IAEA BULLETIN

INTERNATIONAL ATOMIC ENERGY AGENCY

The Flagship Publication of the IAEA | December 2016

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Nuclear Security

Commitments and Actions

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IAEA BULLETIN
is produced by the
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and Communication (OPIC)
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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, including decommissioning.

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.

Nuclear security: a global response to a global threat

By Yukiya Amano, Director General, IAEA

The threat of nuclear terrorism is real. The possibility of criminals getting hold of nuclear and other radioactive material cannot be ruled out. Much progress has been made in tackling this threat nationally, regionally and globally, but more needs to be done. International cooperation is vital.

As the global platform for cooperation in nuclear security, the IAEA helps countries to establish and maintain robust and sustainable national nuclear security regimes. We help ensure that measures are taken to protect nuclear and other radioactive material, as well as the facilities in which such material is housed, from malicious acts.

This has been an important year for nuclear security with the entry into force of the Amendment to the Convention on the Physical Protection of Nuclear Material. This establishes legally binding commitments for countries to protect nuclear facilities as well as nuclear material in domestic use, storage and transport. I encourage all countries that have not yet done so to adhere to this Amendment and thereby contribute to a stronger global nuclear security regime.

In this edition of the *IAEA Bulletin*, you will learn about the different areas of security where our work is making a real difference. We highlight the progress made in a number of countries.

For example, in Kazakhstan, the world's leading uranium producing country, security measures developed with the IAEA have helped to make uranium reserves more secure (page 4).

You will learn about how nuclear security measures are part of the fabric of Cuba's modernization of its hospitals (page 20), about Viet Nam's investment in industrial radiography (page 16) and about Zimbabwe's border control programme (page 6). You will also learn about Hungary's experience in using nuclear forensics to support criminal prosecution (page 8), and about Indonesia's experience in establishing a nuclear security culture methodology (page 14). You will also meet three young women who won the first IAEA essay contest on how to improve nuclear security worldwide (page 23).

The primary responsibility for nuclear security lies with each individual country. But the threat to nuclear security is global and requires a global response. One of the ways in which the IAEA contributes is by bringing together political leaders and technical experts to share experience and learn from each other.

The *IAEA International Conference on Nuclear Security,* taking place at ministerial level in Vienna in December 2016, is an opportunity to set priorities in nuclear security for the coming years. It offers a chance to consider whether there are any weaknesses in the global nuclear security framework that need to be addressed. I expect that the conference will also reaffirm the IAEA's central role as the global platform for cooperation on nuclear security.

I trust that this edition of the *IAEA Bulletin* will give you an insight into this very important area of our work.

As the global platform for cooperation in nuclear security, the IAEA helps countries to establish and maintain robust and sustainable national nuclear security regimes.

— Yukiya Amano, Director General, IAEA

(Photo: Kozloduy NPP)

(Photo: D.Calma/IAEA)

(Photo: D.Calma/IAEA)

IAEA News

Improving security of Kazakhstan's natural uranium

By Andrew Green

At more than 20 000 tonnes per year, Kazakhstan is the world's leading uranium producing country.
(Photo: Kazatomprom)

Kazakhstan, producer of more than 20 000 tonnes of natural uranium per year, has welcomed recently developed IAEA security guidance.

"It is difficult to overstate the importance and timeliness of the guidance," said Eldar Nikhanov, physical protection officer at a uranium mine in Kazakhstan under the State-run company Kazatomprom. "Since we adopted new security measures consistent with the guidance, there have been no incidents of unauthorized removal of natural uranium."

Strengthening international security

In 2010, Kazakhstan established a comprehensive system for the control and physical protection of natural uranium. Its experience in implementing this system contributed to the development of a series of new IAEA security guidance documents compiled in a publication entitled Nuclear Security in the Uranium Extraction Industry, issued in February 2016.

"As a world leader in uranium ore concentrate production, Kazakhstan is

The LLP Ortalyk ISL in situ recovery mine in southern Kazakhstan.
(Photo: Kazatomprom)

aware of its responsibility to contribute to natural uranium security measures within the international community," Nikhanov said.

The IAEA publication includes specific measures to address insider and outsider threats and covers physical protection, inventory control and transport security. It also provides guidance on how to develop facility security plans and comprehensive transport security plans. Kazakhstan has a total of 23 production sites for extracting and processing uranium, and the security of each one of these has been strengthened significantly thanks to the recent IAEA guidance, Nikhanov said.

An international legal framework calling for prudent management practices is in place to ensure that natural uranium stays secure. The IAEA has built on this by informing State regulatory bodies and industry operators on prudent management practices to protect uranium ore concentrate from unauthorized removal during production, storage and transport. Kazakhstan, a major contributor to the guidance, has implemented these measures at the national level, Nikhanov said.

Meeting security challenges

At each of Kazakhstan's 23 uranium mining sites, the implementation of the security measures has helped strengthen physical protection and information security by improving site access control, burglar alarms and video surveillance.

"We are aware of the black market for natural uranium and the need for strong, practical security measures," Nikhanov said. "From industry experience, these measures will greatly reduce risks of theft."

Training is another focus. "Properly training workers is the main challenge in ensuring mines stay secure," he said. Kazatomprom's experience in quality control shows that mining workers need clear and simple guidelines to follow. According to Nikhanov, those provided by the IAEA this year have been an invaluable resource.

"Security regimes need to be embedded into the uranium extraction process from the start," said Assel Khamzayeva, nuclear security officer at the IAEA. "There is a real need for these kinds of specific measures to be adopted, and it is more difficult and costly to add them later."

Nuclear security at

1 Enhancing detection capabilities at the Victoria Falls border crossing provides confidence to people visiting Zimbabwe that measures are in place to prevent disruption caused by radioactive materials and helps to protect the local environment.

2 "Nuclear security is an enabler," explains Justin Mupamhanga, Deputy Chief Secretary in the Office of the President and Cabinet. We realize the number of applications where nuclear technology is key. Nuclear security measures, like detection at points of entry and exit, ensure that materials cannot be taken to non-peaceful uses and offers people the ability to visit our parks and wildlife destinations."

3 Detection capability, including procedures and equipment, is only successful with full stakeholder engagement. Officials from nine organizations, including the Ministry of Defence, the Zimbabwe Revenue Authority, the Radiation Protection Authority and with support from the IAEA, work to strengthen procedures for collective action should nuclear or other radioactive material be detected at Zimbabwe's borders.

4 At the Victoria Falls International Airport, officials test a scenario in which radioactive material is smuggled into the country. Once the material is detected, they have to seamlessly deploy the equipment and test the responsiveness of their plan. This enables Zimbabwe to determine the best standard operating procedures for a multi-agency response.

Zimbabwe's borders

5 Using detection equipment like radionuclide identification devices and gamma spectrometers enables Zimbabwe to better tackle illicit trafficking or any inadvertent movement of material. As part of its Integrated Nuclear Security Support Plan, Zimbabwe is committed to strengthening its national framework related to radiation detection to secure its borders.

6 "Without a detection capability in place, when handling goods and processing people we are dealing with an unknown risk," says Reward Severa, Head of the Radiation Protection Authority of Zimbabwe. "We are living in a global village. Whether people come to visit Victoria Falls or bring their vegetables to market, we need to take every necessary precaution."

7 Local vendors and tourists cross the border from Zambia on foot. Like the airport, this point of entry is of strategic importance for tourism and trade in south-east Africa. "Nuclear security enables communities to co-exist," adds Severa. "Detection capabilities increase confidence that Zimbabwe is a secure tourist destination and a viable trading partner."

8 By ensuring that equipment is in the right hands and by trying and testing processes in the field, officials demonstrate the strength of Zimbabwe's national detection capabilities. Validating standard operating procedures helps minimize the risk posed by material out of regulatory control and illustrates Zimbabwe's commitment to nuclear security to the benefit of tourism and trade.

