

IAEA BULLETIN

INTERNATIONAL ATOMIC ENERGY AGENCY

April 2010 | 51-2 | www.iaea.org/bulletin



Keys to Security

Beneficial, Responsible, Sustainable • A Look Into the Future • Globalisation of Cancer



The International Atomic Energy Agency is the world's centre of nuclear cooperation. Created in 1957 as the intergovernmental “atoms for peace” organization within the UN system, the IAEA contributes to global peace, development, and security in essential ways — helping to prevent the spread of nuclear weapons, and fostering safe, secure and peaceful uses of beneficial nuclear technologies for human development.

The Agency assists its Member States, in the context of social and economic goals, in planning for and using nuclear science and technology for various peaceful purposes, including the generation of electricity, and facilitates the transfer of such technology and knowledge in a sustainable manner to developing Member States. By developing nuclear safety standards, the Agency promotes the achievement and maintenance of high levels of safety in applications of nuclear energy, as well as the protection of human health and the environment against ionizing radiation. The Agency also verifies through its inspection system that States comply with their commitments, under the Non-Proliferation Treaty and other non-proliferation agreements, to use nuclear material and facilities only for peaceful purposes.

The work is multi-faceted and engages multiple governmental and other partners at national, regional and international levels in and outside the UN system. IAEA programmes and budgets are set through decisions of its own policymaking bodies — the 35-member Board of Governors and the General Conference of all Member States. Reports on IAEA activities are submitted periodically or as cases warrant to the UN Security Council and UN General Assembly.

The Agency is headquartered at the Vienna International Centre in Vienna, Austria. Operational field and liaison offices are centred in Toronto, Canada; Geneva, Switzerland; New York, USA; and Tokyo, Japan. The IAEA runs or supports research centres and scientific laboratories in Vienna and Seibersdorf, Austria; Monaco; and Trieste, Italy.

The IAEA Secretariat is a team of around 2300 professional and support staff led by **Director General Yukiya Amano** and six Deputy Directors General who head the major departments:

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Management

Mr. Olli Heinonen

Safeguards

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Nuclear Energy

Mr. Werner Burkart

Nuclear Science & Applications

Ms. Ana Maria Cetto

Technical Cooperation

Mr. Tomihiro Taniguchi

Safety & Security



KEYS TO SECURITY

As this issue of the IAEA Bulletin goes to print, nuclear security is becoming a headline theme. An international summit will convene shortly in Washington, D.C., to consider global approaches to securing nuclear technologies, sites and facilities against the threat of malicious activity. Preventing such willful acts is one of the many keys that can enable the peaceful development of nuclear technology.

In this April 2010 issue, we will examine several other keys that grant us a higher level of security in different senses.

For instance, current research and development in long-term nuclear waste disposal technologies will grant future generations the security that high-level radioactive waste will be safely sequestered over centuries. An in-depth article on these long-term storage technologies offers insight into international disposal strategies and current prognoses for their deployment.

A key limiting factor in nuclear power's growth is its level of public acceptance. The Swedish town of Oskarshamn may be one of the world's most 'nuclear-friendly' communities. Its inhabitants feel so secure that our correspondent could not find a single nuclear detractor within the town limits. That unusually high level of confidence is not a coincidence: the Äspö Hard Rock Laboratory that tests high-level nuclear waste disposal technologies and a nuclear power plant are located near Oskarshamn. We take a look at the town's perception of nuclear power and waste as a case study in how community acceptance can be fostered.

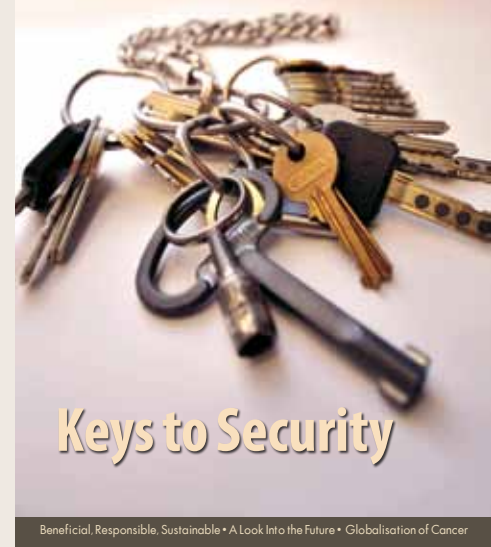
As the Swedish case study demonstrates, security requires credible, personal engagement. Experienced experts, knowledgeable in these methods and systems, are critically important for a plant's safe operation. The security procedures and technologies used today to protect nuclear power plants and other nuclear sites are as complex as the technology they guard. Among IAEA Member States the demand for such expert training and advice is growing. In partnership with the IAEA, the International Nuclear Security Training Centre in Obninsk, Russia, expanded its extensive training capabilities to offer this key expertise to IAEA Member States. Our article provides an up-close view of the Centre's work.

Security will again be a frequently-cited term in Op-Eds and the news when the Nuclear Non-Proliferation Treaty's (NPT) five-year review conference commences in May. The IAEA's inspections play a key role in the NPT verification regime. Through its training programme, the Agency ensures that inspectors are ready to monitor and verify that the safeguards we all depend upon for our security are in place.

The NPT also refers to regional treaties that assure the total absence of nuclear weapons from territory of those nations that undertake such agreements. "Nuclear weapons-free zones" (NWFZs) now girdle the territories of the entire Southern hemisphere. Mongolia's Resident Representative to the IAEA, Ambassador Enkhsaikhan, shared with us his experience in establishing Mongolia as an internationally-recognized NWFZ, recognized by its neighbours and anchored into international law.

And finally, I would like to acknowledge the IAEA Bulletin's long-serving editor, Lothar Wedekind, who over the past quarter-century steered, sustained, expanded and adapted the journal in swiftly changing times. Beginning in 1974 and until his retirement in 2009, Lothar ensured that the IAEA Bulletin remained a vocal and authoritative forum for debate on the issues that shape peaceful nuclear development. It is a distinct privilege to assume responsibility for this enterprise that includes a rich publishing history, as well as an on-line presence. The IAEA Bulletin team's monumental effort to build a searchable, six-language, on-line journal archive is now nearing completion, securing this legacy for a broad global population. In future, readers can be assured that the team will continue to innovate to reach the growing, global audience that follows peaceful nuclear developments.

— Peter Kaiser, Editor-in-Chief



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IAEA BULLETIN

is produced by the

Division of Public Information
International Atomic Energy Agency
P.O. Box 100, A-1400 Vienna, Austria
Phone: (43-1) 2600-21270
Fax: (43-1) 2600-29610
IAEBulletin@iaea.org
www.iaea.org/bulletin

Division of Public Information

Director: Marc Vidricaire
Editor-in-Chief: Peter Kaiser
Managing Editor: Giovanni Verlini
Assistant Editor/Design: Ritu Kenn

Language Editions

IAEA Bulletin is also available in
Arabic, Chinese, French, Russian and Spanish.

IAEA BULLETIN is published twice a year and distributed without charge to a limited number of readers interested in the IAEA and the peaceful uses of nuclear energy. Written requests should be addressed to IAEBulletin@iaea.org.

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Cover Photo: Dean Calma/IAEA
IAEA Bulletin is printed in Austria.

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“Our shared goal is to assist countries embarking on nuclear power to do so knowledgeably, profitably, safely and securely.”

— IAEA Director General Yukiya Amano, p14



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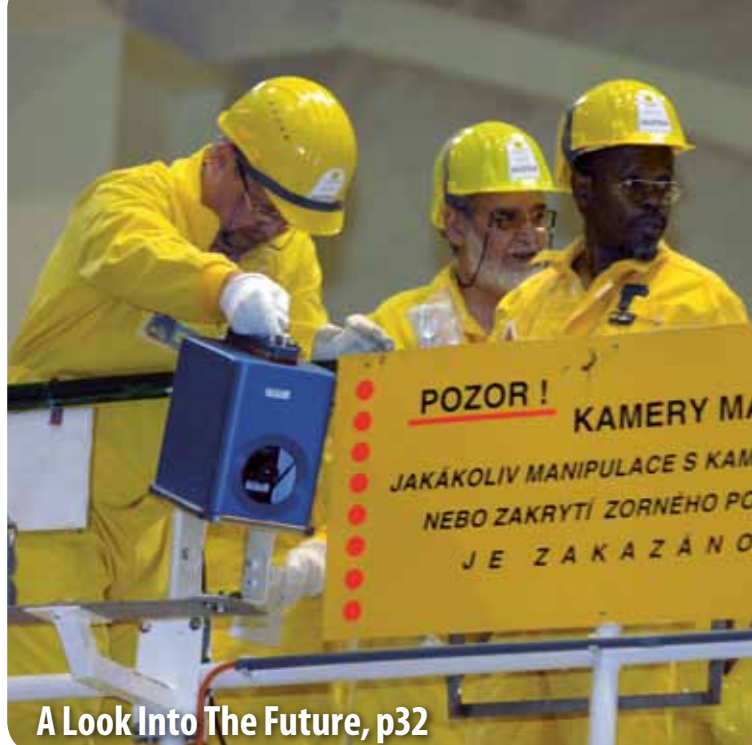
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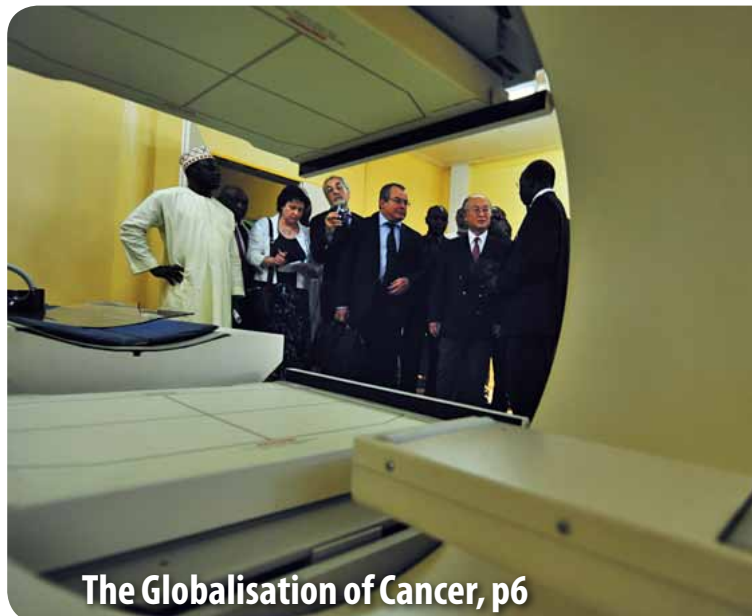
The IAEA's Department of Technical Cooperation launched a regional project on the use of nuclear techniques to address coastal management issues in the Caribbean.

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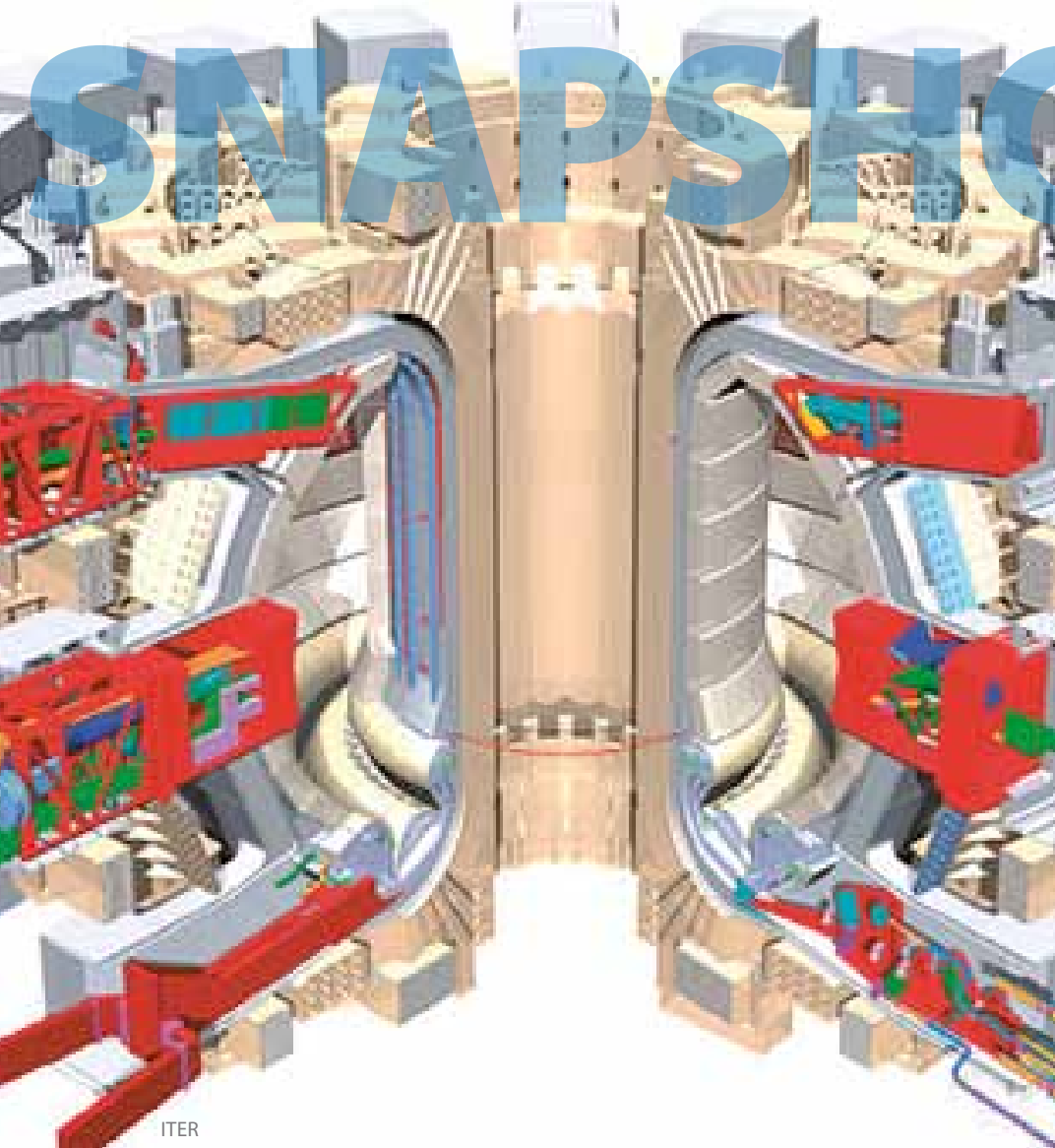


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SNAPSHOTS



Future of a Fusion kind

The International Thermonuclear Experimental Reactor (ITER) and the IAEA are implementing a cooperative agreement, signed in October 2009, where both organizations exchange information regarding the study and potential application of fusion energy, participate in each other's meetings and organize joint scientific conferences.

The agreement also includes cooperation on training, publications, plasma physics and modelling, and fusion safety and security. In addition, the IAEA has a fusion programme which focuses on increasing international cooperation and support for science and technology for fusion power.

Helping Haiti

Eight mobile X-Ray Units, purchased by the IAEA, were delivered to Haiti in March 2010 as emergency medical relief for those injured in the earthquake that devastated the country two months earlier.

The three digital and five analogue X-Ray machines will be used by doctors diagnosing and treating injuries and illness.

6million

Every year, more than 10 million young children die in developing countries.

According to the World Health Organization, six million of these deaths are linked to malnutrition.

from our image bank



1500

The IAEA's calibration assistance of radiotherapy equipment is delivered to 1500 hospitals in 116 countries that lack the infrastructure to conduct their own checks.



Combating Cancer

In December 2009, Director General Yukiya Amano visited Nigeria in his first official trip to a Member State.

During the three-day trip he kicked off his initiative to focus global attention on improving cancer care in developing countries.

(Photo: Afolabi Sotunde)

Out of Africa

African countries joined forces with the IAEA in November 2009 to take a decisive step in the fight against the tsetse fly, the main carrier of parasites that cause sleeping sickness in humans and trypanosomosis in animals. The pest has long been a serious health hazard, significantly hindering development across much of the African continent

IAEA and EC Joint Research Centre Increase Collaboration

The IAEA and the European Commission Joint Research Centre's Institute for Energy (EC/JRC-IE) signed an agreement in October 2009, expanding their ongoing collaboration to enhance scientific and technical cooperation in nuclear energy planning, nuclear safety and nuclear technology.

