAEA technical assistance activities. It attempts to clarify that there are many ways to structure a NEPIO and that each could result in the successful execution of all functions and activities. Several case studies are included. Consistent with the revision of IAEA Nuclear Energy Series No. NG-G-3.1 (Rev. 1) Milestones in the Development of a National Infrastructure for Nuclear Power published in 2015, this publication recognizes that the NEPIO plays an important and evolving role in each of the three phases of nuclear power infrastructure development.

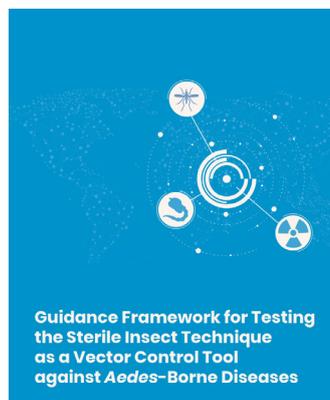
IAEA Nuclear Energy Series; ISBN: 978-92-0-100619-6; English Edition; 36.00 euro; 2019



## Certification of Trace Element Mass Fractions in Marine Sediment IAEA-475

describes the production of new certified reference materials (CRM) for trace element mass fractions in a sediment matrix in accordance with the requirements of international guidelines for the production and characterization of CRMs. Eight laboratories with demonstrated measurement capabilities participated in the characterization of the sediment sample. The IAEA-475 sediment sample was produced in the frame of a Peaceful Uses Initiative project for the production of a CRM for trace elements and organic contaminants in marine sediment from the Pacific.

IAEA Analytical Quality in Nuclear Applications Series No. 62; English Edition; 2020



## Guidance Framework for Testing the Sterile Insect Technique as a Vector Control Tool against Aedes-Borne Diseases

is intended to be a comprehensive guide for programme managers tasked with recommending a “go/no-go” decision on testing, full deployment and scale-up of the sterile insect technique (SIT) in regions of the world affected by diseases transmitted by Aedes mosquitoes. This guidance document will inform stakeholders and all persons involved with SIT testing on vectors of human diseases about how to plan, develop, test and evaluate the impacts of the technology against Aedes mosquitoes, the main vectors of dengue, yellow fever, chikungunya and Zika. The nine chapters of this document cover the processes for decision support—including risk assessment and regulatory aspects, technical aspects (e.g., insect mass rearing), entomological and epidemiological indicators, as well as community involvement, cost effectiveness and programme monitoring and evaluation.

WHO & IAEA; ISBN: 978-92-4-000238-8; English Edition; 2020

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