Text: Danielle Dahlstrom; Photos: D.Calma/IAEA

The deterrent effect of nuclear forensics: the case of Hungary

By Laura Gil

A State capable of identifying the origin and history of intercepted nuclear or radioactive material can have a deterrent effect. This is why nuclear forensics — the examination of nuclear and other radioactive material as part of criminal or nuclear security investigations — is an important tool.

"A country with strong nuclear forensics capabilities is not the best target for terrorist groups," said Éva Kovács-Széles, Head

"We have 20 years of real experience in investigating confiscated nuclear material and radiological crime scenes. We have an increasing scientific knowledge. And we have a good and strong connection with the IAEA, a connection that goes back to the 90s."

— Éva Kovács-Széles, Head, Nuclear Security Department, Centre for Energy Research, Hungarian Academy of Sciences

of the Nuclear Security Department at the Hungarian Academy of Sciences' Centre for Energy Research.

But establishing a nuclear forensics programme is not an easy task. The case of Hungary — whose forensics laboratory was recently designated as the first IAEA Collaborating Centre in nuclear security — is a good example for the region and for the world, said David Smith, nuclear security coordinator (forensics) at the IAEA.

Scientists specialized in nuclear forensics examine samples of nuclear and other radioactive materials using a variety of analytical techniques. The results of the examination provide information on the potential use, manufacture and age of the materials, which helps law enforcement officials make informed decisions regarding a potential criminal prosecution.

Hungary, which operates a nuclear power plant, a research reactor and a training

(Photo: D.Calma/IAEA)

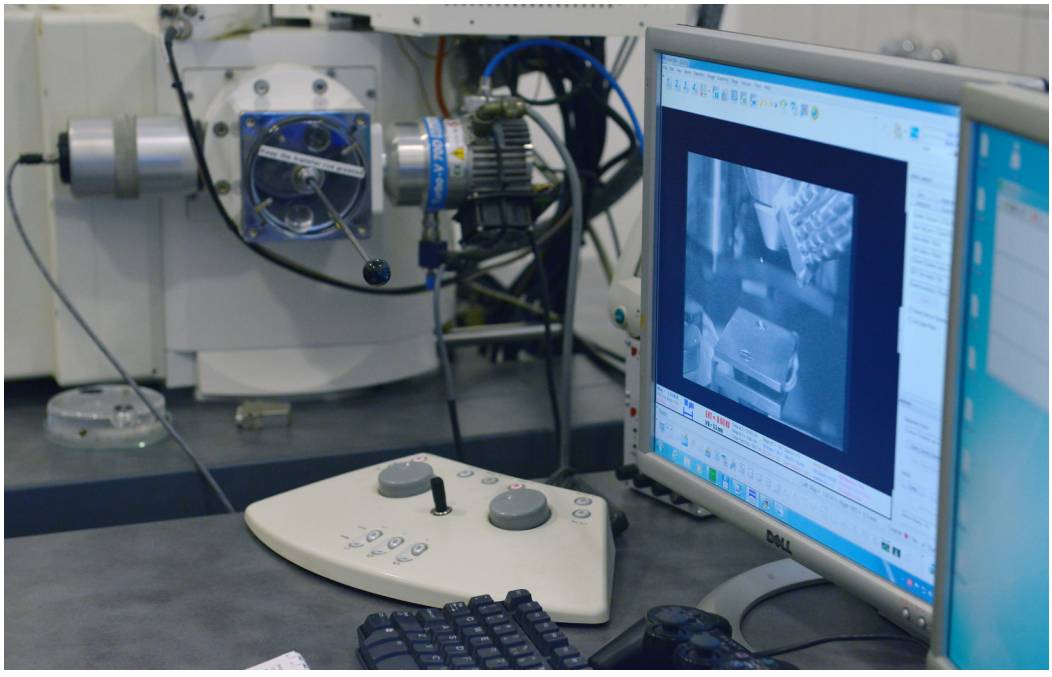
How nuclear forensics sup
and a national nucl

reactor, started working on nuclear forensics in the 1990s as a response to a series of illicit trafficking events. Today, it has a well-equipped centralized national Nuclear Forensic Laboratory with a team of specialists who conduct research and perfect their methods. These ensure that all material is secured, documented and protected, and all appropriate precautions are taken to preserve the evidence.

The country has also established the prototype of a national nuclear forensics library, a database that contains information about all its nuclear material. Having a record of all materials is useful, Kovács-Széles said, because when something goes missing, authorities can easily identify it through comparisons.

But none of this infrastructure would have an impact without a properly trained team to operate it, Kovács-Széles added.

"We've established a nuclear security working group in Hungary where all the



(Photo: D.Calma/ IAEA)

ports criminal prosecution
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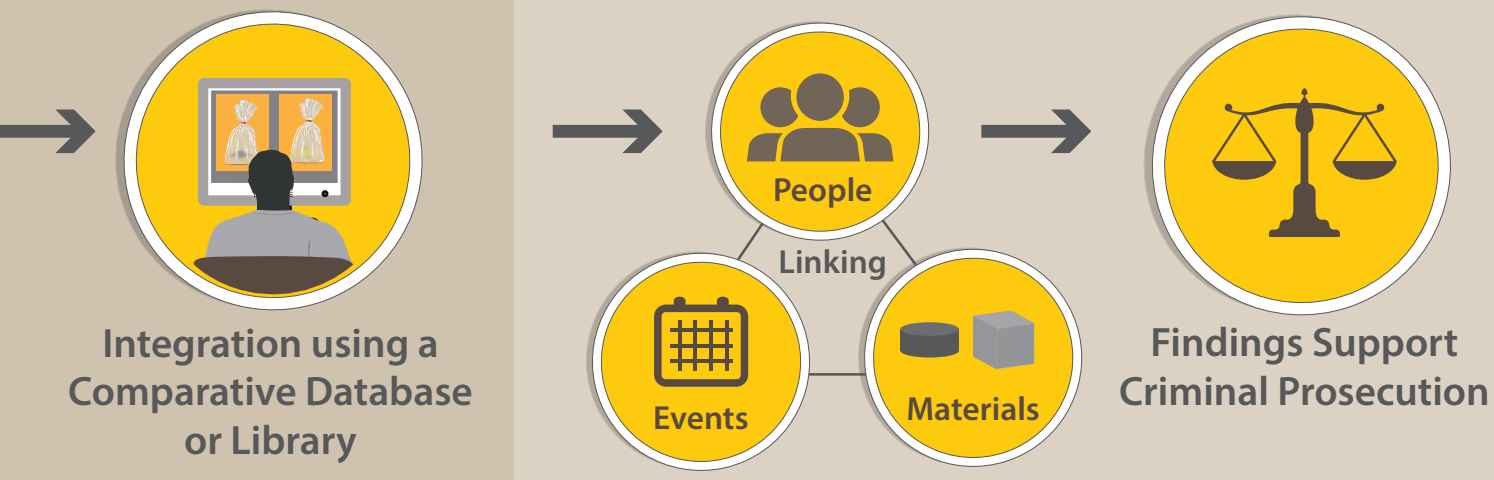


(Infographic: R.Kenn/IAEA)

responsible authorities sit to think and consult together: the Hungarian police, the bomb disposal unit, the traditional forensics institute, the counter terrorism centre, law enforcement agencies and so on."

Close cooperation between law enforcement officials and nuclear scientists can be a key tool to prevent radiological terror attacks or to solve radiological crimes, Kovács-Széles said.

"We have 20 years of real experience in investigating confiscated nuclear material and radiological crime scenes. We have an increasing scientific knowledge. And we have a good and strong connection with the IAEA, a connection that goes back to the 90s."