Five main areas will be the focus of increased cooperation:

- 1 infrastructure to introduce nuclear power programmes;
- 2 life management for long-term nuclear power plant operation (including instrumentation and control systems to support operational excellence);
- 3 advanced reactor technology development and fuel related technologies and waste management;
- 4 planning and modelling nuclear energy deployment; and
- 5 jointly organizing technical meetings, publishing joint documents and implementing IAEA technical cooperation missions.

IAEA Safeguards inspectors together with the experts from the Czech State Office for Nuclear Safety jointly verify a load of High Enriched Uranium (HEU) fuel held in special Skoda casks before it is brought back to Russia.

(Nuclear Institute Rez, Czech Republic, 30 November 2007. Photos: D.Calma/IAEA)

For more information and photos visit www.iaea.org





the globalisation of Cancer

by Louise Potterton

Cancer has gone global. Once seen as the disease of the rich and old, cancer now kills over seven million people a year, with 70% of these deaths occurring in developing countries.

IAEA Director General Yukiya Amano is briefed at the facilities of the Abuja National Hospital by its Medical Director Dr. Segun Ajuwon. (Abuja, Nigeria, 15 December 2009. Photo: Afolabi Sotunde)

"Not so long ago, cancer was thought to be uniquely a disease of the high income, industrialised countries of the West," said Professor Peter Boyle, a leading cancer expert and President of the International Prevention Research Institute.

"But with increasing life expectancy and the exportation of the cancer risk factors from the western

to the low resource countries, we're seeing a huge increase there. Today, the majority of new cancers are diagnosed in low and medium resource countries."

The number of cancer cases is growing globally, but developing countries are worst hit by the cancer crisis, since the resources needed to prevent, diagnose and treat cancer are severely limited or nonexistent.

"The harsh reality is that many developing countries today are struggling with a lack of cancer aware-

ness, cancer treatment facilities and resources," said Nancy Brinker, a cancer campaigner and World Health Organization (WHO) Goodwill Ambassador for Cancer Control.

"Cancer victims in many countries are unscreened, undiagnosed and untreated right up until the end without so much as pain medication," she said.

"Cancer is by no stretch a rich country's disease, but if we fail to act, the treatments and cures for cancer will have become a rich country's luxury. We have the duty and the ability to save millions of lives in the years to come."

Professor Boyle and Ms. Brinker were guest speakers at a seminar on the Globalisation of Cancer, organised in October 2009 in Vienna by the IAEA's Programme of Action for Cancer Therapy (PACT) to highlight the negative social and economic impacts of cancer on developing countries.

According to Professor Boyle, the cancer crisis has to be tackled on many fronts: "Firstly, we've got to control the risk factors. And we've got to change people's attitudes towards cancer and convince them that it's not a death sentence."

"We've got to implement screening for cancer where we can and catch these cancers early. Then we've got to get the resources, the surgery, the oncology, the radiotherapy, everything in place to get the best possible outcome," he said.

After tobacco some of the highest cancer-causing risk factors in developing countries are infectious agents like Human Papillomavirus, Hepatitis and HIV.

According to figures from the World Health Organization, the number of cancer cases doubled globally between 1975 and 2000.

The latest figures, presented during the PACT seminar, showed that cancer will double again by 2020 and nearly triple by 2030 — with projections of 26 million new diagnoses and 17 million deaths.

Massoud Samiei, the Head of the PACT Programme, said: "Most of the developing countries have very fragile economies and small budgets for health care systems. So when additional diseases occur or start to increase, alongside the well known diseases like malaria, HIV and TB, then there will be a crisis."

He added that it is important to put cancer on the 'global health agenda' since the disease is not given the 'same priority' as other diseases.

"Cancer does not feature in the Millennium Development Goals. So we work with the WHO and other UN Agencies to bring cancer to the attention of the donors and the public at large, to show that this is also an important disease."

He stressed the need for additional funding to help countries in the developing world to focus on cancer prevention and early detection and, where appropriate, to expand cancer diagnostic and treatment services.

During the Vienna seminar both Ms Brinker and Professor Boyle praised the efforts of the PACT programme, which helps developing countries to build sustainable cancer control programmes and called for a 'new approach' to confront the global cancer crisis.

Although cancer is a devastating disease, it is largely preventable and also curable if detected early.

"Compared to other global health communities, the global cancer control community is diffuse and often ineffective. It needs to be re-launched and to acquire focus and priorities," said Peter Boyle. Ms Brinker called for a "concentrated effort of political will".

However, the participants stressed that although cancer is a devastating disease, it is largely preventable and also curable if detected early, particularly for common cancers such as breast, colorectal, prostate, cervix and head and neck.

"While effective treatment could increase patients' survival and reduce cancer mortality in the short term, preventive measures such as tobacco control, reduction of alcohol consumption, increased physical activity, vaccinations against liver and cervix cancers, and screening and awareness could have a great impact on reducing the global cancer burden," said Massoud Samiei.

The seminar concluded that the rapid increase in the global cancer burden represents a real challenge for health systems worldwide and requires urgent and coordinated international action. 

*Louise Potterton, IAEA Division of Public Information.
E-mail: L.Potterton@iaea.org*

The War Cry

Nancy Brinker, World Health Organization Goodwill Ambassador for Cancer Control, spoke with the IAEA's Louise Potterton about the Agency's role in tackling the cancer crisis in developing countries.

It started with a promise to a dying sister and became the global leader of the breast cancer movement. The "Susan G. Komen for the Cure" charity was founded in 1982 by Nancy Brinker, the younger sister of Susan who lost her battle against breast cancer at the age of 36.

Inspired by Susan's concern to help other women suffering with the disease, Nancy promised her sister she would do everything in her power to fight breast cancer, which is on the increase worldwide.

What would you say are the main priorities at the moment to tackle this crisis in developing countries?

The main issue is awareness. There are developing countries that don't mention the word cancer. We have a UN that within its Millennium Development Goals has cancer mentioned nowhere. It consumes more lives today than AIDS, TB and malaria all added up and it's galloping in size. It's a giant human tsunami that's already happening. By the year 2030, it will be completely out of control. And yet 40% of cancers deaths are preventable.

Do we need to see more of a global movement as far as

cancer is concerned? We see this with HIV/AIDS, we see this with malaria but not with cancer.

We definitely do. We need a cancer global fund and we at Susan G. Komen are leading the way in terms of what we believe has to be done. But there is no question that governments must make a huge commitment. Governments, associations, organisations like the IAEA, everyone has a piece of this. So it wouldn't

be just one fund but rather a combination of NGOs, government funding, private sources and a concentrated effort of political will.

What would you say is now the main role of the IAEA in tackling this cancer crisis?

The main role is to help combat the growing cancer epidemic, particularly in sub-Saharan Africa where the needs are greatest. Globally, as many as 100 million people could die of cancer in the next 10 years.

The IAEA is playing a significant role by using nuclear technology for peaceful purposes, and more people need to know that the IAEA has been providing radiation medicine and technology for over 30 years to the developing world.

In fact, the IAEA devotes over \$15 million and its expertise each year to help developing countries improve their capacity to fight cancer. It is vital work and I fully support their mission. There are huge bodies of research and real clinical care that rely on the expertise developed by the IAEA. We have to be able to make sure we support it, promote it, fund

Susan G. Komen for the Cure — the US-based breast cancer foundation — was launched in 1982 by Nancy Brinker in honour of her sister, Susan, who died of the disease in 1980. Since then Ms Brinker has worked tirelessly to help improve the survival chances of other women with breast cancer. The charity has evolved into the world's largest grassroots network of breast cancer survivors and activists. Thanks to events such as its signature awareness- and fund-raiser, the Komen Race for the Cure, a 5 km run that takes place in more than 200 cities, the foundation has invested nearly US\$ 1.5 billion in fighting breast cancer.

For more information visit www.komen.org



Globally, as many as 100 million people could die of cancer in the next 10 years. The IAEA is playing a significant role by using nuclear technology for peaceful purposes, and more people need to know that the IAEA has been providing radiation medicine and technology for over 30 years to the developing world.

— Nancy Brinker, WHO Goodwill Ambassador

it and make it part of a cancer control programme.

A breast cancer diagnosis does not necessarily mean a death sentence in countries where the facilities are available. But this is not the case in many parts of the developing world. How can this be addressed?

By changing the culture of awareness and making it appropriate for people to be screened in clinics and embrace early detection and prevention.

It's extremely important to have programmes for screening and diagnosing this disease early. So many of the cancers that are diagnosed in Africa and in different parts of the world where there are low resources are detected at very late stages. So a person does not have a hope of living through it.

Our work isn't rocket science. It's about understanding and applying what we know. And this work isn't sexy, it's not glamorous, it's not the kind of science that gets people on fire. What it does do though is reach into the hearts and minds of people. Now we have to reach into the pockets of huge governments, of government agencies, of people, to make the commitment and have the political will to make all of the treatment, screening, and diagnosis that we have in developed countries available in one form or another in low resource countries.

You were recently appointed as a Goodwill Ambassador for cancer for the World Health Organization (WHO). Can you tell me about this position?

This is a position that has never been designated or filled before. But I think it's a nod by the WHO to the enormity and the size of the cancer problem. I've been very blessed in my life to be busy and to have led the largest breast cancer organisation in the world.

I wasn't exactly looking for something else to do but this is a very important 'something-else-to-do' because this is a message to not just foreign governments but to the UN, to the major governmental and NGO communities in the world. It's a call for action. If I can do nothing else, it will be to raise awareness and challenge people to finally make the commitment to address cancer in their countries, in their communities and in their villages.

Your campaigning has got a personal side to it. Your sister died of breast cancer. Can you tell me how your sister inspired you to do what you do?

She not only inspired me, she made me promise her that I would do this. When someone asks you when they're dying to realise something that gives their life meaning, there's no question about it. Of course I promised that I would do it. I didn't know that it would take the rest

of my life — but it has and I'm sure it will. Yet the journey has been so amazing. It is fraught with challenges and hills and valleys every day. But I'm very encouraged versus thirty years ago.

How do you think your sister would feel today if she were here now? Would she be proud of what you've achieved?

I think she would very much like the activities, the outcomes and the work that we have developed through Susan G. Komen. The organisation looks like her — outreaching, loving, concerning, very personal in nature. I think, like me, she would want to make sure that everyone in the world had access to care and an opportunity to not be victimised by this disease.

The sad reality is that there is still tremendous work to be done. We don't know what causes breast cancer and we don't know how to prevent it. Women are still dying unnecessarily in our own backyards.

And on the global front, the situation is worse. Ten million women around the world could die from breast cancer in the next 25 years. ☸

Louise Potterton, IAEA Division of Public Information. E-mail: L.Potterton@iaea.org

CERVIX CANCER SCREENING PROJECT
PARTICIPATING INSTITUTIONS:
ORCI, IARC & INCTR
PRINCIPAL INVESTIGATOR:
DR. TWALIB A. NGOMA

The Human Factor in Cancer Control

by Angela Leuker

The IAEA is responding to critical human resources shortages in Africa with the launch of a virtual university and a regional training network for cancer control.

As the incidence of cancer increases in developing countries so too does the need for skilled cancer care professionals to help fight the growing epidemic. But with over-burdened health services already afflicted by acute staff shortages, attracting doctors and nurses to this specialized field is particularly difficult. Now the IAEA is launching a Virtual University for Cancer Control and Regional Training Network (VUCCnet) with the aim of helping to fill the human resources gap in Africa.

According to the World Health Organization (WHO), there were 667,000 new cancer cases in Africa in 2008 alone, and more than half a million cancer deaths. And these figures are set to rise dramatically over the next decade. Yet it's estimated that Africa currently has a needs-based shortage of more than 818,000 health workers. The field of cancer care and control is one of the hardest hit because human resources are mainly channeled towards the continent's heavy burden of infectious diseases. In addition, a number of more specific hurdles hamper recruitment.

Barriers to Recruitment

Three years ago, when 25-year old Miriam Owusu Sekyere was considering oncology nursing, many people in her home country, Ghana, tried to dissuade her.

“There are many misconceptions about working in an oncology unit,” she says. “Some people believe that proximity to radiotherapy may result in cancer later on in life or that a young woman could become infertile. I was discouraged, and frightened.”

But Miriam’s family and colleagues were supportive and she went on to successfully complete her oncology nursing training in South Africa, funded by the Ghanaian government. Today, working in the cancer unit of the Komfo Anokye teaching hospital in Kumasi, Ghana’s second largest city, Miriam is dedicated to her job and says she has never regretted her decision. (See box, “A Personal Journey,” in this article.)

As Miriam’s story illustrates, fear and misunderstandings surrounding the nature of the work are hindering many sub-Saharan African countries in their efforts to recruit and train cancer care professionals. At the same time, poor conditions and few prospects of career development do little to entice Africa’s brightest and best into oncology. The reality is more likely to be a long hard slog of low paid work in poorly equipped cancer centres, where the numbers of patients are overwhelming. That’s why the IAEA, through its Programme of Action for Cancer Therapy (PACT) and in collaboration with WHO and other international partners, is aiming to tackle the human resources shortfall where it can have the most impact — on the ground, in Africa.

Cancer Centres Linking Learning, Mentorship

Four established cancer centres in sub-Saharan Africa will form the hub of a pilot phase for the VUCCnet, which has been developed to advance knowledge transfer, professional mentorship and continuous learning across the region. High-quality training programmes will be delivered through a network formed by the four pilot centres together with mentor cancer centres in countries such as Egypt and South Africa. The Virtual University of Cancer Control (VUCC) will provide students with access to information and training modules online. Content will be developed with reference to the pattern of prevalent cancers in sub-Saharan Africa,

namely those of the cervix, breast, head and neck, and prostate, as well as lymphomas and Kaposi’s sarcoma, the AIDS-related cancer.

Dr. Kennedy Lishimpi, Acting Executive Director of the Cancer Diseases Hospital (CDH) in Lusaka, Zambia, says that cancer is a major public health problem across the region. For example, Zambia now has one of the world’s highest rates of cervical cancer, at 53.7 per 100,000 women. Since the CDH opened in 2006, it has treated more than 3,500 patients with a total staff of just 32.

“These are the only staff with oncology training in Zambia today, so clearly we need to train more people,” says Lishimpi. “The creation of centres of excellence in Africa, backed by a virtual university, is a great concept because it will provide good resources for already practicing oncologists and other cancer professionals. It will also help to train the core staff that are urgently required in oncology units in Africa.”

Halting the Brain Drain

Long term, it is hoped that the VUCCnet will help ensure the spread of sustainable, comprehensive cancer care and control across the region. It also aims to staunch the flow of trained health care professionals away from Africa to better jobs and opportunities in the world’s richer countries. It’s been estimated that every year thousands of newly qualified doctors and trained nurses go abroad in search of better salaries and conditions. Others do not return to their home countries following training overseas. This ‘brain drain’ of medical professionals not only has a negative impact on the quality and availability of health care in African countries but also represents a huge loss of government financial investment in education and training.

While the return of trained medical personnel will be difficult to accomplish, it is hoped that by expanding radiotherapy facilities, improving working conditions and salaries, and offering better career and training opportunities to cancer care professionals in Africa, they will be encouraged to stay on. And that is at the heart of the VUCCnet initiative.

Addressing a Vital Global Health Need

Acknowledging the mission and vision of IAEA/PACT in the global fight against cancer, Ambassador Glyn T. Davies, Permanent Representative of the

USA to the IAEA, said his country was proud to continue its support of these 'noble efforts' by donating \$750,000 to the VUCCnet project. "PACT is more than just a programme addressing a vital, critical, global health need," he said in a speech given on the occasion of World Cancer Day 2009. "It is also a model of how the IAEA is promoting the peaceful use of nuclear technology in a results-based way, focusing on cost-effectiveness and on building sustainable partnerships between recipient countries and donors."

VUCCnet is a timely new initiative that draws on the IAEA's parallel efforts in cancer education and training. Through its Technical Cooperation programme for Africa, the Agency already supports individual

fellowships and scientific exchanges in cancer management. At the same time, VUCCnet will rely on the technical expertise and competence of the Division of Human Health for training content and curricula. The IAEA's experience in Distance Assisted Training (DAT), a fellowship programme providing support for doctors from countries without formal university programmes in nuclear medicine, will be invaluable. VUCCnet will also benefit from other relevant IAEA experience, such as the Applied Sciences of Oncology Distance Learning Course. 

Angela Leuker is a consultant at the IAEA's Programme of Action for Cancer Therapy (PACT). E-mail: ALeuker@yahoo.co.uk

A Personal Journey by Angela Leuker

The story of nurse Miriam Owusu Sekyere in Ghana shows how barriers to recruitment and training of cancer professionals in Africa can be overcome.