An example to follow

The working group serves as an example to other countries trying to make relevant stakeholders work together to face threats in a coordinated manner, said Smith from the IAEA.

"Hungary's journey in nuclear forensics reflects IAEA guidance, technologies, methodologies and approaches," Smith said.

The IAEA has provided Hungary with training, guidance and technical assistance on nuclear forensics through research and scientific programmes for the past eight years. It has involved Hungary in the IAEA's coordinated research programme, facilitated the exchange of scientists to share practical experience through expert missions and fellowships, and provided guidance on the establishment of the Nuclear Forensic Laboratory.

While Hungary's forensics experts are already collaborating with neighbouring countries such as Croatia and Romania, they plan to share their experience, laboratory equipment and improved techniques with all Central and Eastern European countries and others further afield. In July 2016, the IAEA designated the Hungarian Academy of Sciences' Centre for Energy Research as a Collaborating Centre in nuclear forensics.

"The idea is to have Member States rely on nuclear forensics routinely as a tool they can readily utilize to fulfil their nuclear security responsibility," Smith said. "We help them answer critical questions. How do you collect the evidence? How do you establish a chain of custody? Where do you take the material? What analytical capabilities do you need? Do you have a national nuclear forensics database or library for interpretation?"

The IAEA assists countries in identifying the plans, procedures and advisable steps to take. "Nuclear forensics is not a contingency, it's not hypothetical," Smith said. "It's something States can use now."

How the United Kingdom seeks to enhance nuclear security with the help of IPPAS

By May Fawaz-Huber

Participants attend opening of IPPAS follow-up mission at the Office for Nuclear Regulation (ONR) headquarters in Bootle, UK, February 2016.
(Photo: Office for Nuclear Regulation)

In October 2011, an IAEA team of international nuclear security experts conducted an International Physical Protection Service mission (IPPAS) to the United Kingdom. They visited the Sellafield civil nuclear site, as well as Barrow Port, which is used for the transport of nuclear material. The IAEA conducted a follow-up mission in February 2016.

IPPAS missions provide advice on how to improve the effectiveness of a State's physical protection regime, either nationally or at facility level. They do so by comparing it with relevant international legal instruments, guidelines and best practices, particularly the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material and the IAEA Nuclear Security Series guidance publications.

"The missions have been valuable in allowing the UK to draw upon the expertise of the IAEA and other Member States in a range of disciplines across nuclear security," said Robin Grimes, Chief Scientific Adviser to the Foreign and Commonwealth Office. "They have identified areas of good security practice that the UK can share with others."

The 2011 mission team included experts from seven IAEA Member States — Canada, France, Germany, the Netherlands, Slovenia, Sweden and the United States of America — as well as from the IAEA Secretariat. They had extensive experience in various areas of nuclear security, including legislative and regulatory practices, physical protection, transport security, security culture, policing and contingency planning. They performed a national level review of the legal and regulatory framework, as well as a review of the security measures and procedures in place to execute this framework at facilities and during transport.

"The mission underlined the importance of nuclear security, including security culture, for the nuclear industry and promoted discussion of this issue within the industry," Grimes said, adding that IPPAS missions were "one of a number of ways in which the British Government demonstrated to the public its commitment to nuclear security."

The follow-up mission reviewed the actions taken in response to the 2011 mission's recommendations and provided further advice.

The Sellafield nuclear site, which was visited by the IPPAS team during their mission in October 2011 and during the follow-up mission in February 2016.
(Photo: Sellafield LTD)

"The follow-up mission also aimed at evaluating the current status of the UK's physical protection regime of nuclear material and nuclear facilities, as well as its implementation at Heysham nuclear power station," said Arvydas Stadalnikas, Senior Nuclear Security Officer at the IAEA. The mission sought to provide further advice to enhance the UK's nuclear security regime, as well as identify good practices that could be beneficial to other Member States, he added.

The follow-up mission team included experts from Canada, France, Lithuania, the Netherlands, Switzerland, the United Arab Emirates, the USA and the IAEA.

"The UK was very happy to welcome two IPPAS missions because of the commitments regarding the confidentiality of sensitive information made by those taking part in these missions," Grimes said. He added that the UK does have in place a robust and effective security regime for its civil nuclear industry; however, it seeks to achieve continuous improvement in this regime. "We strongly encourage other States to consider inviting an IPPAS mission," he said.

This year is the 20th anniversary of the service. Since the first mission in 1996, IPPAS has been helping Member States identify ways to strengthen the protection of their nuclear materials and facilities against unauthorized removal and sabotage. During this period, the IAEA has conducted 75 IPPAS missions in 47 countries and at the IAEA laboratories in Seibersdorf, with the participation of more than 140 experts from around the world.

States that have recently hosted IPPAS missions include Albania, Canada, Japan, Malaysia, New Zealand, Norway, Poland, Sweden and the United Arab Emirates. Several others, including Australia, China, the Democratic Republic of the Congo, Germany, Hungary, Jamaica, Lithuania, Madagascar and Turkey have requested IPPAS missions for 2017.

"The significant increase in the number of requests for IPPAS missions demonstrates that this independent international advisory service is being recognized for its value in the exchange of views and advice on nuclear security," Stadalnikas said. "IPPAS' 20-year anniversary marks significant achievements, which are an incentive for the IAEA to continuously enhance this service to make it more beneficial to Member States."

The IAEA has established a database of good practices identified during IPPAS missions and made available with consent from host countries. It is accessible to Member States through the IAEA Nuclear Security Information Portal.

Security culture: one for all, and all for one

By Miklos Gaspar


(Photo: D.Calma/IAEA)

"An enhanced security culture is particularly important for a country that is considering the introduction of nuclear power, like Indonesia."

— Khairul Khairul, Senior Nuclear Security Officer, National Nuclear Energy Agency (BATAN), Indonesia

Preventing the theft of nuclear material and attacks and sabotage against nuclear installations is a challenge that governments, nuclear regulators and operators around the world are increasingly facing.

"Terrorism is a real threat that exists around the world and also in Indonesia. And it can affect nuclear security," said Khairul Khairul, a senior nuclear security officer at Indonesia's National Nuclear Energy Agency (BATAN), which operates three research reactors. "We need to strengthen the notion of nuclear security in our entire workforce by developing a strong nuclear security culture."

Nuclear security culture refers to the characteristics, attitudes and behaviour of individuals, organizations and institutions that enhance and support nuclear security. It is about the importance of the human factor in nuclear security.

"Historically, there has been a focus on nuclear safety and safety culture around the world, particularly after the Chernobyl accident in 1986. We now need to develop the same focus for security," Khairul said.

The coherent and rigorous implementation of a security culture implies that staff remain vigilant of the need to maintain a high level of security, said Kazuko Hamada, Nuclear Security Culture Officer at the IAEA. "Ultimately, the entire nuclear security regime depends on the people involved. It is the human factor — including management and leadership — that must be addressed in any effort to enhance nuclear security culture."

Organizations need to have a nuclear security policy, a sound management system and regular training and sensitization techniques for employees to understand nuclear security risks. Culture evolves slowly, and people are often resistant to change, Hamada added. "Maintaining a strong nuclear security culture requires persistent effort and continuous monitoring."

The IAEA has offered assistance and support to its Member States in the area of security culture ever since the term was coined a decade ago. It is currently developing guidance for security culture self-assessment and enhancement for countries and for organizations responsible for nuclear security.

In Indonesia, many of BATAN's 2800 employees have gone through security

awareness training and have participated in drills and exercises over the last few years, Khairul explained. Around 1000 employees periodically attend training events on nuclear security culture. They learn about the importance of information protection and of compliance with facility procedures. They are also better informed about the need to avoid divulging information that has the potential to undermine security, including by being on the alert for insider threats (see Box below). "An enhanced security culture is particularly important for a country that is considering the introduction of nuclear power, like Indonesia," he said.

Self-assessment in Bulgaria

Bulgaria has operated nuclear power plants for decades and has used IAEA guidance and services to enhance its security culture.

In 2013, the Kozloduy nuclear power plant's management team conducted a nuclear security self-assessment to evaluate the extent of nuclear security culture at the plant. The self-assessment, based on IAEA methodology, identified areas for improvement as well as areas where good practices had to be maintained, said Vladimir Yankov, Head of Analysis and Control of Physical Protection at the plant's Security Division. This led to the development of an action plan for ongoing enhancement of security culture at the plant.

Since culture is often difficult to change, the plant's management decided to undertake self-assessments every two years to check progress made and update the action plan.

"The key message we transmit to our staff is that security is a shared responsibility," Yankov said. "It cannot be done by security professionals alone."

Hidden but real: Insider threat

Nuclear installations are well guarded and protected against violent intrusion from the outside. But their employees, contractors and other individuals with access to, authority over, or knowledge of nuclear material may be a weak link in guarding against the theft of nuclear material.

"In the past we were mostly concerned about outside attacks. We now need to focus more and more on insider threats, too," said Tapani Hack, Section Head for Nuclear Security at Finland's Radiation and Nuclear Safety Authority (STUK). Insiders can be engaged in malicious acts by, for instance, leaking information to terrorist groups or playing a part in the theft of materials. Or they can pass on information inadvertently.

STUK has recently revised its security regulations for nuclear operators, requiring the development of preventive measures against insider threats. Operators now need to submit their security plan to STUK for approval. This applies equally to nuclear installations under construction. "We now expect operators to consider insider threats from the moment of planning," Hack said.

The IAEA has developed a guidance document and training courses to help countries educate their nuclear workforce in preventing theft of nuclear material by insiders. A new tool, currently under development, includes the three-dimensional model of a hypothetical facility, and the task for trainees is to find a way to smuggle nuclear material out of it. Once they find a way, they need to identify upgrades to protection systems and internal controls to prevent the theft.

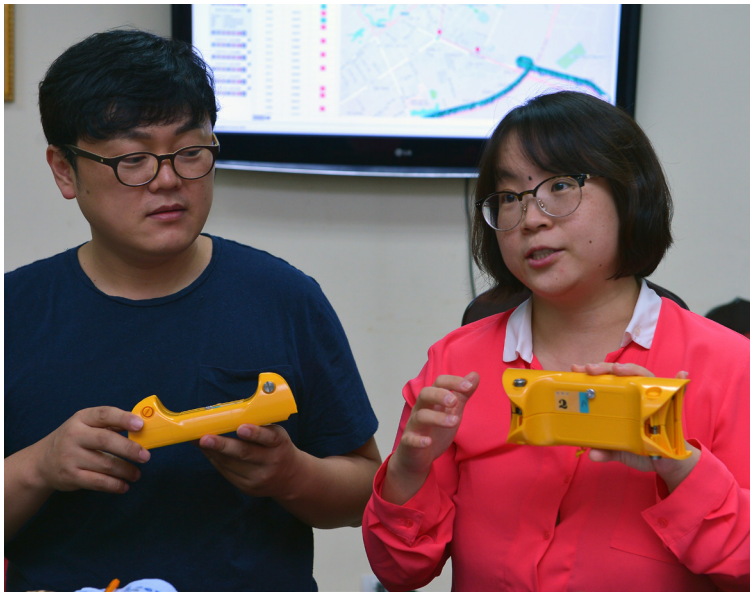
A new IAEA training tool includes a 3D model of a hypothetical facility for the identification of insider threats.

Nuclear security and

1 Outside Hanoi, a steel fabrication plant annually produces over 3000 tonnes of industrial equipment for domestic use and export. The quality of welded pipes and tanks for plants and refineries is integral to getting products to market and ensuring that Viet Nam's industry continues to be a mainstay of its economy.

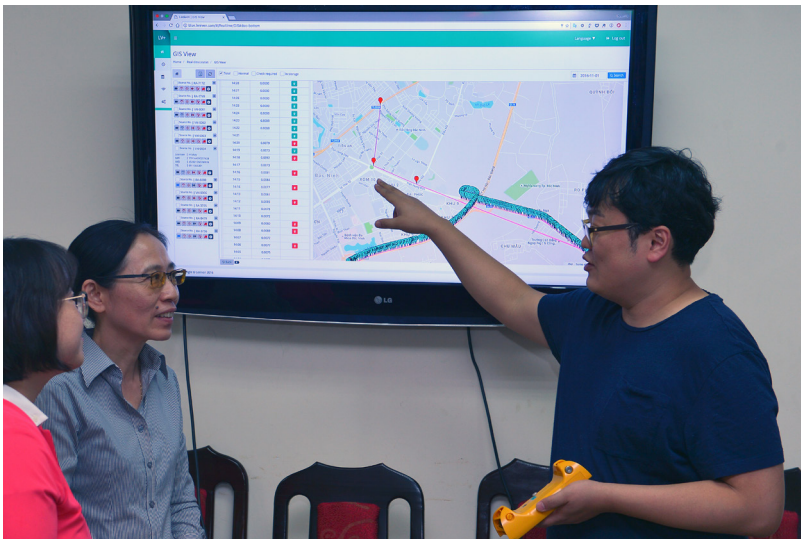
2 In a similar way that X-rays are used to check for cracks in bones, industrial radiography devices are used to check for cracks or flaws in industrial components. These devices contain radioactive sources and are portable, making them vulnerable to loss or theft. Each year, cases of lost or stolen radioactive sources are reported to the IAEA.

3 Nguyen Nu Hoai Vi, from the Vietnam Agency for Radiation and Nuclear Safety explained: "After an incident of a source stolen and later recovered, we implemented enhanced security measures for portable sources. Together with the Republic of Korea, we implemented a tracking system for radioactive sources, which links workers in the field to the regulator, thereby improving security."



4 "Viet Nam's Radioactive Source Location Tracking System — based on the Republic of Korea's Radiation Source Location Tracking, or 'RADLOT', system — enables real-time monitoring of the movements of high-activity radioactive sources, which helps to detect a loss or theft and allows for quick recovery," added Kiwon Jang (right) from the Korea Institute of Nuclear Safety. Because such sources are portable, tracking their location is essential."

d industry in Viet Nam



5 The tracking system is comprised of two parts: a mobile terminal unit that attaches to the device and a central control system. The mobile terminal unit sends information on location and dose rate, reflecting both safety and security considerations in its operation. The regulator receives an alert if suspicious activity occurs.

6 Regulators can access the central control system through a web interface. The mobile terminal units provide information necessary to respond to security related incidents, bringing together technology and regulatory oversight. Being able to quickly locate radioactive sources and regain regulatory control over them ensures that safety and security are maintained.