Miriam Owusu Sekyere, an oncology nurse, works in the cancer unit of the Komfo Anokye teaching hospital in Kumasi, Ghana. (Photo: M. Sekyere)

Nurse Miriam Owusu Sekyere was 25 years old when the hospital where she was working offered to send her to South Africa for specialized training in oncology. But a lot of people tried to dissuade Miriam from taking the opportunity, as some have the mistaken belief that simple proximity to radiotherapy may damage your health. Miriam says she became discouraged and frightened. But, with the support of her family and colleagues, she went on to successfully complete her oncology nursing training.

Now, three years later, Miriam is working in the cancer unit of the Komfo Anokye teaching hospital in Kumasi, Ghana's second largest city, and says she has never regretted her decision. But the workload is heavy. Ghana has only two oncology units for the whole of the country: Korle Bu teaching hospital, which serves the southern sector of Ghana, and Komfo Anokye serving the northern sector. These two centres also take patients from neighbouring countries such as Burkina Faso and Cote d'Ivoire, which have no cancer treatment facilities of their own.

Since it opened in 2004, Komfo Anokye's oncology unit has treated more than 4300 cancer patients, with a staff of 10 or fewer. Currently, the department has two trained radiation oncologists, one radiopharmacist, one medical physicist, one radiotherapist and three oncology nurses, including Miriam herself. A similar situation exists at the Korle Bu hospital. Ghana's two cancer units have no wards for

patients and function on an out-patient only basis. This means that hospital staff must work long hours to cope with the overwhelming ratio of patients to health professionals.

Ghana's severe staff shortages are typical of those found across the region of sub-Saharan Africa. Miriam believes that many health professionals shy away from working in oncology because of its high-risk reputation and the fear that they will not be sufficiently protected. Another major factor, she says, is the paucity of training opportunities. "It's very expensive to send cancer professionals abroad for training and Ghana is a low income country. It simply cannot afford to train enough health professionals to fill the human resources shortfall."

Lack of incentives and low salaries are a further factor. "There's little motivation to specialize in oncology," Miriam says. "And little to stop the few trained professionals from leaving for better conditions elsewhere. Hence the shortage."

Miriam believes a regional training network, along the lines of the IAEA/PACT planned VUCCnet, will help advance the global fight against cancer, especially in Ghana and Africa as a whole. "It will create training opportunities for those health professionals wishing to specialize in oncology and, as a result, will encourage trained staff to stay on," she says. And that will benefit cancer patients and cancer care professionals alike. 

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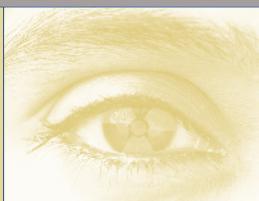
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Beneficial, Respo

by Yukiya Amano

More than twenty new states, including many developing countries, could bring their first nuclear power plants online within two decades. This is a cause for celebration. Nuclear power can make a major contribution to economic development and helps to mitigate climate change. Its use should not be the sole prerogative of the rich.

But introducing nuclear power is a highly complex business. Ever closer international cooperation will be needed to ensure that it is done properly. As the use of nuclear power increases, suppliers of technology have a special responsibility which goes well beyond the handover of a nuclear plant. They must be reliable partners for operators throughout the lifetime of power plants.

The new customers, for their part, have a responsibility to put the infrastructure in place and to implement the highest standards of safety and security, create a sound legal framework and establish an independent regulatory structure. They must be aware that they are taking on a responsibility stretching hundreds of years ahead, if we take nuclear waste disposal into account.

Nuclear power is a mature technology. Its performance and economics have improved in the last two decades, and the greatly strengthened safety and security record of nuclear power in the aftermath of the Chernobyl disaster has added to its attractiveness.

Deciding whether to introduce nuclear power is a sovereign national choice. For those countries which are interested in introducing nuclear power, the IAEA provides assistance at all stages of the process. The IAEA has developed basic concepts to ensure that nuclear energy is developed beneficially, responsibly and sustainably.

Beneficially means that nuclear energy must be cost-effective and reliable and offer clear benefits such as reducing carbon emissions.

Responsibly means countries must abide by the highest safety and security standards and implement IAEA safeguards so the Agency can verify that nuclear materials are being used exclusively for peaceful purposes. All countries with nuclear power should adhere to the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. All countries are encouraged to implement a so-called *Additional Protocol* to their safeguards agreement with the IAEA, which boosts transparency by giving the Agency's inspectors more authority.

Sustainably means that nuclear energy must be available on a predictable basis over many decades to justify the enormous costs of building nuclear power reactors, and in a manner which is not harmful to the environment.

Sustainability also requires that countries considering nuclear power have confidence that they will have access to a supply of nuclear fuel. In 2009, the IAEA's Board of Governors approved a Russian proposal to create a reserve of uranium that the Director General could make available to a country if it was cut off from its supplies for other than commercial reasons.

The IAEA's Role

The IAEA plays a key role in helping to share the advantages of nuclear power with interested countries. In doing so, the IAEA pays special attention to ensuring high standards of nuclear safety and security and implements safeguards to verify that all nuclear activities in Member States are exclusively peaceful.

The IAEA does this through key areas of its work.

First, it provides practical guidance to countries considering whether nuclear power might be suitable for them. Two key Agency documents spell out, simply and clearly, everything which they need to do.

nsible, Sustainable

The IAEA is well-placed to assist countries embarking on nuclear power to do so knowledgeably, profitably, safely and securely.

One is entitled *Considerations to Launch a Nuclear Power Programme*. It lays out all issues that decision makers need to consider to ensure that nuclear energy is developed beneficially, responsibly and sustainably.

The other is called *Milestones in the Development of a National Infrastructure for Nuclear Power*. It systematically defines all the milestones that should guide a country's preparation of the infrastructure for nuclear power. These cover the appropriate legal and regulatory framework, engineering, financial and environmental concerns, safety and security, as well as the appropriate safeguards regime. These milestones are designed to help countries make progress, not to put obstacles in their way.

Our second key role is as a *reviewer*. At the request of a Member State, we assemble teams of experts to conduct detailed reviews of, for example, the operational safety of its nuclear facilities, the effectiveness of its regulatory system or its overall progress in preparing for nuclear power. This system of peer review — which involves experts sharing information and experience with other experts — is of immense value. It helps to increase transparency, to the benefit of all.

The IAEA provides a broad range of training to Member States. For example, we organize highly specialised technical training for nuclear engineers and scientists. In Montpellier, we help to run courses in nuclear law. This training helps countries to build up their own expertise so they can make informed decisions and are well prepared in dealing with vendors, consultants, industry associations and other governments.

The IAEA plays an active role in contributing to technological development. A good example is the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO). Continual innovation in nuclear technology is essential. Fast reactors, for example, make it possible to extend the lifetime of uranium resources from hundreds of years



to thousands of years, to lower costs and to reduce nuclear waste.

Conclusion

Let me state again that our shared goal is to assist countries embarking on nuclear power to do so knowledgeably, profitably, safely and securely. I have no doubt that this conference will lead to improved coordination and help to achieve the IAEA's statutory objective, which is *"to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world."* ☸

IAEA Director General
Yukiya Amano speaking
at the International
Conference on Access to
Civil Nuclear Energy held
in Paris on 8 March 2010.
(Photo: NEA/OECD)

Yukiya Amano is Director General of the IAEA.

This article is based on public statements he made in March 2010 at the International Conference on Access to Civil Nuclear Energy. The event, held in Paris, France, was hosted by the Nuclear Energy Agency/Organisation for Economic Cooperation and Development and the French Government.

Judge Nuclear

Nuclear power is a technology that is available today, has very low greenhouse gas emissions and could be expanded substantially to reduce future emissions.

Nuclear power has very low greenhouse gas emissions and, according to the Intergovernmental Panel on Climate Change's (IPCC) analysis, it has the largest mitigation potential at the lowest average cost in the energy supply sector.

These are the merits on which nuclear power should be judged in climate change deliberations.

Yet nuclear power is currently excluded from the Clean Development Mechanism and Joint Implementation. Such exclusion is not based on climate concerns.

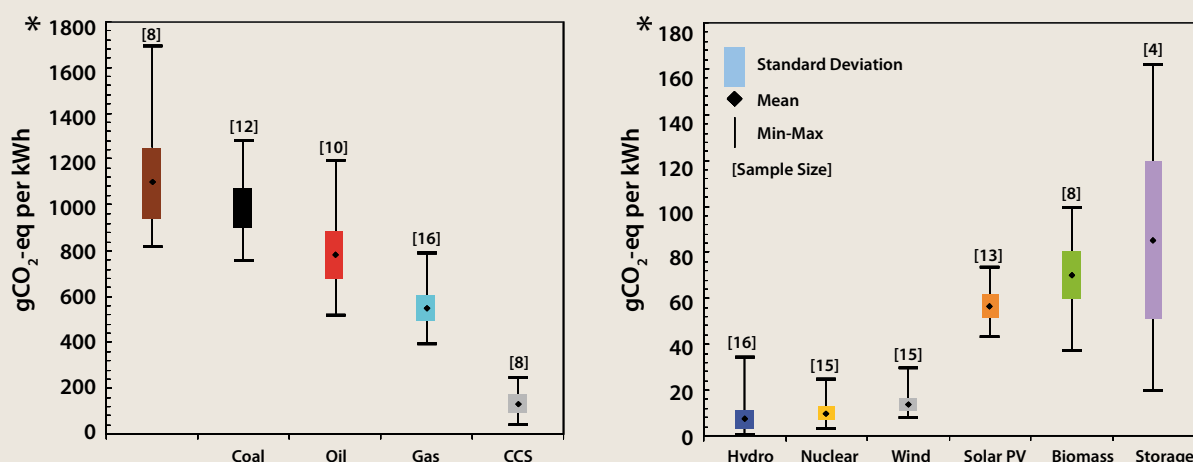
The Clean Development Mechanism (CDM) and Joint Implementation are two 'flexible mechanisms' included in the Kyoto Protocol to the United Nations Framework Convention on Climate Change to help countries meet their treaty-specified targets in limiting or reducing greenhouse gas emissions. Through the CDM, a country with a treaty-specified target (i.e. most developed countries) can partly meet that

target by investing in a project that cuts or eliminates greenhouse gases in a country without a treaty-specified target (i.e. most developing countries). Joint Implementation (JI) is the same thing except between countries that both have treaty-specified targets. Nuclear power projects are explicitly excluded from consideration under both the CDM and JI.

The underlying concerns about nuclear power are that it could be unsafe, uneconomic, or associated with weapons production. But negotiations on climate change are not the appropriate forum to deal with any of these concerns.

As regards safety, the Convention on Nuclear Safety provides an effective international mechanism for review. To judge costs, it is investors who are best equipped to forecast what will be economically attractive now and in the future. And, as concerns proliferation, there is in place the now indefinitely extended Nuclear Non-Proliferation Treaty (NPT), and the growing adherence to the Additional

Fig. 1: Life Cycle GHG Emissions for Selected Power Generation Technologies



*NB: The vertical scales in the two figures differ by a factor of ten.

Note: [WEISSER, D., A guide to life-cycle greenhouse gas (GHG) emissions from electric supply technologies, Energy 32 (2007) 1543–1559]. Left panel: fossil technologies. Right panel: non-fossil technologies.

on its Merits

by Hans-Holger Rogner, Ferenc L. Toth and Alan McDonald

Protocol that further strengthens the safeguards agreements under this Treaty.

The UN Commission on Sustainable Development has concluded that although countries disagree on the role of nuclear power in sustainable development, "[t]he choice of nuclear energy rests with countries". It is not for climate change agreements to remove that choice.

The best chance for sustainable development — for meeting the needs of the present without compromising the ability of future generations to meet their needs — lies in allowing those future generations to make their own decisions about energy supply options, and allowing these options to compete on a level playing field.

Very Low Greenhouse Gas Emissions

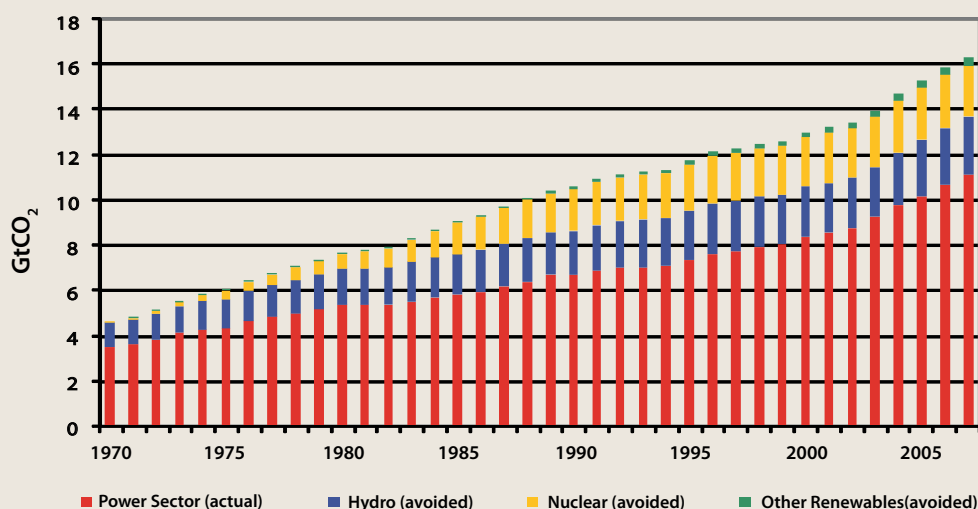
Figure 1 compares greenhouse gas (GHG) emissions from the full nuclear power life cycle — mining ura-

nium; making fuel; building, operating and decommissioning the power plant; and dealing with the waste — to life-cycle emissions from other power generation technologies. Note that the scale in the panel on the right, for non-fossil technologies, is smaller. It only goes from zero to 180 grams of carbon dioxide equivalent per kilowatt-hour ($\text{gCO}_2\text{-eq/kWh}$). The scale for fossil fuels in the left panel goes all the way from zero to 1800 $\text{gCO}_2\text{-eq/kWh}$.

Hydropower, nuclear power and wind power have the lowest life-cycle GHG emissions, more than an order of magnitude below fossil-fuel power plants and two thirds below the estimates for solar photovoltaics and biomass. For nuclear power, the mean is approximately 10 grams of carbon dioxide equivalent per kilowatt-hour ($\text{gCO}_2\text{-eq/kWh}$), a figure derived from 15 estimates ranging from 2.8 to 24 $\text{gCO}_2\text{-eq/kWh}$. However, because of their intermittent nature, many renewables cannot provide reliable baseload electricity.

Thus, while wind and solar power can complement baseload generation, they cannot fully substitute hydroelectric and nuclear power.

Fig. 2: Global CO_2 Emissions from the Electricity Sector and Emissions Avoided by Three Low Carbon Generation Technologies



Source: IAEA calculations based on OECD International Energy Agency, World Energy Statistics and Balances; Energy Balances of Non-OECD Member Countries, OECD, Paris (2008).

Most of the GHG emissions come from fuel cycle activities 'upstream' of the power plant, including uranium mining, milling, enrichment and fuel fabrication.

Most of the variation in nuclear power's estimates comes from different assumptions about the technologies used to enrich uranium, specifically whether gaseous diffusion or centrifuge technology is used and what electricity source is used to power the enrichment plant. Centrifuge technology needs only 2% of the electricity needed by gaseous diffusion plants, and if the electricity for enrichment is assumed to come from coal-fired power plants, estimated GHG emissions are high; if it is assumed that nuclear power, hydropower and wind power delivers electricity for enrichment, estimated emissions are low.

As centrifuge plants continue to displace retiring gaseous diffusion plants and as more of the power for enrichment plants comes from low-carbon elec-

tricity, GHG emissions from the nuclear power life cycle will tend toward the lower end of the range shown in Figure 1.

GHG Emissions Already Avoided by Nuclear Power

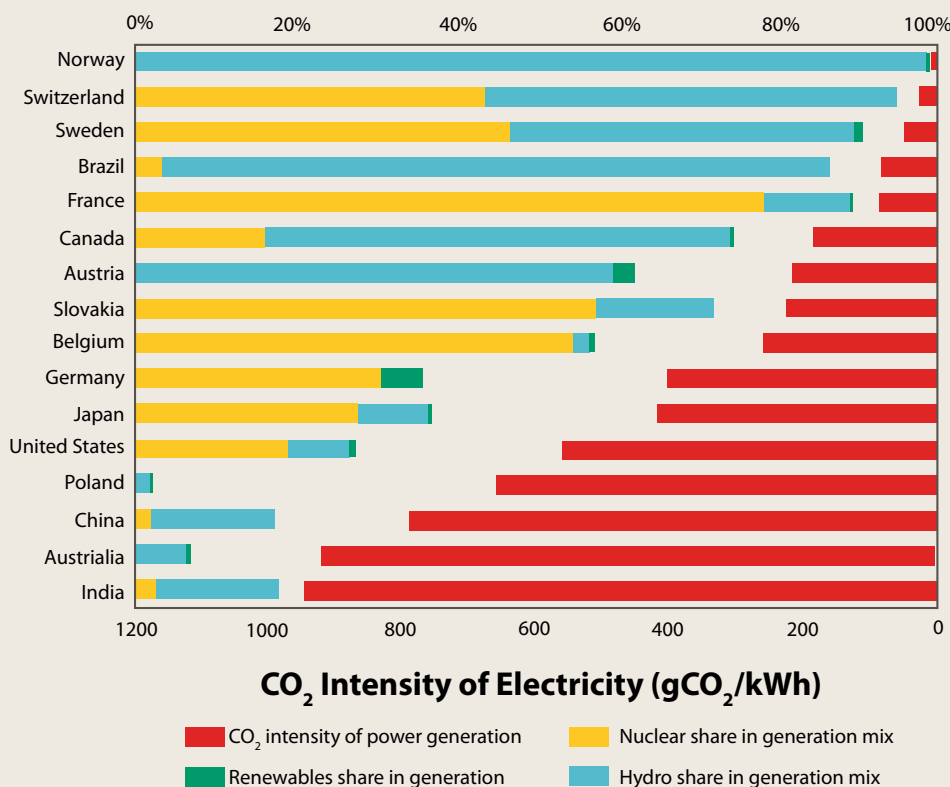
Nuclear power has been part of the world's electricity supply for over 50 years. Today, there are 437 power reactors in operation around the world, and since the mid-1980s, nuclear power's share of global electricity production has been 14 to 16%. Thus nuclear power has already avoided significant GHG emissions, about the same as the emissions avoided by hydropower.

The red bars in Figure 2 show the historical trend of CO₂ emissions from global electricity generation. In 2007, for example, global CO₂ emissions from electricity generation were about 11 gigatonnes (Gt). But without renewables, hydropower and nuclear power, they would have been an estimated 16.4 Gt.

Such estimates of avoided emissions depend very much on what one assumes would have produced the replacement electricity in the absence of renewables, hydropower and nuclear power. For the estimates in Figure 2, it was assumed that the electricity generated by these three sources would have been produced by increasing the coal, oil and natural gas fired generation in proportion to their respective shares in the electricity mix. This approach probably underestimates the emissions avoided by nuclear power in the 1970s and early 1980s. Many of the new nuclear plants built after the oil crises of the 1970s were intended to reduce oil and gas dependence, and coal plants would more likely have been built in their absence than a proportional mix of coal, oil and gas.

Figure 3 shows, at the national level, the correlation between low CO₂ emissions and high shares of hydropower or nuclear power. The chart shows that countries with CO₂ intensities that are less than 20% of the world average, i.e. less than 100 gCO₂/kWh, generate 80% or more of their electricity from either hydropower (e.g. Norway and Brazil) or nuclear power (e.g. France) or a combination of the two (e.g. Switzerland and Sweden).

Fig. 3: Shares of Non-Fossil Sources in the Electricity Sector and CO₂ Intensities for Selected Countries in 2006



Source: IAEA calculations based on OECD International Energy Agency, CO₂ Emissions from Fuel Combustion, Vol. 2008 release 01.

At the other end of the scale, countries with high CO₂ intensities of 800 gCO₂/kWh or more have either no nuclear or hydropower in their electricity mix (e.g. Australia) or only limited amounts (e.g. China and India).

Large GHG Avoidance Potential for the Future

The Fourth Assessment Report of the IPCC estimates the future GHG mitigation potential of various electricity options, specifically fuel switching among fossil fuels, nuclear power, hydropower, wind power, bioenergy, geothermal, solar photovoltaic, concentrating solar power, as well as coal and gas with CO₂ capture and storage. The IPCC analysis starts with the reference scenario in the World Energy Outlook 2004, published by the OECD/International Energy Agency. It then estimates the GHG emissions that could be avoided by 2030 by adopting various electricity generating technologies in excess of their shares in the reference scenario.

The analysis assumes that each technology will be implemented as much as economically and technically possible, taking into account practical constraints such as stock turnover, manufacturing capacity, human resource development and public acceptance. The estimates indicate how much more of each low carbon technology could be deployed at different cost levels (relative to the reference scenario).

The costs are the difference between the cost of the low carbon technology and the cost of what it replaces. The estimates are shown in Figure 4 for technologies with mitigation potentials of more than 0.5 GtCO₂-eq. The width of each rectangle in Figure 4 is the mitigation potential of that technology for the carbon cost range shown on the vertical axis. Each rectangle's width is shown by the number directly above or below it. Thus, nuclear power (the yellow rectangles) has a mitigation potential of 0.94 GtCO₂-eq at negative carbon costs plus another 0.94 GtCO₂-eq for carbon costs up to \$20/tCO₂. (Negative cost options, in the IPCC report, are those options whose benefits such as reduced energy costs and reduced emissions of local and regional pollutants equal or exceed their costs to society, excluding the benefits of avoided climate change). The total for nuclear power is thus 1.88 GtCO₂-eq.

The figure indicates that nuclear power has the largest mitigation potential at the lowest average cost in the energy supply sector. Hydropower offers the

second cheapest mitigation potential but its size is the lowest among the five options considered here.

The mitigation potential offered by wind energy is spread across three cost ranges, yet more than one third of it can be utilized at negative cost. Bioenergy also has a significant total mitigation potential but less than half of it would be available at costs below \$20/tCO₂-eq by 2030.

Conclusion

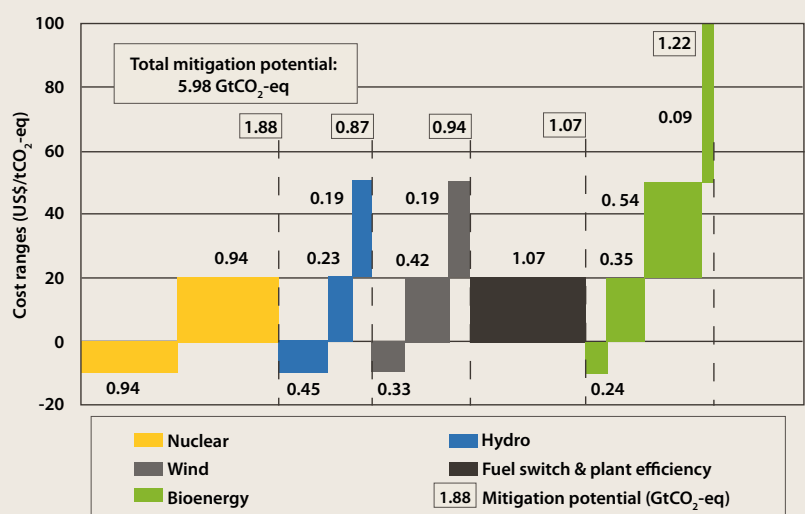
With 60 countries considering introducing nuclear power in their energy mix, its role on the world's stage is set to grow. It is important that post-Kyoto agreements judge nuclear power on its merits with respect to climate change, and include nuclear power projects in the Clean Development Mechanism and Joint Implementation.

Hans-Holger Rogner is Head of the IAEA's Planning and Economic Studies Section. E-mail: h.h.rogner@iaea.org

Ferenc L. Toth is a Senior Energy Economist in the IAEA's Planning and Economic Studies Section. E-mail: f.l.toth@iaea.org

Alan McDonald is Head of the Programme Coordination Group of the IAEA's Department of Nuclear Energy. E-mail: a.mcdonald@iaea.org

Fig. 4: Mitigation Potential in 2030 of Selected Electricity Generation Technologies in Different Cost Ranges



Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Metz, B., Davidson, O.R., Bosch, P.R., Dave, R., Meyer, L.A., Eds), Cambridge University Press, Cambridge (2007).



by **Didier Louvat** and **Phil Metcalf**

Closing the Cycle

Disposal options for low level waste have been developed and good prospects for geological disposal of radioactive waste appear to be on the horizon in several member states.

Spent fuel and radioactive waste management are particularly challenging tasks faced by new and existing nuclear power countries and a prime concern of the public. This is especially relevant since the lifetime of a nuclear power programme can be up to 100 years or more and the need for adequate management of spent fuel and radioactive waste goes well beyond this.

The importance of the safe management of radioactive waste for the protection of people and the environment has long been recognized, and considerable experience has been gained in defining safety goals, establishing safety standards and in develop-

ing technology and mechanisms for safety demonstration. Nevertheless, whilst significant progress has been made in IAEA Member States in managing their radioactive waste safely, efforts are still needed in a number of countries to develop national strategies and to strengthen national infrastructure to implement national strategies.

The Global Safety Regime

The safety of radioactive waste management is recognized as being of international concern because of the global nature of the nuclear

Drums of mock radioactive waste at the Rokkasho-mura visitors centre, Japan, show how radioactive waste is packaged and stored.

(Photo: K. Hansen/IAEA)

industry and as the long timeframes involved in its management reduce the relevance of international borders. This recognition becomes stronger with the increasing use of nuclear energy. With a view to ensuring the safety of radioactive waste management the international community has established and adheres to a global nuclear safety regime comprised of several elements. These include the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and the International Safety Standards. This international regime is complemented by national legal and regulatory frameworks.

The Global Inventory of Radioactive Waste

Since the emergence of nuclear energy exploitation in the 1940s, the global inventory of radioactive waste managed to date, including cumulative volumes disposed, amounts to around forty one million cubic meters of low- and intermediate-level waste, two hundred thousand metric tons (heavy metal) of spent nuclear fuel, four hundred thousand cubic metres of high-level waste and two billion cubic metres of residues coming from the uranium production cycle. It should be noted that the vast majority of high-level waste (about 89%) is from Cold War weapons development activities in the USA and former Soviet Union. Of this, the majority is in unprocessed, liquid form. The average annual global disposal rate for all waste classes combined is approximately three million cubic meters per year, primarily low-level or very low-level waste. Annual accumulation of high-level waste is fairly constant, with an average accumulation rate of approximately eight hundred and fifty cubic metres per year worldwide (based on the average volume of high-level waste produced per metric tonne of spent fuel reprocessed). Low, intermediate and high level waste are different classes of waste requiring progressively greater levels of containment and isolation from people and the environment.

Options for the Disposal of Radioactive Waste

The waste generated to date has been managed in a variety of ways. Some is held in a variety of storage facilities pending decisions on its final disposition, some is stored waiting for the development of a final disposal facility, and some has been placed in final disposal. Different types of disposal facility

have been developed, but in principle all are made of a series of engineered and natural barriers designed to isolate the waste from the biosphere and contain its radioactive content to eliminate radiation risks for people and the environment. Storage and disposal of low level radioactive waste is a well established practice worldwide and over one hundred disposal facilities exist. Storage of spent nuclear fuel and high level waste is also a well established practice. The development of disposal facilities for spent nuclear fuel and high level waste has been underway for almost three decades and is only just coming to fruition. The design option selected is disposal in deep geological horizon (a rock layer of a particular composition), and while at a mature stage of conceptual development, remains to be implemented.

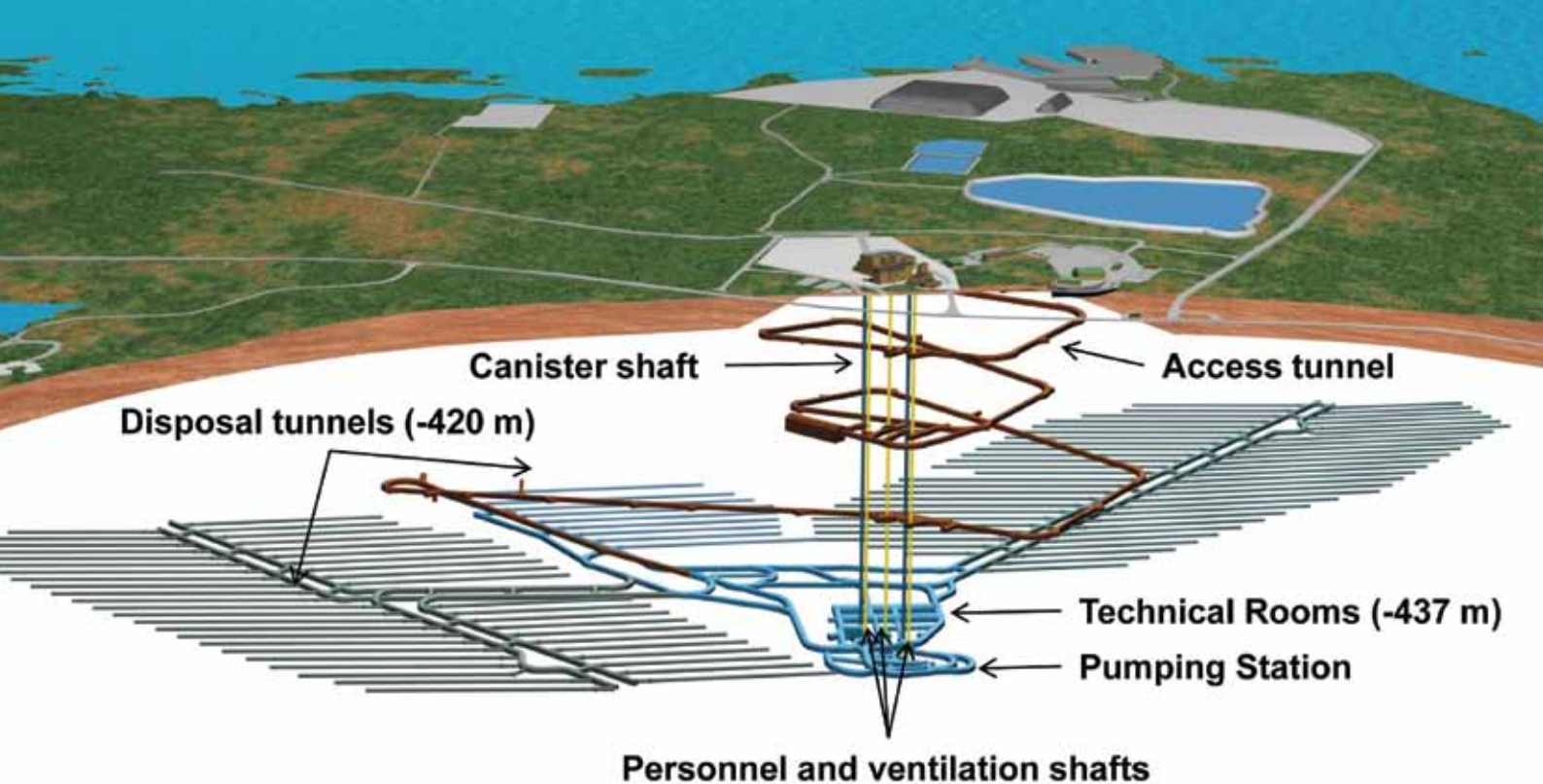


Geological Disposal of High Level Radioactive Waste

Projects to develop geological disposal facilities for high level radioactive waste and spent nuclear fuel have been under development in a number of countries. A great deal of the activities carried out to date were concerned with investigating the suitability of different host geologies, conceptual designs for disposal facilities and with achieving the host communities' acceptance. These technological and sociopolitical aspects have progressed together with many lessons learned, in particular the need for well founded scientific investigation together

Researching ways of securing radioactive waste. The Grimsel underground rock laboratory in the Swiss Alps is used all year round to investigate ways to safely dispose of highly radioactive waste. In this picture, a tunnel of the deep repository for spent nuclear fuel can be seen.

(Grimsel Underground Rock Laboratory, Switzerland).



An artist's rendering of a final disposal facility for high-level nuclear waste.

(Image: Posiva Oy)

with open and transparent dialogue between all interested parties.

A number of countries have made good progress with both the technological development and public acceptance to the extent that licence applications are now being prepared and submitted to national regulatory authorities. A licence application for the Yucca Mountain Facility in the USA was submitted in 2008 and is under review by the USNRC, although there is political uncertainty over the future of the project*. A licence application is scheduled for 2010 in Sweden for a geological disposal site at Forsmark, with the construction of the disposal facility expected to start in 2015 and the operation expected to commence in 2023.