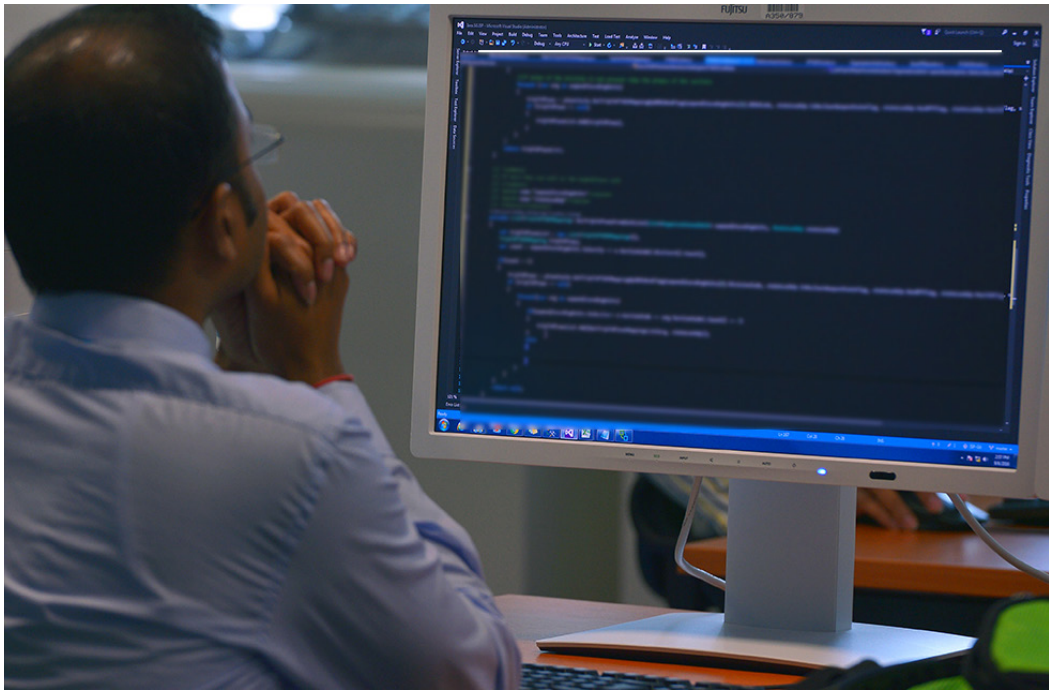
7 To test the Radioactive Source Location Tracking System, colleagues from the Republic of Korea and Viet Nam perform field tests to verify the tracking system's functionality under various operating conditions. Testing the system ensures that the licensee and regulator are clear about their roles and responsibilities and that, when deployed, it will provide an additional layer of security.

8 "Radiation does not have boundaries," Kiwon Jang concluded. "That is why cooperation in nuclear security is so important." The Radioactive Source Location Tracking System project reinforces how technology, when anchored in a strong regulatory framework, can bolster a national nuclear security regime to the benefit of industry and other peaceful uses of nuclear applications.

Text: Danielle Dahlstrom; Photos: D. Calma/IAEA

Guns, guards, gates and geeks: Romania strengthens computer security at nuclear installations

By Laura Gil



(Photo: D. Calma/IAEA)

A cyberattack could swipe all the information stored on your computer or even prevent it from working. That's bad enough. But a cyberattack on a nuclear power plant could lead to sabotage or theft of nuclear material. Computer security, concerned with the protection of digital data and the defence of systems and networks against malicious acts, is a critical component of nuclear security.

"The advance of computers and their use in all aspects of nuclear operations has changed the security paradigm," said Donald Dudenhoeffer, Information Technology Security Officer at the IAEA. "Information and computer security must be considered as components in the overall nuclear security plan."

Nuclear security has long been dominated by a focus on physical protection — often referred to as guns, guards and gates — but today's criminals have also embraced computers as a means and target of attacks. A cyberattack could lead to the loss of nuclear security information, the sabotage of nuclear installations and, combined with a physical attack, the theft of nuclear or other radioactive material. Computers now play an essential role in the safety, security and management of nuclear facilities; it is of vital importance that all systems are properly secured against malicious intrusions.

"We all need to be prepared to defend ourselves from the non-benign environment of the internet and the digital age," Dudenhoeffer said. "We all use computers, and we all need to build greater awareness of the threats, risks and means for protection." Regulators and operators of nuclear installations are increasingly aware of the importance of computer security and are seeking to enhance their nuclear security programmes. Romania, according to Dudenhoeffer, is one exemplary case.

"We understand the importance of protection against all kinds of threats that may affect the safe, secure and reliable operation of our nuclear installations, including threats directed at computer and information security," said Madalina Tronea, Coordinator at the Nuclear Regulations and Standards Unit of the National Commission for Nuclear Activities Control (CNCAN) in Bucharest, Romania.

In 2012, a group of IAEA specialists conducted an International Physical Protection Advisory Service mission in Romania. They provided the authorities with a list of recommendations to further develop an adequate regulatory framework for the protection of nuclear installations against various threats, including cyberattacks.

Shortly afterwards, a team of nuclear regulators from the CNCAN started working on a regulation that came into force in November 2014. The regulation focuses on the protection of systems, equipment and components — including software for instrumentation and control systems — that are important to nuclear safety, security, safeguards and emergency response. In addition to the regulation, the CNCAN issued a document outlining cyberthreats taking into account new threats and recent computer security events in industry around the world.

"We pay attention to the global context and to the changes in both threats and countermeasures," Tronea said. "And we do our best to ensure an adequate prevention and protection against computer security incidents as well as effective response to such events, should they occur."

In that same year, the Romanian Government approved a National Strategy for Nuclear Safety and Security, which includes objectives dedicated to the continuous improvement of computer security in the nuclear sector.

People: the problem and the solution

Studies show that the majority of computer security incidents are caused by human errors.

"People: human capacity development is one of the best investment areas," Dudenhoeffer said. "We don't need a world filled with experts in computer security. We need a world filled with people who are aware of the computer security risks and basic measures of defence. We need a well-informed workforce and leadership."

Thanks to the IAEA training courses that Romania has participated in since 2013, the country has built a sustainable network of stakeholders. Through the network, stakeholders now share experiences in nuclear security and work together to build

(Photo: CNCAN)

robust information and computer security programmes.

Through national training courses, online learning, expert meetings and train-the-trainer programmes, the IAEA works with national leadership and stakeholders of the nuclear industry to better understand cyberthreats and to develop good practices that enhance computer security. National training courses, Dudenhoeffer said, are some of the most valuable activities that the IAEA conducts in computer security.

"In physical protection, you can see what you're protecting and visualize probable attack scenarios," Dudenhoeffer said. "But in cyberspace, criminals have many more targets including those not at the facility; you could even be attacked at home. We must learn to think like the criminals to better understand how to protect against cyberattacks wherever we are."

Nuclear security of

1 Cuba is a leading hub for medical research and cancer treatment in Latin America and the Caribbean. Physical protection is installed at radiotherapy facilities to detect entry of and delay access to an intruder. This minimizes the likelihood of unauthorized access and maximizes nuclear security.

2 "Cuba is a developing country," explained Juan B. Sosa Marín, Colonel, Chief of the Ministry of the Interior's Dangerous Substances Department. "We want to demonstrate how even a small country can contribute to enhancing radioactive source security and, hence, minimize the threat posed by nuclear terrorism. We are confident that we have undertaken measures to strengthen our national nuclear security regime and to protect our tradition of excellence in medicine."

3 Security at oncology facilities is a high priority. High-activity radioactive cobalt-60 sources are vital for cancer treatment. Together with the IAEA, Cuba upgraded physical protection measures in nine medical facilities in order to secure the sources.

4 "Strong physical protection measures help us to limit access and make daily operations run smoothly. They also enable us to comply with regulations, which in turn provide confidence that our source is secure. Ultimately, we are able to provide uninterrupted treatment to even more patients because our source is secure", explained Dr Niurka Rodríguez Hernández.

Cuba's medical facilities

5 Cuba installed physical protection systems such as steel reinforced doors, motion sensors and cameras at six facilities outside Havana to delay unauthorized access to such a facility, detect any unauthorized movement, and ensure a timely response. The goal for Cuba is to increase security by decreasing the risk of theft or sabotage.

6 In close cooperation with Cuba, IAEA experts visit facilities to ensure that equipment is in place and functioning according to the agreed plan.

7 Improving the physical protection at facilities also contributes to improved radiation protection by limiting unauthorized access to controlled areas. In this regard, nuclear security shares the same objective with radiation safety to protect people from the harmful effects of ionizing radiation. This ensures that the source is used to the benefit of patients.