In Finland, the licence application for a geological disposal at the Olkiluoto site is planned for the end of 2012 with a licence for operation expected in 2018 and operation starting in 2020. In France, a licence application for construction of a geological disposal in the Meuse area is planned for the end of 2014 with construction starting after 2016 and operation commencing in 2025. Finland and Sweden will dispose spent fuel while France will dispose vitrified waste resulting from spent fuel reprocess-

ing. Extensive scientific investigations of the phenomena and process influencing the safety of disposal facilities have been carried out in all cases and engineering solutions have been developed for the underground disposal configuration. Safety arguments have been developed and these have and are being assembled together with all the supporting scientific, technical and managerial information and evidence into structured safety cases, which form the basis for licensing considerations. Review and approval of the safety cases by the regulatory authorities will commence in Sweden, Finland and France. While considerable experience has been developed in licensing nuclear facilities, to date these have been facilities with a finite lifetime and under operational control. Geological disposal licensing is recognized to be a new process for the regulatory authorities whose unique challenges arise from the long timeframes involved and the role played by the natural geological environment.

The host geological environments have been chosen after careful consideration of their properties and an assessment of how the disposal facility and its geological environment will evolve over the time period required for the radioactive content to substantially decay. Such timeframes are of the order of tens to hundreds of thousands of years; long timeframes in a human perspective, but less so in terms of geological history. The regulatory authorities in countries interested in geological disposal have recognized these changes and over the past decade have engaged in considerable dialogue to develop harmonized approaches establishing both the safety objectives and criteria as well as how these should be met. This dialogue aims to bring

**In January 2010, the US Secretary of Energy announced the creation of a Blue Ribbon Commission on America's Nuclear Future that will provide recommendations on managing used fuel and nuclear waste. In March, the Department of Energy withdraw its pending licence application for a permanent geological repository at Yucca Mountain.*

about international safety standards. They have also engaged in international harmonization projects to exchange ideas and experience on the associated licensing process.

Safety Standards and International Projects

The development of international safety standards for geological disposal and demonstrating safety has been ongoing for several years and a large measure of consensus has been achieved. Nevertheless as the detailed process of compiling safety cases and licence applications for geological disposal facilities progresses and the regulatory authorities prepare for and embark on their review many points of detail remain to be resolved. A revised and consolidated international Safety Requirements standard for radioactive waste disposal has been developed and approved by IAEA Member States and updates will be issued this year. Detailed guidance on the safety case and its review by the regulatory authorities is also at an advanced stage of preparation and should assist greatly with achieving an internationally harmonized approach.

As indicated, the countries currently moving towards the licensing of geological disposal facilities and others with less advanced programmes recognize the benefits of internationally harmonized approaches to the licensing process and are engaged in various related initiatives. Within the European region an initiative has been underway for some time on this harmonization process and at the international level the IAEA and the Nuclear Energy

Agency/Organisation for Economic Cooperation and Development (OECD NEA) both have projects underway, namely the Safety of Geological Disposal (GEOSAF) and the Integration Group for the Safety Case (IGSC) projects. These harmonization projects are addressing key issues regarding the structure and content of the safety case and its evolution over the project lifetime, the approach to supporting safety assessment and the safety criteria for assessing long term post-closure safety. It is envisaged that this work will lead to consensus on many aspects of the safety demonstration and licensing processes.

Conclusion

As the world moves to increase the generation of energy from nuclear power, increasing amounts of radioactive waste will continue to be generated. As more advanced reactor designs and fuel cycle options evolve, there will undoubtedly be greater efficiencies realized, resulting in reduced generation of radioactive waste. Nevertheless increasing volumes of radioactive waste will accumulate and will have to be safely managed. Disposal options for low level waste have been developed and good prospects for geological disposal of radioactive waste appear to be on the horizon. The next decade should confirm these prospects and bring about safe closure of the nuclear fuel cycle. ☸

Didier Louvat heads the IAEA Waste and Environment Safety Section. E-mail: D.Louvat@iaea.org. Phil Metcalf heads the IAEA Radioactive Waste and Spent Fuel Management Unit. E-mail: P.E.Metcalf@iaea.org.

A 16 million year old crystal cave was discovered at Grimsel.

(Grimsel Underground Rock Laboratory, Switzerland.)





Synergy in

Russia opens the world's first international training centre.

With over 40 heads of states set to convene at the Nuclear Security Summit to be held in April 2010 in Washington, the matter of nuclear security remains a focus of international concern. Though the world has not yet been struck by a 'dirty bomb,' the risk that a terrorist group amasses radioactive material and detonates it in a major city remains.

Among the principal priorities for IAEA Member States that have relatively substantial nuclear material within their borders is to ensure that it is never tampered with, never accessed, and above all else, never stolen. Vast financial resources are spent annually by countries to protect nuclear facilities (sites with reactors, enrichment and/or reprocessing capabilities), and pressure remains on security specialists and equipment to provide seamless safe-keeping as the world prepares for an expected growth in nuclear power.

The IAEA and ISTC work together to offer practical security training to IAEA Member States.
(Photo: J. Knapik/IAEA)

While nuclear security has remained an affair primarily dealt with at the state level, a new example of international cooperation can be found 100km south-west of Moscow, in the former

Soviet-era closed city Obninsk. Known for having the world's first civilian nuclear power station, Obninsk is also host to the Interdepartmental Special Training Centre (ISTC), a nuclear security training site that aims to be an exemplar of international cooperation in strengthening nuclear security worldwide.

Instituted in 1975, the ISTC is led by a team of veteran security experts who work to train teams of nuclear security guards and professional staff in all matters of protecting nuclear sites. In 1993, the ISTC was established by the Ministry of Atomic Energy in the Russian Federation, and now operates under ROSATOM. Throughout its history, the ISTC has been used to train security management, guards and systems operators throughout the former USSR and Russia, and over 12,000 Russian specialists have gone through its courses since 1993. Now the centre is opening up and, with help from the IAEA, has internationalized its services.

Cooperation between the IAEA and the ISTC began in 2001, when both organizations jointly considered cooperation in programmes and activities. It was



Nuclear Security

by Dana Sacchetti

quickly determined that a closer relationship could be beneficial, and the IAEA and ISTC began to offer practical security training to IAEA Member States. Given the common language and cultural familiarities, assistance from Obninsk was first provided in the area of staff development to States from central and eastern Europe and the former Soviet Union. The Canadian government has also assisted the international effort, and has provided funding for training, curriculum development, and equipment.

In recent years, course offerings were broadened and made available to several other countries. Training is provided in the form of regional and national courses on practical operation and physical protection systems inspections. This courseware gives training to inspectors, physical protection systems operators, and managerial staff working at nuclear and nuclear-related sites. Over 300 international participants have been trained in these courses and further enrolment is expected in coming years. Reception has been positive.

"I think Obninsk has been a very good programme," said Anita Nilsson, Director of the IAEA's Office of Nuclear Security. "The training that they offer is designed to fulfil requirements from the Russian programme itself, so the knowledge and training is

part of a formalized training programme for Russia operators. This is a tremendous strength to have."

Over 300 international participants have been trained in these courses and further enrolment is expected in coming years.

The centre and its cooperation with the IAEA have passed several important milestones over the past 12 months. In May 2009, the ISTC inaugurated newly revamped indoor and outdoor training facilities, and marked the occasion with high-level visits from IAEA Deputy Director General Tomihiro Taniguchi and representatives from the Government of Canada, one of the major donors to the facility.

In November 2009, the ISTC hosted an IAEA-sponsored pan-European course, with professionals hailing from a dozen countries taking part in a two-week training workshop on physical protection and



other elements of nuclear security. Another course designed by the IAEA and the ISTC recently trained university students with an interest in security. Talks are also underway to enhance the centre's capability to offer psychological training to security staff. The site is now considered fully active and receives teams on a monthly basis from states across Europe and Asia.

In addition to training courses, the ISTC has also worked on a request basis to educate and train security personnel who may work at some highly visible nuclear facilities. A delegation of Pakistani security inspection staff were trained at the ISTC in summer 2009, and training courses have also been held for personnel managing security at the Bushehr nuclear power plant in Iran in 2003.

On Site

While at the ISTC, security personnel receive hands-on and classroom training on physical protection, radiation protection, device management, and practical security training and security culture. Courseware and training is conducted on a campus spread out over several hectares in central Obninsk.

The outdoor site is used extensively, simulating the fencing, lighting, detection sensors and other apparatus typically used at a nuclear facility. All sensors are routed to a central alarm station, where students can simulate various security situations. The site also features a testing ground of over 2000 square meters, equipped with 20 detection devices and CCTV systems.

Indoors, staff from the ISTC employ a series of testing laboratories, classrooms, and security simulation facilities to train visitors on several aspects related to security. The training and courseware used is geared towards staff with engineering and technical backgrounds, and typically involves topics related to information protection, physical pro-

tection, and emergency response and prevention. Several classrooms are set up for practical training and qualification improvement for specialists in the security field.

Although the ISTC acts as a governmental institution of the Russian Federation, the Centre also works in close cooperation with a variety of geographically dispersed vendors to test and certify equipment for deployment at nuclear-related facilities. This work forms another primary purpose for the ISTC: to ensure that the technologies used to secure nuclear sites are rugged, sound, and capable of withstanding a variety of stress conditions. A large testing certification laboratory, provided by the US Department of Energy (DOE) is on site to put physical protection equipment through rigorous, non-destructive testing. Sophisticated machines are used to simulate extreme temperatures, strong vibrations that mimic an earthquake, and electromagnetic testing in the case of attempted sabotage or mechanical interference. After testing, the ISTC reports whether the machinery has passed certification.

All these features combine to make the ISTC an exceptional nuclear security training site, providing an international platform for training specialists and testing equipment to protect any type of nuclear fuel cycle facility. In years to come, the IAEA-ISTC relationship will broaden, as both organizations work to provide comprehensive nuclear security training for specialists from around the world.

"Science and industry are constantly making headway, and new unique developments aimed at improving the physical protection of nuclear sites continue to appear," explained Yuri Barabanov, ISTC Director. "We hope that our cooperation with the IAEA will continue and grow in the years to come."



Dana Sacchetti is a press officer at the IAEA's Division of Public Information. E-mail: d.sacchetti@iaea.org

Photos, left: Security components are tested in a humidity chamber, along with other environmental stress tests.

Right: Guards receive training on physical protection for nuclear facilities. (D.Sacchetti/IAEA)

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Living with Nuclear

by Louise Potterton

In the Swedish city of Oskarshamn, public support for nuclear power and acceptance of nuclear waste is strong.

The picturesque peninsula where the Oskarshamn nuclear power plant is located is open to the public. (Photo: L.Potterton/IAEA)

Motorists driving towards Oskarshamn, southern Sweden, are greeted with large and colourful posters welcoming them to the 'Municipality with Energy'. Smaller signs warn them to 'be aware of moose'.

Local attractions in this beautiful, coastal region include a boat trip around the five thousand islands, a museum dedicated to the Nordic country's most famous woodcutter and the 'Långa Soffan' — the longest and oldest wooden bench in the world.

But aside from the area's natural beauty, the cultural assets and that record-breaking bench, Oskarshamn also plays a pivotal role in the country's 40-year old nuclear power industry, which provides nearly 50% of Sweden's electricity with the remainder generated by hydropower.

The region is home to one of the country's three nuclear power plants, which operates three reactors, and the base for the interim storage facility for all of Sweden's spent nuclear fuel.

The underground laboratory, where research is carried out for a final repository for spent nuclear fuel, and the canister laboratory that is developing the copper containers for this disposal facility are also located in Oskarshamn.

As for the future, plans are underway to build the encapsulation facility in the Oskarshamn region where the spent fuel will be sealed in copper canisters prior to disposal.

Watching the locals taking a dip in the sea at one Oskarshamn's Baltic beaches, the children playing at a summer fête in the grounds of the power plant or the tourists enjoying a meal on the waterfront, it is clear that Oskarshamn is a place where people, the environment and the nuclear energy industry live side by side in harmony.

"In my opinion Oskarshamn is the world's most nuclear-friendly region," said Peter Wretlund, the Social Democrat mayor of the Municipality. "We've been living alongside the nuclear power industry for four decades and feel safe and secure about this."

His town hall colleague, Lennart Karlsson, the development manager for the region, which has a population of 26,000, added: "Everybody has a relative or knows somebody that is working for the industry. So it's an important factor as far as social security is concerned. Around 3,000 people depend on this industry for their income."

But it is not just the economic advantages that play a vital role in Oskarshamn's acceptance of the nuclear energy industry but also the transparency and openness of the companies that operate the plant and manage nuclear waste in the region. These companies offer public tours of their facilities and undertake extensive outreach work among local communities.

"There's a lot of openness from the industry itself and from the communications people that provide information to the local inhabitants," said Mr. Karlsson.

Rolf Persson, project manager for nuclear waste issues in Oskarshamn said: "The nuclear power plant is part of our daily life and it's been very successful with its openness regarding the way it operates."

"The people who live close-by are informed of what to do in case of an incident but this isn't something they're really concerned with. We haven't had any major incidents, but we were affected by Chernobyl and that's more in peoples' minds than our own plant."

The picturesque peninsula where the Oskarshamn nuclear power plant is located is open to the public. After purchasing the land, the company that owns and operates the three reactors, OKG, decided to renovate and maintain the houses in the village that date back to the 18th century.

OKG Communications Manager, Anders Österberg, explained the reason behind this approach: "It's based upon a strategic company decision to be open to the public in all communicative matters. It's important for the public to be able to come close to a plant and see for themselves that no dangerous operations take place there."

Visitors to the peninsula are invited to walk along the nature trail in the surrounding woods, see the nuclear power exhibition, or enjoy refreshments at the coffee shop watched by a herd of sheep against the backdrop of the stunning Swedish coastline and three nuclear reactors.

And for those members of the public who want to get a closer look inside the plant, tours can be arranged. Every year around 3000 visitors, many from Swedish schools, get an insight into the workings of a nuclear power station.



Local teenager, Simon, who has a summer job as a gardener in the grounds around the plant said: "It's good that they're so open and show the public how it all works. It's not a problem having the industry here, I don't feel scared or anything."

And pensioner, Waldy, who has lived in the vicinity of the plant site all her life and is showing a visitor from Stockholm around the exhibition, said: "I feel absolutely safe living here. The people in charge of

Oskarshamn, one of Sweden's three nuclear power plants, which is located on the Simpevarp peninsula. Owned and operated by OKG, its three nuclear reactor units account for 10% of Sweden's total electricity generation. (Photo: L.Potterton/IAEA)

the plant have it under control. I think it's very positive for the area."

During the summer months OKG runs a programme of activities that includes a bicycle race, a popular children's festival and a local handicrafts exhibition. And the plant itself is not a blot on this beautiful landscape. The three reactors feature bold, black stripes designed by a Swedish architect and said to symbolise 'the line of the forest against the sky'.

In 2007 Oskarshamn was named 'The Springfield of Sweden' by the Swedish daily newspaper *Sydsvenska Dagbladet*, referring to the fictional town in the American cartoon series 'The Simpsons'.

About 84% of those who responded to the poll voted in favour of having the disposal site in their region, compared with just 41% in a nationwide poll.

According to the newspaper Oskarshamn deserved this title due to the similarities between the two towns. They are both located on the coast, have a similar number of inhabitants, are roughly the same age and most importantly are home to a nuclear power plant.

The reporters even tracked down an equivalent to 'Moe's Bar' in the popular 'Kråkan' pub, compared the two town halls and found a likeness between Springfield mayor Joe Quimby and Oskarshamn's Peter Wretlund.

The article caused some laughter at the town hall but considering that the Springfield Nuclear Power Plant is notorious for its bad management at the hands of its sinister owner Montgomery Burns, OKG Communications Manager, Anders Österberg, was not particularly happy with the comparison.

"Of course there are some demographical similarities but when it comes to running a nuclear power plant there are no resemblances at all. In the world of cartoons everything is extremely exaggerated, otherwise it wouldn't be funny at all. In the real

world we take our power plant operations very seriously and therefore have a good safety record," he said.

Most of Sweden's nuclear waste operations are also based in Oskarshamn, run by the Swedish Nuclear Fuel and Waste Management Company (SKB), which is owned by the country's nuclear power companies.

SKB has a very active and energetic public information team for the Oskarshamn region, who visit schools, local businesses and run information stands at local events.

Four times a year residents also get a copy of the magazine 'Lagerbladet' where they can read about SKB activities in their region and members of the public are invited to learn more about nuclear waste management first-hand by visiting the facilities.

In addition, once a year the SKB ship that transports radioactive waste from Sweden's power plants to Oskarshamn is turned into a public information centre, complete with coffee shop, exhibition and guided tours.