8 "Upgrades to our physical protection measures help to guarantee that no unauthorized person can access our sources. We can safely and securely treat our patients so that no harm can come to our community and our country can continue to advance," Dr Rodríguez Hernández concluded.

Text: Danielle Dahlstrom; Photos: D. Calma/IAEA

Pakistan's national Centre of Excellence contributes to sustaining nuclear security

By Aabha Dixit

> **"Pakistan's Centre of Excellence for Nuclear Security will offer cutting edge education and training in nuclear security and contribute to the work of the International Network for Nuclear Security Training and Support Centres."**
>
> *— Muhammad Anwar Habib, Chairman, Pakistan Nuclear Regulatory Authority*

Pakistani front line officers and first responders are in a better position to fight illicit trafficking in nuclear and other radioactive materials, as well as to use advanced radiation detection and monitoring equipment, thanks to training they have received at the country's Centre of Excellence for Nuclear Security. This is just one of the benefits the country has reaped from the Centre, which is collaborating with the growing International Network for Nuclear Security Training and Support Centres (NSSC Network), building national capacity through training and strengthening technical and scientific support programmes.

Since the establishment of the Centre of Excellence, Pakistan has organized training courses on nuclear security for personnel from national and regional organizations. The Centre of Excellence also offers technical support to personnel involved in the maintenance and upgrade of facilities, with a focus on enhancing technical and scientific skills and quality control of equipment.

With an integrated capacity building programme in place, Pakistan can now offer its training facilities to other countries for capacity building in physical protection of nuclear power plants and nuclear security, said Muhammad Anwar Habib, Chairman of the Pakistan Nuclear Regulatory Authority, adding that a new Physical Protection Exterior Laboratory was established in April this year.

Specific training enhances security

Pakistan has used its Centre of Excellence to promote and share best practices in nuclear security through three affiliated institutes: the Pakistan Centre of Excellence for Nuclear Security (PCENS), the National Institute of Safety and Security (NISAS), and the Pakistan Institute of Engineering and Applied Sciences (PIEAS).

The PCENS offers training in nuclear security and response, while NISAS conducts specialized courses to provide comprehensive training for effective regulatory operations. In addition, PIEAS conducts academic courses at the master's level in nuclear security. Academic courses in this field will prepare the next generation of young engineers and scientists to take up nuclear security responsibilities, Habib said.

"Pakistan's Centre of Excellence for Nuclear Security will offer cutting edge education and training in nuclear security and contribute to the work of the International Network for Nuclear Security Training and Support Centres," he added.

What is the NSSC Network?

The NSSC ('Nuclear Security Support Centre') concept, developed by the IAEA, is a means to strengthen the sustainability of nuclear security in countries, and has the following objectives:

1. to develop human resources through the implementation of tailor-made training programmes;
2. to establish a network of experts; and
3. to offer technical support for equipment management and scientific support for the prevention and detection of, and response to, nuclear security events.

The NSSC Network was established in 2012 in response to the international community's growing focus on nuclear security. It fosters nuclear security culture and enhances coordination and collaboration among States that have established, or are interested in establishing, an NSSC.

"The NSSC Network has become an established community of practice for Member States and the IAEA to exchange information, identify best practices, and deepen cooperation on the development of such centres," said Juan Carlos Lentijo, Deputy Director General and Head of the IAEA Department of Nuclear Safety and Security.

How to improve nuclear security worldwide: Three young women win IAEA essay contest

By Jeremy Li

Three essays that provided actionable and innovative recommendations to strengthen nuclear security through stronger border controls, closer international cooperation and public education won the IAEA's first ever nuclear security essay contest.

"These essays demonstrate a clear and compelling understanding of nuclear security and its many intricacies," said Tim Andrews, Head of the Programme Development and International Cooperation Section at the IAEA. "They look to the future."

In preparation for the International Conference on Nuclear Security: Commitments and Actions, the IAEA invited students and young professionals to submit essays focusing on challenges and recommendations to strengthen nuclear security. A panel of experts from the IAEA and the International Nuclear Security Education Network selected three winners from among the 353 submissions received. The winners will present their papers at the conference, taking place in Vienna in December 2016.

The perspectives of young professionals have the potential to contribute fresh and compelling insights into the future of nuclear security, Andrews said, explaining the rationale behind organizing the contest. The three winners will each receive a 2000 euro cash prize with a certificate signed by IAEA Director General Yukiya Amano. The IAEA will also sponsor their attendance at the conference.

Community engagement for nuclear security

One of the winning submissions, an essay by Sudanese student Abeer Mohamed from Ritsumeikan University in Japan, entitled *Encouraging Community Engagement as a Strategy to Strengthen Nuclear Security in Our Borders,* highlights the threats and challenges in developing countries with porous borders and limited security control resources due to the lack of sufficient equipment and finances. To improve border security, she suggests engaging the broader communities through education, establishing domestic policies, and channelling better communication between community and law enforcement agencies.

The importance of regional cooperation

The entry by Singaporean student Noor Azura Zuhairah Binte Abdul Aziz, from University College London, entitled *The Future of Nuclear Security in Southeast Asia: Commitments and Actions,* focuses on the importance and implications of nuclear security in the South-east Asia context. It discusses regional problems stemming from terrorism, maritime piracy and insufficient border controls. To address these challenges, she proposes to build closer international cooperation, especially among member countries of the Association of Southeast Asian Nations, to strengthen capacity building and to create training programmes for all countries within the region, as well as to establish a comprehensive regulatory framework.

A medical physicist's perspective

Katharine Thomson from Musgrove Park Hospital in the United Kingdom drew parallels between the common challenges of medical and other applications of radiation in her essay entitled *Future of Nuclear Security: Commitments and Actions — A Medical Physicist's Perspective*. She put forward three approaches to meet the challenges: engaging the public through education programmes, controlling access to dangerous material and thereby eliminating the risk of insider threats, and enhancing cybersecurity by building comprehensive, usable and respected cybersecurity systems.

Nuclear security from cradle to grave

By Raja Abdul Aziz Raja Adnan

On 8 May 2016, the Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM) finally entered into force, almost eleven years after its adoption. The world will be a more secure place as a result of the commitments that States party to the Amendment have made.

The Amendment establishes legally binding commitments for countries to protect nuclear facilities as well as nuclear material in domestic use, storage and transport. Under the Amendment, countries are required to establish appropriate physical protection regimes for nuclear material. They also take on new obligations to share information on sabotage, including on credible threats of sabotage.

The entry into force of the Amendment demonstrates the international community's resolve to act together to strengthen nuclear security globally. It also helps reduce the risk of an attack involving nuclear material, which could have catastrophic consequences.

States have also made other specific commitments to improve nuclear security, for instance through voluntary participation in initiatives such as the Global Initiative to Combat Nuclear Terrorism and by subscribing to the Joint Statement on Strengthening Nuclear Security Implementation issued in 2014.

Through activities under successive Nuclear Security Plans, the IAEA has been assisting States to transform these commitments into actions. The IAEA International Conference on Nuclear Security in December 2016 provides an opportunity for States to take stock of their commitments, as well as of the actions they have taken to fulfil those commitments, and to consider the way forward.

This includes providing advice on the future direction of IAEA support for nuclear security. In implementing the Nuclear Security Plans, the IAEA has positioned itself in a leading role as the global platform for strengthening nuclear security. Such a role builds on our recognized technical capacities, the strength of our membership, which currently totals 169 States, and our inclusive approach, which ensures that the voices of all States are heard in identifying the problems and the solutions to those problems.