Katarina Odehn is responsible for local public outreach at SKB in Oskarshamn: "Our main message is that nuclear waste is not an issue that you can say yes or no to. It exists and we have 5,000 tonnes of spent fuel at the interim storage site and need to find a solution for its safe disposal," she said.

She added that SKB wants to inform people about how they take care of the waste today and the solutions they have for the future, namely deep disposal for the spent nuclear fuel.

"We try to be very open with people and tell them that there are no stupid questions. Nuclear waste can be a difficult issue to understand but we explain our waste management work in an easy way."

"You can't force people to listen but you can be among people, be available to people. Sometimes people even call us at home after working hours with questions. We try to answer them and if we can't, we contact one of our experts and get back to the caller," said Ms. Odehn.

The trip to SKB's underground laboratory, which is based on the island of Åspö surrounded by lakes and forests, is one of Oskarshamn's most popular tourist attractions. Here visitors can get a glimpse into the future and witness a 'dress rehearsal' for a final repository for spent nuclear fuel.

At this unique laboratory, which is part of the IAEA's 'Network of Centres of Excellence' for underground laboratories, research is being carried out for the deep geological disposal of high-level radioactive waste.

Thirty countries around the world currently operate nuclear reactors, but there is still no facility in place for the permanent disposal of the spent nuclear fuel or high-level radioactive waste, which remains hazardous for up to 100,000 years.

One solution is to dispose of the waste in deep underground repositories and the consensus of the waste management experts internationally is that this system of geological disposal is the best option currently available or likely to be available in the foreseeable future. Several countries, including Sweden, Finland and France, have decided to move forward with this option.

A short bus ride through a tunnel takes tourists into the Swedish bedrock. Here they can touch rock that is 1.8 billion years old, taste 7000-year old water and more importantly see how spent nuclear fuel will be disposed of in the future.

In general visitors react positively to what they have seen. One schoolboy said, "I think it's a good idea to bury the waste underground, compared with some of the other ideas I've heard, such as sending it into space."

Others felt that there was too much information and one man commented: "I think it's important to make the spent fuel retrievable after putting it into the ground. Maybe it's too early to spend lots of money burying it and we should be looking at ways to reuse the energy in the spent fuel."

After 30 years of research and investigations, SKB recently announced that it has selected a location north of Stockholm for the final disposal of its spent nuclear fuel and it will submit permit applications for the construction of the repository in 2010.

If everything goes according to plan, the disposal will begin in around 2023. Oskarshamn was one of two sites selected in 2002 for the potential location for the repository, and a survey conducted in 2009 on behalf of SKB showed strong local support for the construction of the site in the municipality.

About 84% of those who responded to the poll voted in favour of having the disposal site in their region, compared with just 41% in a nationwide poll.

Oskarshamn Mayor Peter Wretlund said: "When it was announced that it would be constructed elsewhere in Sweden, people were very disappointed. There was a feeling of emptiness.

"I suppose we are quite laid back when it comes to these issues. For example, on April Fools' Day a local paper ran an article to say that the nuclear waste should be buried under the town's central park.

A short bus ride through a tunnel takes tourists into the Swedish bedrock. Here they can touch rock that is 1.8 billion years old, taste 7000-year old water and more importantly see how spent nuclear fuel will be disposed of in the future.

There wasn't very much reaction to this, apart from some people asking whether this was really the best place!"

In Oskarshamn town centre, Maria, a waitress at a whole food cafe, said: "I've heard that in other countries with nuclear power some people are uncomfortable with it. I grew up here, and at first I didn't like the idea of living near a nuclear power plant, but over the years I've grown used to it.

"SKB does very good public outreach work, and I've been on the tours of the underground laboratory and the canister laboratory. People here in Oskarshamn were sad that we didn't get the repository for the spent nuclear fuel because it would have created jobs."

And beyond Oskarshamn, support for nuclear power in Sweden as a whole remains strong. In a recent EU survey on attitudes to nuclear energy 62% of Swedes questioned voted in favour of nuclear power.

In 2009 the Swedish government announced plans to lift a ban on the building of new reactors, overturning the 1980 referendum in which Swedes voted to phase out nuclear power.



Louise Potterton, IAEA Division of Public Information.
E-mail: L.Potterton@iaea.org



A Look into the

Safeguards and verification is going through a sea of change. The IAEA is convening an international symposium to examine how to prepare for future verification challenges.



The nuclear landscape is evolving, offering both challenges and opportunities to the IAEA and its Member States. Global interest in nuclear power generation is increasing. This expansion will bring additional nuclear activities, facilities and more nuclear material under safeguards around the globe. It also suggests growing international nuclear cooperation and trade in nuclear and related equipment, items and materials. All this is likely to significantly increase the IAEA's safeguards activities.

With technological progress, the IAEA will need to be prepared to safeguard new, more advanced and larger scale nuclear fuel cycle facilities. At the same time, future nuclear technology and facilities may be designed to be more proliferation resistant and safeguards friendly. Scientific and technological progress can also help improve the evaluation of information and enhance detection capabilities, as well as provide further opportunities to improve both safeguards implementation and organizational effectiveness and efficiency.

As the world gives more attention to nuclear disarmament, so the IAEA may also be requested to take on further verification tasks, for example, in relation to fissile material declared as excess to defence requirements.

Of course, just as it rightly considers challenges yet to come, the IAEA will still need to continue addressing those it already faces today. In recent years, a number of developments have tested the nuclear non-proliferation regime and have placed increasing expectations on the IAEA safeguards system. Proliferation risks related to globalisation — such as covert supply of nuclear and related technology as well as the greater availability of proliferation-sensitive information through the media — are likely to grow. The importance placed on the IAEA's ability to provide credible assurances of the peaceful use of nuclear energy seems sure to rise.

The Home Front

In addition to external challenges, the IAEA will also need to confront its own organizational challenges. It is already striving to achieve greater efficiencies in its work. But in the years ahead, with its financial resources remaining under strain, the efficiency demands upon the IAEA look set to grow. Competing with Member States in the recruitment of expert staff from a shrinking pool of nuclear professionals poses a further test. The IAEA will also

With technological progress, the IAEA will need to be prepared to safeguard new, more advanced and larger scale nuclear fuel cycle facilities.

(Photo: D.Calma/IAEA)

by Olli Heinonen
Future

An International Forum

The Symposium on International Safeguards: Preparing for Future Verification Challenges is hosted by the IAEA in cooperation with the European Safeguards Research and Development Association (ESARDA) and the Institute of Nuclear Materials Management (INMM). It will be held from 1-5 November 2010 in Vienna, Austria.

need to find better ways to retain the knowledge of staff when they leave the IAEA.

All these developments highlight the evolving nature of the IAEA's operating environment and the importance of adapting to change and continually improving both the effectiveness and the efficiency of the safeguards system. They also underscore the importance of preparing more actively for the future.

An international safeguards symposium to be held in November 2010 aims to provide an opportunity for stakeholders jointly to explore possible solutions to the various current and future challenges outlined above in support of the IAEA's nuclear verification mission.

The Programme

The purpose of this event, staged every four years, is to foster dialogue and information exchange between the IAEA and experts from Member States, the nuclear industry and the broader nuclear non-proliferation community. The focus of this year's symposium is how best, from a technical perspective, to prepare for future verification challenges during this time of change.

The symposium programme will consist of approximately 25 sessions over five days and will be held in the new conference building at the Vienna International Centre. It will begin with opening plenary sessions, continue with parallel topical sessions on succeeding days and conclude with another plenary session on the fifth and final day.

A variety of topics will be addressed. In the context of the wider non-proliferation regime, participants will explore how to enhance the IAEA's detection capabilities and build confidence in compliance with safeguards obligations. The symposium will also explore ways to improve cooperation between the IAEA and Member States when implementing safeguards, so as to enhance their effectiveness and efficiency. It will also address the newer proliferation challenges posed by an increasingly interconnected world: for example, covert trading in nuclear know-how and technology. Moreover, participants will consider possible IAEA verification roles in support of arms control and disarmament.

Interaction with other verification and non-proliferation regimes will be another area considered as will possible synergies between safety, security and safeguards.

Looking into the future, participants will be asked to examine how best to prepare for the global nuclear expansion. The symposium will address how to build proliferation resistance into the design of advanced new types of nuclear facilities, as well as how best to deal with innovative fuel cycles. There will be discussion about how the IAEA can cope with the expected increase in its safeguards workload. The symposium will also address the question of whether refining the implementation of the State-level concept and integrated safeguards is part of the answer, along with, for instance, greater use of remote data-driven inspections.

Technology is sure to continue to play a key role: for verifying nuclear material and activities; for detecting undeclared nuclear material and activities; and for the collection, analysis and integration of information. At the same time, the contribution made by personnel will remain vital. Husbanding intellectual resources is vital right across the lifespan of professional staff, whether through staff training, maintaining expertise, or managing and preserving knowledge.

Conclusion

By bringing together the leading experts in the field from across the world, this symposium will examine the key nuclear verification challenges ahead with the aim of preparing how best to meet them. ☸

Olli Heinonen is the IAEA's Deputy Director General of Safeguards.

Symposium on International Safeguards Preparing for Future Verification Challenges

**1–5 November 2010
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ESARDA





Training the

Newly recruited safeguards inspectors take to the field.

Students gather and chatter nervously at the end of an intensive, three-month course. They are waiting for exam results.

The examiner asks for silence: "Thanks for showing up," he says. "We should now discuss the results of the test.

"Question one was relatively clear. 'Under the Additional Protocol, which of the following statements are correct?' The correct answer is F. Any questions?"

These are not your regular students. They are future IAEA safeguards inspectors and the 'Additional Protocol' is just one of the many aspects of the organisation's system of safeguards they need to understand.

After months of training the new recruits are now embarking on their first inspections at nuclear facilities around the world.

IAEA safeguards are measures through which the Agency seeks to verify that a state is not diverting nuclear material or equipment to develop or produce nuclear weapons or other nuclear explosive devices.

Activities include placing seals, installing cameras and verifying inventories, receipts and shipments at nuclear facilities.

States accept the application of such measures through the conclusion of safeguards agreements with the IAEA and the Agency currently applies safeguards in more than 170 countries and inspects over 900 nuclear facilities.

There are currently 250 inspectors and every year the IAEA runs an introductory course on the safeguards systems for the organisation's newly appointed inspectors.

Therese Renis, an experienced inspector who conducts part of the introductory course, said: "We verify declared nuclear materials at declared facilities. But in addition to measuring nuclear material, reviewing accountancy and auditing the books, we're always looking for signs or indications of potentially undeclared nuclear materials and activities."

"So there is a whole set of tools the inspectors need to learn. They need to understand the safeguards system in general, the legal background, the underpinnings for the activities we conduct."

She added that the inspectors need to learn how to use the various types of field equipment and how to record the results of their inspections once they come back to IAEA headquarters.

"Of course we can't teach the new inspectors everything, but we can arm them with the tools and skills



IAEA Inspectors

by Louise Potterton

they need to first go into the field and start to conduct their activities there," said Ms Renis.

Thirteen fledgling inspectors, recruited from many different countries across the world, took part in the training course, which involved written and oral tests and concluded with an inspection exercise at an operating nuclear power plant.

"The course has been very demanding but also very fruitful," said one new inspector from Mexico adding that he sees his new position as both a "challenge and a privilege".

"This job gives me the opportunity to be part of a system that is working in favour of peace and security in the world," he said.

The physicist, who has previously worked for the Mexican National Commission of Nuclear Safety and Safeguards, added, "Regardless of the background of the attendees, at the end of the course I discovered that everyone was speaking the same language - the language of the safeguards inspectors."

Another student from Nigeria, who was educated in nuclear physics and formerly employed by British Nuclear Fuels, said that he was attracted to the job because he wants to represent Africa on a global stage and be part of a team that 'makes the world more peaceful.'

"As an IAEA inspector we have to ensure that a state is using nuclear technology only for peaceful purposes," he said.

And a new inspector from Indonesia, who worked for 20 years for the Indonesian Atomic Energy Agency as a senior safety engineer said: "I learnt so much about the safeguards system, issues that I never knew before. For example, the legal aspects, the technical matters and how we carry out the verifications."

In general the inspectors travel for up to 100 days in a year and, depending on the location, could be away for up to four weeks. They visit a wide range of nuclear facilities, including power plants, research reactors, fuel fabrication and reprocessing facilities. In 2009 over 2000 inspections were performed.

Vacancies for new inspectors are posted periodically on the IAEA's website. Candidates need to have a university degree in engineering or science and experience in the nuclear field.

"There are a wide range of attributes and skills that are desirable, but we recognise that not all candidates will have all skills. So we look for the people with the right sets of skills that will complement the teams we already have at the IAEA," said Therese Renis. 

There are currently 250 inspectors and every year the IAEA runs an introductory course on the safeguards systems for the organisation's newly appointed inspectors. (Photos: D. Calma/IAEA)

*Louise Potterton, IAEA Division of Public Information.
E-mail: L.Potterton@iaea.org*

Where It All Begins

by Sasha Henriques

Safeguards inspectors travel to nuclear facilities around the world, but few have ever seen a uranium mine — the source of the raw material for nuclear fuel. The IAEA organises training exercises for inspectors so



1 Dolni Rozinka is a uranium mine in the Czech Republic, situated 180 km (113 miles) east of Prague. Training for IAEA safeguards inspectors begins with a trip down the mine shaft.



2 Accompanied by the sounds of dripping water and creaking steel, inspectors travel 1050 metres below the surface to witness firsthand the underground uranium mining operations. Here, two IAEA staff members gingerly exit one of the mine's lifts.



they can become familiar with the so-called ‘front end’ of the nuclear fuel cycle. This photo essay records one such exercise carried out at a uranium mine in the Czech Republic.



3

Miners drilling shot holes so they can blast out the uranium-bearing rock at Rozna I, the last active uranium mine in central Europe. They work up to 1200 metres below the surface, for six straight hours, five days a week. Because miners are exposed to ionizing radiation, they are only allowed to work 2100 shifts underground in their lifetime. For a number of years the Czech Republic has been between the eighth and the tenth largest uranium producer in the world.



4

On the surface, one of the head frames for the mine’s elevators rises high into the sky. Czech mines supply around 30% of the uranium requirements for the country’s two nuclear power plants.



5

Uranium ore is processed into a concentrate known as yellowcake, which is produced at a plant a few kilometres from the mine.



6

At the uranium processing plant, an IAEA safeguards inspector gets ready to take a sample of yellowcake for analysis.



7

Yellowcake is packed in special, tightly sealed steel drums similar in size to oil barrels. Each weighs no more than 350 kg when full.



8

Inspectors check the barrels which are ready to be shipped abroad. Only countries that have an Additional Protocol are required to declare their yellowcake stockpiles to the IAEA. As of March 2010, only 95 countries had Additional Protocols in force.



9 Inspectors' curiosity is aroused by waste water treatment technology using both ion-exchange and reverse osmosis processes to remove uranium and heavy metals from wastewater. The water treatment plants are located inside the uranium remediated areas as well as in the chemical processing plant.



10 When abandoned mines are flooded, the water rising to the surface contains some uranium and other contaminants. So, it must be treated before being discharged into the surrounding area. Here, mine managers discuss the finer points of water collection and treatment with the inspectors.



11 Aboveground, inspectors go through more training exercises designed to improve their skills with technologies and procedures that they could expect to use during inspections at uranium mining and ore processing facilities.



12 Inspectors need to learn how to read a site's landscape to detect signs of possible clandestine nuclear activities. Here, the trainers use the area's decommissioned mine shafts and remediated land to create realistic exercises for inspectors.



Pages From The Past

IAEA Safeguards: A Look at 1970-1990 and Future Prospects *by Jon Jennekens*

Twenty years ago, in an article published in the IAEA Bulletin Jon Jennekens looked at how the entry into force of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) in 1970 had influenced the IAEA's safeguards activities.

Fears that nuclear weapons would spread to many countries have fortunately not come true. To an important degree, the application of international safeguards has furthered this reality. For the IAEA, the operation of an effective worldwide safeguards system is a great responsibility, one that has been carried out over the past quarter century.

Even after 25 years, new challenges arise: Complicated installations are built that handle large quantities of fissionable material which have to be safeguarded. Verification techniques which were once satisfactory become obsolete. Today's political developments as well — for example, the discussion of disarmament on many fronts — have opened up a much greater general readiness to accept verification than was true when the safeguards system began in the 1960s. IAEA safeguards will benefit both in cost efficiency and credibility if they are allowed to keep up with the advances made in other verification schemes.