Our member states recognize the IAEA's central role in strengthening the nuclear security framework globally. They have identified areas where additional assistance to improve national nuclear security regimes is required. We stand ready to respond to our Member States' needs by ensuring that they have the support necessary for cradle-to-grave nuclear security. The IAEA offers an inclusive platform that can help achieve a truly global response to a global concern.

US $1 million donation to boost IAEA efforts on child nutrition

(Photo: IAEA)

The IAEA has received a grant of over US$ 1 million from the Bill and Melinda Gates Foundation to support its work on combating malnutrition in children. The funding, announced in late September 2016, will cover the cost of research using stable isotope and related techniques to collect data on healthy growth and body composition in infants, mainly in low and middle income countries. The results will contribute to Member States' fight against both childhood obesity and undernutrition.

The funding is the first major donation from a non-State donor to the IAEA in recent years. The IAEA is enhancing its efforts to promote partnerships and attract funding from private donors.

"Fighting malnutrition is a great example of the use of nuclear techniques in support of development objectives," said IAEA Deputy Director General and Head of the Department of Nuclear Sciences and Applications Aldo Malavasi. "The funding provided by the Gates Foundation will enable the IAEA and its partners to accelerate research in this area."

The grant is intended to contribute to the IAEA coordinated research project (CRP) 'Longitudinal Measures of Body Composition of Healthy Infants and Young Children up to Two Years of Age Using Stable Isotope Techniques'. This project will generate reference data on body composition changes in healthy children in order to better understand the effects of low birth weight, wasting and stunting on body composition.

The above-mentioned CRP is following infants from birth to 12 months of age and is collecting data on body composition, assessed using the deuterium dilution technique. The deuterium dilution technique involves measuring a person's saliva and/or urine just before they consume a dose of deuterium labelled water and repeating the process three to five hours later. The increased level of deuterium shows in the person's saliva and urine samples. Scientists can calculate the percentage of body fat-free mass based on the extent of the dilution of the deuterium in the body. The person's pre-dose samples of urine or saliva are compared with the post-dose samples to calculate fat-free mass and ultimately the amount of fat in the body.

These data complement information on weight, length, skinfold thickness and mid-upper arm circumference, as well as on infant feeding practices and health, when the children are three, six, nine and 12 months old.

The grant from the Bill and Melinda Gates Foundation will allow for follow-up of infants in Brazil, South Africa and Sri Lanka at 18 and 24 months of age. In addition, it will support the study of changes in body composition in infants from birth to six months in Australia, India and South Africa. The overall aim is to collect information on children from various ethnic groups around the world. The Foundation is supporting dozens of projects that intersect with and complement IAEA efforts to target and better understand the causes of malnutrition.

Appropriate nutrition in the first 1000 days — from conception to an infant's second birthday — is essential for optimum growth and brain development; inappropriate nutrition can increase the risk of ill health in later life, said Christine Slater, a nutrition specialist at the IAEA.

Only recording the height and weight of infants, as traditionally done, does not capture the quality of body growth. Equally important is monitoring body composition, which includes assessing the relative amounts of fat and lean, or fat-free, tissue. "Two individuals can have the same weight and height but differ markedly in the proportions of fat and lean tissue and hence risk of developing non-communicable diseases in later life," Slater added. Higher percentage of fat tissue carries an increased risk of disease.

The data records collated will be used to construct charts on changes in body composition as children grow. These can be used as reference data for the evaluation of nutritional interventions, such as education campaigns for mothers on appropriate complementary feeding practices or nutrition supplementation for the prevention and treatment of malnutrition in young children.

— By Aabha Dixit

Iraq uses nuclear technology to improve crop productivity and adapt to climate change

(Photo: IAEA)

A new drought-tolerant wheat variety developed with the support of the IAEA and the Food and Agriculture Organization of the United Nations (FAO) has increased yields fourfold in Iraq. This mutant variety now accounts for close to two thirds of all the wheat produced in the country.

Iraq is increasingly making use of nuclear technology to improve its crop yields and cope with the consequences of a changing climate. Researchers in the country have developed new drought-tolerant plant varieties and improved water and soil management.

These developments have helped enhance food production and adapt to climate change, said Ibrahim Bakri Abdulrazzaq, Director General of Baghdad's Agricultural Research Service, which is subordinate to Iraq's Ministry of Science and Technology. "We have developed efficient packages of technology that aim to overcome the most pressing problems in the area of agriculture."

Iraq's rangelands, where shepherds herd their sheep and cattle, have seen warmer temperatures and less rainfall since the early 2000s. Without a vegetative cover, they have become less fertile and more susceptible to erosion, affecting the country's rain-fed agriculture and the wheat-producing provinces, Abdulrazzaq explained.

From 2007 to 2011, Abdulrazzaq and his colleagues worked alongside experts from the IAEA and FAO to find solutions to these challenges through induced mutation breeding. This technique involves exposing plant seeds and cuttings to radiation to generate genetic variability and then selecting the improved agronomic traits of interest.

Iraqi scientists used the technique to develop four improved varieties of traditional crops that tolerate both drought and salty soil — conditions typical of dry areas that hinder plant growth. The varieties are also resistant to lodging — when stems or roots are displaced from their vertical and proper placement — and seed shattering, both major causes of yield loss in crops.

"All the results have gone directly to the farmers. Now, the farmers tell us they want the new plants," Abdulrazzaq said. "They are even ready to pay more because they know the wheat and the barley are salt-tolerant, drought-tolerant and have high productivity."

Whereas the conventional variety of Iraqi wheat only produces one tonne per hectare, the new variety developed through mutation breeding boasts a productivity of four tonnes per hectare. Almost 65% of the wheat produced in Iraq today comes from these new varieties.

These new varieties are also more resistant to dust storms — another problem farmers increasingly face. "Some years ago, we had 17 dust storms per year," Abdulrazzaq said. "Now, partly because of the unprotected rangelands, we have more than a hundred dust storms. And this affects the fertility of the soil, water resources and human beings."

More than food

Iraq has also collaborated with the IAEA in applying nuclear technology in other fields, such as nuclear medicine, radiotherapy and industry, including the construction of oil pipes using non-destructive testing methods. Equally important are the decommissioning and environmental remediation of Iraq's nuclear complex destroyed in 2003.

Since 2006, the IAEA has been working with Iraqi officials to reduce the radiological risk to the public and the environment by decommissioning old installations and remediating decontaminated areas and disposal sites.

"The project is a big undertaking," said Eric Howell, Managing Director of the environmental risk assessment company Facilia Projects participating in the project. "It touches on all the relevant fields you could think of: from regulatory support, radiation safety to radioactive waste management. The IAEA has played an integral role in

coordinating the decommissioning work in the country."

Iraqi and IAEA experts discussed these and other areas of technical cooperation during a meeting held in Vienna in August 2016 to chart a new plan of enhanced collaboration, said Abdulghani Shakhashiro, Programme Management Officer at the IAEA.

Meanwhile, scientists and researchers like Abdulrazzaq are working to help Iraq move a step closer to the United Nations Sustainable Development Goals." Sometimes, Iraq gets forgotten. But with more involved stakeholders and an improved security situation, the story can always change," Howell said.