Over the past decade, these developments, coupled with financial limitations, have seriously tested the IAEA's capability to carry out effective safeguards

operations. Necessarily, the Agency has undertaken a number of steps to increase the overall effectiveness of its safeguards work. New diversion scenarios and safeguards concepts for larger and more complex nuclear facilities have been defined, for example, and safeguards at such plants have been updated. A safeguards information system has been introduced for the computerization of all safeguards data, which has greatly improved record handling and evaluation activities. Simultaneous inspection of all facilities in certain countries has been developed to the point of routine application. This procedure has resulted in improvements in safeguards effectiveness.

[...]

In 1970, the IAEA's "Safeguards Committee" was established to elaborate guidelines for use by the Director General in concluding safeguards agreements envisaged in Article III of the NPT. Before then, the safeguards "system" was largely based on the acceptance of safeguards by States receiving nuclear material or equipment from other States for specific projects. Prior to 1970, the scope of safe-

guards implementation was largely limited to individual nuclear installations involving specific quantities of nuclear material and materials and equipment especially designed or adapted for use in nuclear research, development, and industrial activities.

In contrast, the safeguards required by the NPT apply to all source or special fissionable material in all peaceful nuclear activities in non-nuclear-weapon States. The entry into force of the NPT thus brought about an important change in the demands placed upon the Agency. Other changes also affected the Agency's safeguards activities. Before 1970, the nuclear materials subject to IAEA safeguards were either highly enriched uranium (HEU) in the form of fuel elements for research reactors, or relatively small quantities of natural uranium intended for use in research and development facilities and "pilot" production facilities. Other than a dozen or so industrialized States with fledgling nuclear power programmes, there were only 10 or 12 developing countries pursuing nuclear research and development programmes. As a result, there were only isolated instances of international traffic in nuclear materials and equipment.

[...]

In 1970, the reporting of safeguards inspections was done in a relatively simple format that summarized inspection activities and their results. Details of the activities and the "depth" of the inspection were reflected in the inspection report filed by the individual inspector.

In later years, inspection report forms were improved in the interests of consistency, completeness, and reduction of the narrative component. Today's form, commonly called a "logsheet", records all information required for computerized inspection reports.

[...]

Most certainly, the Agency's technical capabilities will need to continue to improve in tune with technological advances being made in nuclear materials measurement and accounting systems. Equally, the trend to computerized nuclear materials handling, processing, and storage systems — with a consequently reduced accessibility to these materials for verification purposes — will force further changes in the interfaces between the IAEA's Inspectorate, the national regulatory authorities of Member States, and the operators of nuclear facilities.

[...]

The 1970 Safeguards Committee

In April 1970, the IAEA Board of Governors adopted a resolution calling for establishment of a Safeguards Committee to formulate guidelines for safeguards agreements in connection with the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which had been opened for signature in 1968 and whose entry into force was imminent.

The Treaty assigns to the IAEA the responsibility of applying safeguards to nuclear material in all nuclear facilities in States that become NPT parties for the exclusive purpose of verification of the fulfillment of their obligations under the Treaty.

[...]

Thus, the future prospects for IAEA safeguards are quite bright, albeit with a not unexpected degree of uncertainty. The continuing importance of IAEA safeguards as a bulwark of the nuclear non-proliferation efforts of the world community is beyond question. States which have undertaken comprehensive safeguards obligations firmly believe that IAEA safeguards provide the only broadly international and therefore credible means of verifying the peaceful nature of their nuclear activities. Those States which have chosen not to undertake such comprehensive safeguards obligations are not asked to forego the many humanitarian benefits of nuclear energy and ionizing radiation, but only to strengthen the already wide-reaching safeguards programme of the IAEA.

The two decades of the 1970s and 1980s have provided striking evidence of the near universal belief in the value of IAEA safeguards. Hopefully, the decade of the 1990s will see the joining together of all States in a truly universal undertaking of a system of verifying the non-diversion of nuclear materials to non-peaceful purposes. 

Jon Jennekens was Deputy Director General and Head of the IAEA Department of Safeguards.

A full version of this article is available online at: www.iaea.org/bulletin

Keeping Nuclear

Ambassador Jargalsaikhany Enkhsaikhan spoke with the Bulletin's Giovanni Verlini about Mongolia's nuclear-weapon-free zone.



Question: What is the origin of Mongolia's nuclear-weapon-free zone (NWFZ) initiative?

Jargalsaikhany Enkhsaikhan: In the late 1960s, nuclear Soviet Union and nuclear China were very close to an all-out conflict. Mongolia, hosting Soviet military bases, was helplessly caught in the middle.

Mindful of its unique geographical location, one of the first independent foreign policy acts of Mongolia after the demise of the socialist system in early 1990s was to ensure that the threat that it felt during the Sino-Soviet dispute would not be repeated in the future. In September 1992, it declared its territory a nuclear-weapon-free zone (NWFZ) and pledged to have that status internationally guaranteed.

Q: What makes Mongolia's NWFZ unique?

JE: Unlike other NWFZs, Mongolia's initiative was a unilateral act of an individual State to turn its territory into a NWFZ. However, knowing full well that a unilateral declaration would not make a credible zone, Mongolia undertook a number of measures aimed at institutionalizing its single-State zone.

First and foremost, Mongolia needed its immediate neighbours' recognition of the zone. This came with the Treaty on Friendly Relations and Cooperation which was signed with the Russian Federation in 1993 and a similar treaty signed with the People's Republic of China, signed in 1994, both sides agreed

not to allow their territories to be used by third States against the state sovereignty and security of the other. Taken together with the Sino-Russian pledge not to use territories of its neighboring third states against each other, these treaties create a favorable political and legal basis for institutionalizing Mongolia's single-State zone at the national and international level. Moreover, in its treaty with Mongolia, Russia pledged to respect its foreign policy of not allowing foreign troops, nuclear weapons, or other weapons of mass destruction to deploy on its territory or transit through it. China made a similar commitment in 1994 in a joint Mongolia-China press statement.

Q: Did Mongolia seek international recognition and support for its initiative?

JE: After a number of rounds of bilateral consultations with the five permanent members of the Security Council (the 'P5'), Mongolia decided to pursue full institutionalization of its zone at the United Nations General Assembly by tabling a draft resolution that would welcome and recognize the zone.

Although the P5 in general welcomed the initiative, they were reluctant to agree to the concept and implementation of a single-State NWFZ, believing that that would reduce or undermine the incentive for establishing traditional (i.e., group) NWFZs and set a precedent for others to follow suit. That is why they were not in a position to provide full support for the initiative and agreed to support it not as a full-fledged "zone" but rather as a vaguely defined "status".

In return for Mongolia's non-insistence on the inclusion of explicit reference to the notion of a single-State NWFZ in the UNGA resolution, they expressed agreement to address Mongolia's security concerns in its broader aspect. Within that context in December 1998 UNGA was able to adopt without a vote a resolution entitled "Mongolia's international security and nuclear-weapon-free status".

Weapons Out

In 2001 the representatives of the P5, Mongolia and the UN met in Sapporo to explore ways of giving the status an international legal basis. They recommended that Mongolia conclude either a trilateral treaty with its immediate neighbors or a six-party treaty with the P5. Mongolia chose to pursue the first path.

Q: How is the NWFZ enforced?

JE: The effectiveness of Mongolia's international commitment depends on the force of its execution at the national level. That is why its international pledge needed to be converted into domestic law. Hence in February 2000 Mongolia's State Great Hural, the country's Parliament, adopted a detailed statute defining its nuclear-weapon-free status and criminalizing violations.

When drafting the legislation, Mongolia bore in mind its commitment under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) which already was part of its legislation. Therefore the acts prohibited by the legislation concerned primarily acts committed by individuals, legal persons and foreign States as well as the ancillary crimes of initiating or participating in the prohibited acts.

However, going further, the law also prohibited the stationing or transporting of nuclear weapons through its territory as well as dumping or disposal of nuclear weapons-grade radioactive material or nuclear waste on Mongolian territory.

Q: How can Mongolia verify that its nuclear free status is not being infringed?

JE: The legislation envisages two levels of verification: national and international. At the national level, the competent authorities are empowered to gather information, stop, detain and search any suspected aircraft, train, vehicle, individual or groups of people to ascertain that the law has been respected and strictly implemented. Also the law calls for greater public oversight of the implementation of the legislation by non-governmental organizations and even individuals, within the mandate provided by the legislation, and to submit proposals to the relevant state authority.

As to international verification, the law stipulates that it can be carried out either in cooperation with the relevant international organizations or through conclusion of special international agreements. So far there has been no need for such verification.

Q: How are violations of the law met?

JE: The law establishes criminal liability for violation of the legislation in accordance with the Criminal Code and stipulates that any facility, equipment or other material or means of transportation used to commit the crime are to be confiscated by the State. An individual or legal person that violates the law is to pay compensation for the damage caused to the interests of Mongolia, to the population, the property and the environment in conformity with the relevant Mongolian legislation or the appropriate international treaty to which Mongolia is a party or principles and norms of international law.

The law also addresses the case of possible involvement by other states in its violation. Thus it stipulates that in case of violation or suspected violation of the law by a foreign state, Mongolia will officially notify that state, request an explanation and peacefully resolve the issue. If deemed necessary, the IAEA and other relevant bodies can be asked for assistance. In the event of a legal dispute, the case can be referred to the relevant international court or to arbitration for resolution.

Together with the law, the State Great Hural of Mongolia also adopted an implementing resolution underlining the national and international importance of the law and empowered the Government to actively cooperate with the IAEA and other relevant international organizations to ensure proper operation of the seismic, infrasound and radionuclide stations designed to monitor possible nuclear weapons tests outside Mongolia and report to the Parliament's relevant standing committee on the implementation of the law.

Q: Has the legislation been reviewed since 2000?

JE: In accordance with the Parliament's implementing resolution, the first thorough review of the implementation of the law was undertaken in 2006

Nuclear Free: A World Map

by Giovanni Verlini

Nuclear free zones currently cover the territories of the entire Southern hemisphere. Treaties banning the development, manufacture, stockpiling, acquisition or possession of any nuclear explosive device are in force in Africa (Treaty of Pelindaba); South America (Treaty of Tlatelolco); the South Pacific (Treaty of Rarotonga); Southeast Asia (Treaty of Bangkok); and Antarctica (Antarctic Treaty). In addition, five Central Asian countries, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, are parties to the Treaty of Central Asian Nuclear Weapon-Free Zone (CANWFZ), the first of its kind comprising States of the former Soviet Union, and the first such zone in the Northern Hemisphere.

The Treaties also commit parties to not test, allow, assist, or encourage testing, dump radioactive waste, or station nuclear weapons on the territory of any of the States party to the Treaties. In addition, they commit parties to apply the highest standard of security and physical protection of nuclear material, facilities, and equipment to prevent theft and unauthorized use, as well as prohibit armed attacks against nuclear installations within the zones.

Mongolia, on the other hand, is one of the few countries that by its national legislation committed itself not to allow stationing on or transit through its territory of nuclear weapons or any part of such weapons. New Zealand was the first country to adopt a legislation that prohibits nuclear weapons on its land and territorial waters as well as its officials from engaging in nuclear weapons-related activities, or aiding or abetting them. The Philippine constitution bans nuclear weapons from its territory, including from its archipelagic waters. Austrian legislation prohibits not only nuclear weapons, but also nuclear energy production, and, being surrounded by many nuclear power plants, underlines the importance of strengthening nuclear liability norms and clearer compensation rules.



by an inter-agency working group representing five ministries, four agencies and one NGO. The group came to the conclusion that most of the provisions of the law were being implemented.

On the other hand it also concluded that it was impossible to verify implementation of its provisions (Article 4.1.4 of the law) regarding prohibition of dumping or disposal of nuclear weapons-grade radioactive material or nuclear waste, since Mongolia has a vast, sparsely populated territory and the authorities and specialists lack adequate information and experience in dealing with nuclear weapons-grade radioactive material and wastes.

The prohibition of the transport of nuclear weapons, parts or components, is also difficult to implement due to the lack of detection equipment and specialized staff.

All in all, the working group made specific recommendations and presented its findings to the Government and Parliament of Mongolia for their possible consideration and follow-up. Copies of the report were also circulated as an official document of the UNGA and the IAEA.

Q: Could such legislation affect negatively peaceful application of nuclear technology?

JE: The legislation makes sure that the prohibitions do not affect peaceful uses of nuclear energy or technology. That is why it underlines that nuclear energy and technology could be developed under license, issued by the state administrative authority in charge of nuclear energy, for the purposes of health care, mining, energy production and scientific research.

Q: What are Mongolia's initiatives in nuclear safety and security?

JE: Mongolia is taking steps to ensure that the safety and security of nuclear facilities and installations in Mongolia itself and in its neighboring areas meet global standards. To that end it needs to accede to such international conventions such as the Convention on Nuclear Safety, the Joint Convention on the Safety of Spent Fuel Management and other multilateral conventions in the nuclear field, and at the same time to cooperate with its neighbors bilaterally and within the framework of these conventions.

In July 2009, a Nuclear Energy Law was adopted dealing with formulation of the necessary safety and security principles, establishing an independent regulatory body and a regulatory control system, stricter rules on issuing special licenses, implementing import and export controls of nuclear material, and compensation mechanisms for nuclear damage among other measures. This further strengthens the legal basis for nuclear security and safety nationally.

Q: What are the future steps in the process of having Mongolia's status finally acknowledged internationally?

JE: Following up on the Sapporo recommendations, Mongolia has taken steps to institutionalize the status at the sub-regional level by pursuing a trilateral treaty regarding the country's status.

In 2007 it presented a draft trilateral treaty to its neighbours. The draft is based on the common provisions of other NWFZ treaties and at the same time

reflects the good relations that Mongolia presently enjoys with its neighbours.

The assurances that Mongolia seeks to acquire are somewhat more limited in scope than those the P5 usually provide to other NWFZs. Bearing in mind its location and relations with its neighbors, Mongolia could settle for their pledge to respect its status and refrain from any acts that could impel Mongolia to violate it.

In 2009 we met twice with Russia and China to discuss the content and the format of the treaty. I hope

that the trilateral talks will soon produce a treaty that strengthens Mongolia's security and at the same time contributes to regional stability, greater confidence and non-proliferation. I also hope that the three other nuclear-weapon states (US, UK and France) will be able to pledge to support the treaty and the status in the form of a protocol to the treaty. 

Ambassador Jargalsaikhany Enkhsaikhan is Mongolia's Permanent Representative to the IAEA. E-mail: enkhsaikhanj@embassy.mn

Life begins at 40 by Giovanni Verlini

In 1970, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) entered into force. Forty years on, the world is awaiting the outcome of its May 2010 review conference.

Over 40 years have passed since the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) officially entered into force on 5 March 1970. Opened for signature in 1968, signed first by the countries that proposed it — Finland and Ireland — to date the NPT has enlisted nearly 190 States as parties.

In essence, the NPT aims to prevent the spread of nuclear weapons and weapons technology, foster the peaceful uses of nuclear energy, and further the goal of nuclear disarmament.

The NPT and the IAEA

The IAEA is not a party to the NPT but is entrusted with key roles and responsibilities under it. The Treaty establishes a safeguards system under the responsibility of the IAEA, which also plays a central role in areas of technology transfer for peaceful purposes.

The role of the IAEA is specifically defined under Articles III and IV of the NPT — which is made up of a preamble and a total of eleven articles.

♦ **NPT Article III:** The IAEA administers international safeguards to verify that non-nuclear weapon States party to the NPT fulfill the non-proliferation commitment they have made, “with a view to preventing diversion of nuclear energy from peaceful

uses to nuclear weapons or other nuclear explosive devices”; and

♦ **NPT Article IV:** The IAEA facilitates and provides a channel for endeavours aimed at “the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world”.