— By Laura Gil

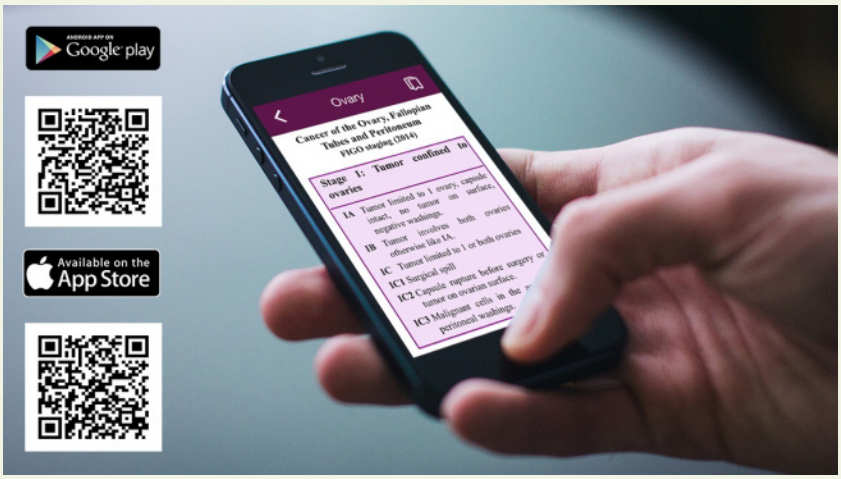
New mobile App to help doctors evaluate cancer in women

Optimizing cancer care for women is the aim of a new mobile app designed to help doctors evaluate more quickly and accurately the extent of cancer in female reproductive organs and select the most appropriate treatment. The FIGO Gyn Cancer Management app is available for use on iOS and Android devices.

"One of the major challenges faced by clinicians is to determine the most effective treatments for their patient, ensuring optimal conditions at minimal risk," said Diana Paez, Head of the Nuclear Medicine and Diagnostic Imaging Section at the IAEA. "Technological innovations like this gynaecological cancer staging app help to address that challenge by bringing key information right to a doctor's fingertips." The app also includes investigation and management strategies based on best practices as endorsed by the International Federation of Gynecology and Obstetrics (FIGO).

Cancer is one of the leading causes of death worldwide, with approximately 14 million new cases and 8 million cancer-related deaths each year. Gynaecological cancers encompass a diverse group of tumours originating in the female reproductive organs — the vulva, vagina, cervix, uterus, fallopian tubes and the ovaries. It is estimated that every year over 1 million cases and half a million deaths worldwide are due to gynaecological cancers.

"Pivotal elements for addressing the cancer burden worldwide are early detection and accurate diagnosis, precise evaluation of disease extent and appropriate selection of a treatment approach," Paez said.



(Photo: IAEA)

If cancer is diagnosed, doctors can use the new app to further plan treatment according to the globally recognized cancer staging and management guidelines published by FIGO. These guidelines represent a standardized system based on expert consensus and are regularly updated to reflect evolving medical knowledge of gynaecological cancers. They constitute a system of criteria that draw on a wide range of medical tests and key variables related to the tumour, including its size and location and whether the cancer cells have spread to the lymph nodes or other parts of the body (metastasis).

These key variables are considered together, giving particular consideration to any spread outside the original location of the tumour. The results are typically expressed as stages ranging from one to four, with several substages. The doctors then use the stages to decide whether surgery, radiotherapy, chemotherapy or any other form of treatment is most appropriate for the patient.

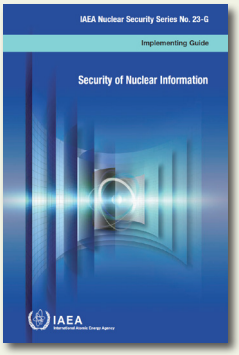
The new app is useful for a range of medical specialists, including gynaecologists, oncologists, pathologists and surgeons.

"Physicians can plug in the key details about a patient's tumour into the app, even when the app is offline, and interactively and quickly find the information they need," said Neerja Bhatla, a gynaecologist from FIGO. "While it's a small step, it's an important one, because it helps to further shorten the gap in access to quality care worldwide."

Cancer management is an important strand of the IAEA's work worldwide. It contributes to helping countries achieve the United Nations Sustainable Development Goals and, in particular, the target of reducing the burden of non-communicable diseases, such as cancer, by one third by 2030.

— By Nicole Jawerth

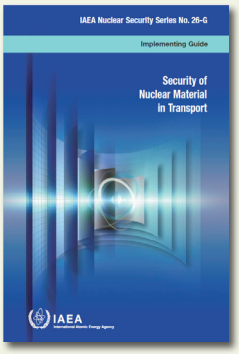
Publications Alert



Security of Nuclear Information

provides guidance on implementing the principle of confidentiality and on the broader aspects of information security (i.e. integrity and availability). It assists States in bridging the gap between existing government and industry standards on information security, the particular concepts and considerations that apply to nuclear security and the special provisions and conditions that exist when dealing with nuclear material and other radioactive material. Specifically it seeks to assist States in the identification, classification and assignment of appropriate security controls to information that could adversely impact nuclear security if compromised.

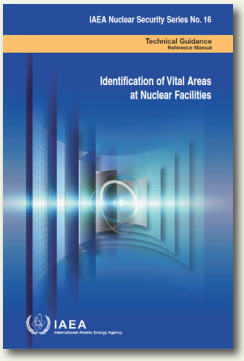
IAEA Nuclear Security Series No. 23-G; ISBN 978-92-0-110614-8; English Edition; 30.00 euro; 2015
http://www-pub.iaea.org/books/iaeabooks/10774/Security



Security of Nuclear Material in Transport

aims to help States and their competent authorities to implement and maintain a physical protection regime for transport of nuclear material. It will also be useful to shippers or carriers in the design and implementation of their physical protection systems.

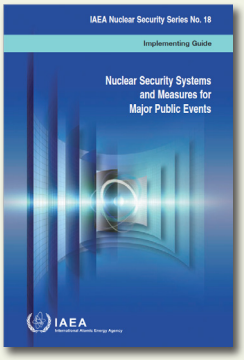
IAEA Nuclear Security Series No. 26-G; ISBN 978-92-0-102015-4; English Edition; 48.00 euro; 2015
http://www-pub.iaea.org/books/iaeabooks/10792/Transport



Identification of Vital Areas at Nuclear Facilities

presents a structured approach to identifying vital areas at nuclear facilities that contain equipment, systems and components to be protected against sabotage. The process for selection of a specific set of vital areas to be protected is based on consideration of the potential radiological consequences of sabotage, and on the design and operational and safety features of a nuclear facility. The publication is part of a set of supporting publications in the IAEA Nuclear Security Series that aim at assisting States in the design, implementation and evaluation of their physical protection systems for nuclear material and nuclear facilities.

IAEA Nuclear Security Series No. 16; ISBN 978-92-0-114410-2; English Edition; 22.00 euro; 2013
IAEA Nuclear Security Series No. 16; ISBN 978-92-0-210915-5; French Edition; 22.00 euro; 2016
http://www-pub.iaea.org/books/IAEABooks/8592/Identification



Nuclear Security Systems and Measures for Major Public Events

provides an overview, based on practical experience and lessons learned, for establishing nuclear security systems and measures for major public events. It covers technical and administrative nuclear security measures that are needed to develop an organizational structure, plans, strategies and concepts of operations, and to make arrangements to implement the developed plans, strategies and concepts.

IAEA Nuclear Security Series No. 18; ISBN 978-92-0-127010-8; English Edition; 30.00 euro; 2012
IAEA Nuclear Security Series No. 18; ISBN 978-92-0-401414-3; Russian Edition; 30.00 euro; 2014
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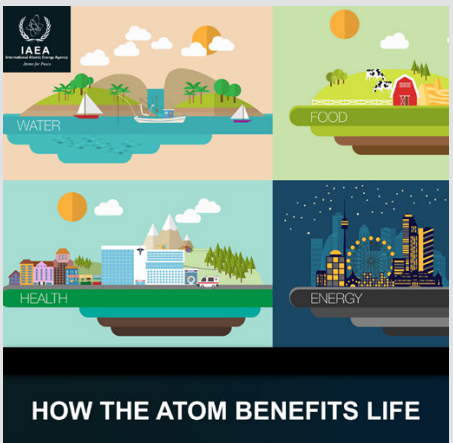

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