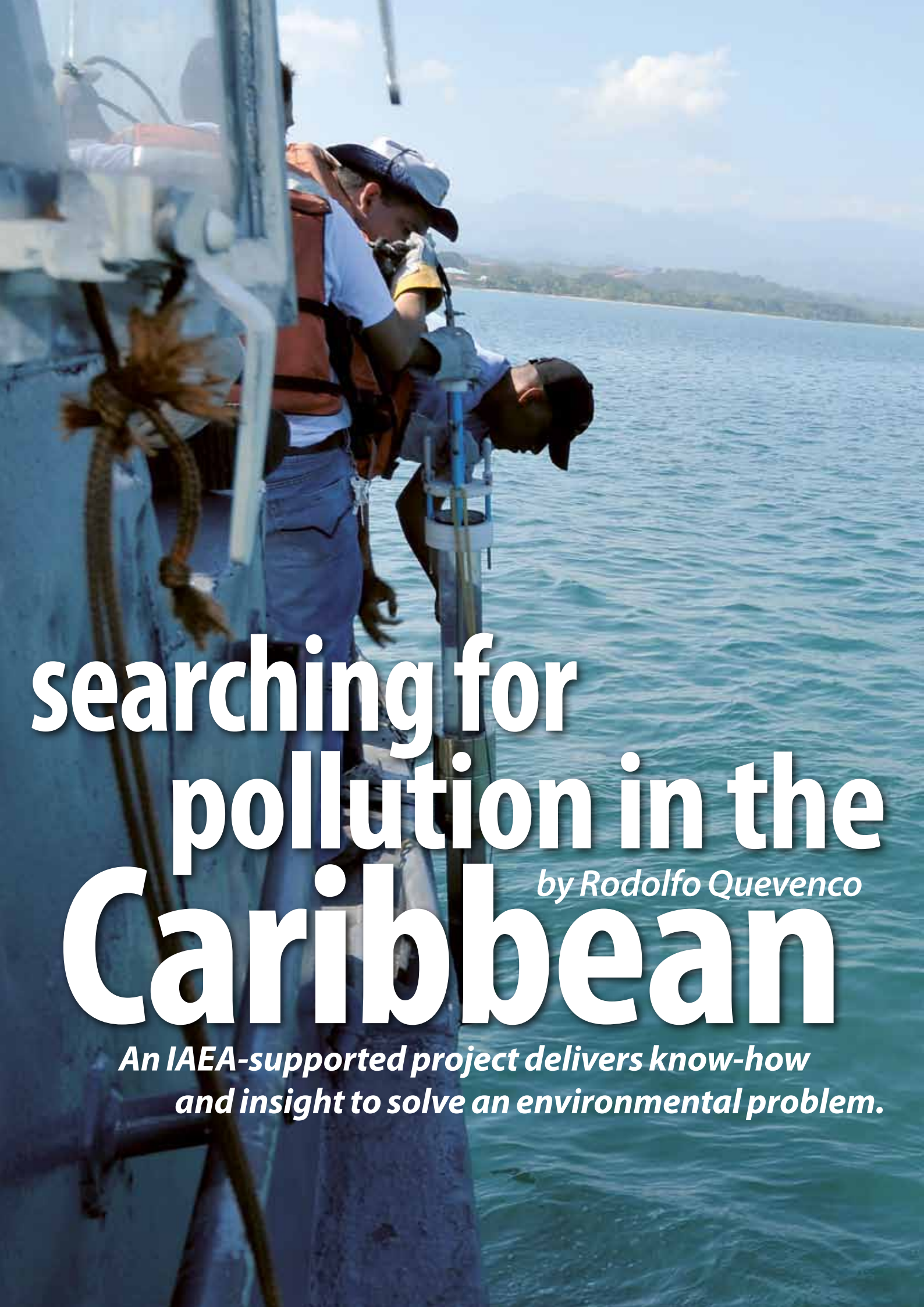
In practical terms, the IAEA is also seen as having roles in connection with verification of nuclear-weapon-free zones and in the context of verifying ex-nuclear weapon material.

Review Process

The NPT is reviewed every five years at Review Conferences of the Parties to the Treaty of Non-Proliferation of Nuclear Weapons. The first such conference was held in Geneva in 1975.

At the 1995 Review Conference in New York it was decided to extend the NPT indefinitely — it had been originally conceived with a duration of 25 years. The next Review Conference will be held in May 2010 in New York.

The Russian Federation, the UK, US are the depositary governments of the NPT. 



searching for pollution in the Caribbean

by Rodolfo Quevenco

*An IAEA-supported project delivers know-how
and insight to solve an environmental problem.*

The hot Caribbean sun bore down on a Honduran naval boat as it criss-crossed the waters of Puerto Cortes, Honduras' main port and one of Central America's most important seaports.

Aboard the vessel, Miguel Gomez Batista, a young radioecologist from Cuba, stared out at the distant horizon with a hint of concern on his face. The ship's depth-measuring instrument had been acting up and the last few readings were definitely off.

Miguel, along with a team of five Honduran biologists, had been up at the crack of dawn. They had spent the last few days preparing supplies and equipment for collecting surface and sediment samples on the coastal waters of Puerto Cortes. Puerto Cortes is a mere 55km drive from San Pedro Sula, where the team was based. But despite their early start, the morning traffic from San Pedro Sula and the unexpected mechanical problems with the boat's diesel engine meant the expedition had to start much later than they had originally anticipated. And now this...

Miguel had other reasons to be concerned.

As a regional expert with solid training and experience in sediment sampling, Miguel had been tasked to lead and train a team of young biologists from Honduras' Center for the Study and Control of Pollutants (CESSCO) in sediment sampling. He flew to San Pedro Sula from Cuba over the weekend; then spent the past couple of days teaching the team proper procedures in the use of sampling tools and sample treatment in the laboratory. The two men and three women from CESSCO were eager and quick to learn, yet largely untested. Up until now, their only practice had been on mock-ups in the laboratory. Today, they would need to prove they could do as well in the field.

And, as if this was not pressure enough, a two-man team from the International Atomic Energy Agency (IAEA) in Vienna had also recently joined the group to observe and record the exercise.

The IAEA, through its Department of Technical Cooperation, had been supporting this regional project since 2007. Docked officially under the code RLA/7/012, the formal title of the project is *Use of Nuclear Techniques to Address the Management Problems of Coastal Zones in the Caribbean Region*. Twelve Caribbean countries participate in the project — Colombia, Costa Rica, Cuba, Dominican Republic, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama and Venezuela. France

and Spain provide additional technical and financial support. The United Nations Environment Programme (UNEP), as well as the Global Environment Facility (GEF) are also active partners in the project.

Concern over the growing incidence of pollution in the Caribbean has been on the rise, as it has the potential to affect livelihoods dependent on fishing and tourism. The UNEP's regional centre in the Caribbean extensively studied pollution in the Caribbean Sea, compiling a list of sites in the Caribbean having high pollution levels. UNEP's list served as the basis for identifying the project's study areas. Puerto Cortes, as one of Central America's major seaports, was among the sites selected.



Role of Nuclear Techniques

Tracking and understanding the sources of pollution in the Caribbean requires a high degree of scientific experience and know-how. The IAEA operates one of the world's leading centres for marine environmental protection, the Monaco-based Marine Environment Laboratory (IAEA-MEL). The laboratory applies nuclear techniques to research, document pollution and other marine problems, and technically assists States facing threats to their seas and coastal waters. With its involvement, the Caribbean project was underway.

"Nuclear techniques are effective diagnostic tools for tracing sources of contaminants," says Joan Albert Sanchez-Cabeza, a physicist who heads the Radiometrics Laboratory in the IAEA's laboratories in Monaco.

Biologists from Honduras Center for the Study and Control of Pollutants (CESSCO) aboard a naval vessel en route to several sampling sites along the coastal waters of Puerto Cortes.
(Photo: D.Calma/IAEA)

The analysis focusses on three types of contaminants, Dr. Sanchez-Cabeza elaborated. "We use techniques to measure the concentration of trace metals (like lead or mercury), hydrocarbons and pesticides. For example, x-ray fluorescence easily reveals the trace metals present in the sediment."

These techniques also bring a deeper historical perspective to the nature and causes of pollution.

"Some of the nuclear techniques we are using provide a new specific approach to the analysis," he said. "We call this dating."

In this project we are not only pinpointing which are the polluted areas but we are also telling society and decision makers what are the pollution trends.

"We use the natural radioactive element lead-210," he clarified. "By looking at that radionuclide we can tell what is the age of a particular sediment layer. We can go back in time to tell how a country's ecosystem was 100 years ago, and what is the status now."

Under the project, scientists collect sediment cores — or vertical pieces of sediment — at the pre-selected sites. Then the different layers of the sediment are examined and analyzed in the laboratories.

"Each layer is actually like a page of history," Dr. Sanchez-Cabeza said. "Nuclear techniques allow us to read that book, and the story written in the sediment."

"In this project we are not only pinpointing which are the polluted areas but we are also telling society and decision makers what are the pollution trends. Are we doing things better? Are things improving or not?"

"We provide them with tools to see if that is the case and, if it is not the case, to correct them if possible. That is the core of IAEA-MEL's contribution," he said.

Learning the Science

Manpower development is one of the essential elements of the project, according to Dr. Jane Gerardo-Abaya, the project's Programme Management Officer in the Latin America Division of the IAEA's Technical Cooperation Department. It is also an area that has shown the most progress, two years into the project implementation.

"We have trained about 40 counterparts from 12 Caribbean countries in core sample collection and over 20 more in data processing and interpretation," she said.

This corps of well-trained scientists forms the regional network of individuals, institutes and laboratories that are actively collaborating - sharing information, expertise and existing capabilities in the participating countries.

"For example," Dr. Gerardo-Abaya pointed out, "laboratories in Cuba, Mexico, Nicaragua, Spain and IAEA-MEL are supporting the sample analyses taken from all 12 Caribbean countries."

The IAEA has furthermore provided substantial field and laboratory equipment to the participating Member States in the Caribbean.

"This would allow these countries to collect samples and analyze certain elements important for the project like lead-210, caesium-137, for sediment dating; and pollutants like heavy metals, hydrocarbons and pesticides," she explained.

"We train the scientists (in the region) to collect, prepare and analyze the samples," Dr. Joan-Albert Sanchez-Cabeza added. "If they do not have the means to analyze for a specific substance, we either provide the means or ask them to send the samples to other laboratories in the region."

"So it is actually a network that is already working - about 15-16 laboratories are continuously collaborating with each other, sending samples and meeting with one another. It is actually a very successful project," he said.

A Regional Approach

In early March 2009, the main counterparts of countries participating in the project RLA/7/012, as well as representatives of Spain, GEF, UNEP, and the IAEA, met in Panama to review the overall status of the project. The review meeting assessed progress

made so far and plotted the steps ahead. With its recent field sampling in Puerto Cortes, Honduras became the ninth country to provide core sediment samples, some of them with support from regional experts. These samples have been processed and are currently being analyzed by various participating laboratories. Other core sampling missions in 2009 also took place in Costa Rica, Panama, and Guatemala.

Two reference publications have been published, through the IAEA. One is a technical document that serves as guide for the collection, processing and analysis of samples. Another is a guide on sediment dating based on lead-210.

The review meeting particularly noted the improved regional capacity in the Caribbean in the use of nuclear techniques to reconstruct the history of pollution in coastal ecosystems. This included more field and laboratory instruments to support sediment collection and preparation of samples, and more counterparts trained in various analytical techniques.

To ensure the quality of results from laboratories, basic standards are provided to the laboratories, and intercomparison exercises are organized.

Project Impact

A core project objective is to get the results into the hands of decision-makers of the countries involved and of relevant regional authorities on the environment. This would be in the form of technical reports, scientific papers, brochures and reports to be published in leading journals or presented at major conferences and symposia.

"The main results will really be of interest for decision-making," states Dr. Jane Gerardo-Abaya. "That is why we need to reach out to stakeholders and decision-makers through existing regional channels. Unless these groups know about the project results, know about the situation and know about the capabilities in the region through this project, the impact will not be reached."

The Panama review meeting showed that, as the project starts on its third year, sufficient data has been gathered that could be provided to decision makers and to society within the next few years.

"At the end of the project, we want to tell the decision-makers this is what happened (in your country) for the last 100 years," Dr. Joan Albert Sanchez-



Cabeza said. "We see that in certain countries environmental policies are working well, though not in others, and this should get them thinking. The results that are now starting to be produced will influence decisions that would have a positive impact on the environment."

Tracking and understanding the sources of pollution in the Caribbean requires a high degree of scientific experience and know-how. (Photo: D.Calma/IAEA)

Building on Regional Collaboration

Project results to date are already beginning to have significant impact in other ways. In an effort to strengthen cooperation and synergies, the IAEA has established its relationships with key institutions in the Caribbean, particularly with UNEP and the Association of Caribbean States (ACS). This would not only enable optimization of resources and efforts but would also help in the wider dissemination of the project's final results.

Several significant offshoots are also being realized from data gathered so far and the technical and analytical capability available in the region are

enhanced, particularly in the use of nuclear techniques for environmental studies.

For example, an IAEA project on the early detection and evaluation of the toxicity of harmful algal blooms (HABs) in the Caribbean region benefits from work already done. Launched in 2009, the four-year project is using the results, as well as capabilities already obtained by participating countries. Another offshoot will probably be a project in 2012, which will assess the effects of submarine ground-water discharges — or waters coming from the continents — on coastal pollution levels, using radon and radium to detect the phenomenon.

All things considered, the work they all just did under this project may be exactly what the Caribbean needs. A *Salva Vida*. A lifeline. A promise of cleaner, clearer waters in the Caribbean for the future.

Project experts agree that the network established through this project, and the collaboration as well as technical capabilities that have been built in the past two years are what makes the project so special.

Dr. Joan-Albert Sanchez-Cabeza sums it up.

"From my point of view, the most important achievement is that we have 12 countries working together looking at pollution. They are helping each other and samples from one country are going to another country. Under this project, they are getting to know each other and collaborating."

All in a Day's Work

It was just shortly before 4pm, the Honduran naval boat slowly maneuvered its way back into port again. Fifteen minutes later, the team of biologists successfully unloaded their cargo. With one last pull, Messi and Carlos, two members of the team,

secured the metal cask containing the core sediment samples to the back of a Toyota pick-up truck that would take the team back to San Pedro Sula.

Miguel, who had also led similar teams in Haiti and Jamaica, was clearly satisfied with the result of the day's work, and the performance of the team.

"Today we went to several highly contaminated sites, and took samples in areas where sampling has not been done before. This is a very good team," he smiled, "and I am really impressed by their work today."

Though tired and with mud splattered all over his shirt, Dennys Canales-Cruz, leader of the Honduran team was equally pleased.

"This has been a very good experience for us to learn how to take samples and use the equipment," he summed up for the rest of the group. "We are confident that the knowledge we gained will be very useful for each of us and for Honduras, in general, to understand the causes and history of pollution so that necessary conservation measures can be taken."

In the days to follow, Miguel and the team will be working in CESSCO's laboratory in San Pedro Sula to weigh, label, code, and prepare the core sediment samples for shipment to the network of laboratories participating in the project. They would also be doing more field work to collect samples at different other sites along the Honduran coasts, and those, too, would need to be prepared for the laboratories.

But for now, a round of fine Honduran beer, maybe *Salva Vida*, to toast a good day's work was probably in order.

All things considered, the work they all just did today under this project may be exactly what the Caribbean needs. A *Salva Vida*. A lifeline. A promise of cleaner, clearer waters in the Caribbean for the future.



Rodolfo Quevenco is a public information officer at the IAEA News and Information Section. E-mail: r.quevenco@iaea.org



Managing Coastal Pollution

Concern over the growing incidence of pollution in the Caribbean has been on the rise, as it has the potential to affect livelihoods dependent on fishing and tourism.

The IAEA's Department of Technical Cooperation launched a regional project on the use of nuclear techniques to address coastal management issues in the Caribbean.



- 1** In 2007, the IAEA launched a regional project on the use of nuclear techniques to address coastal management issues in the Caribbean. Twelve countries are participating: Colombia, Costa Rica, Cuba, Dominican republic, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, and Venezuela. Spain, as well as the IAEA Marine Environment Laboratories in Monaco (IAEA-Mel), provide scientific and programmatic support.



- 2** Scientists from IAEA-MEL, provide scientific and programmatic support to the Caribbean project, by training counterparts in the use of nuclear techniques to analyse samples taken from the field.



- 3** Like other regional experts involved in the project, Miguel Gomez Batista from Cuba received laboratory training at IAEA-MEL in Monaco.



- 4** For the core sampling fieldwork in Honduras, a team of scientists from the country's Center for the Study and Control of Pollutants (CESCCO) was guided by regional expert Miguel Gomez Batista from Cuba on proper procedures for collecting surface and sediment samples



- 5** The Honduran navy provided tactical and logistical support to the CESSCO team during the exercise.

In Honduras, as well as in other Caribbean nations, cooperation among government agencies was a key factor in many of the successful missions conducted thus far.



6 Plotting precise locations of sampling zones first had to be done before sampling could begin. Working under the principle that 'quality of results is no better than quality of samples collected,' the team had to ensure the mission was conducted according to plan.



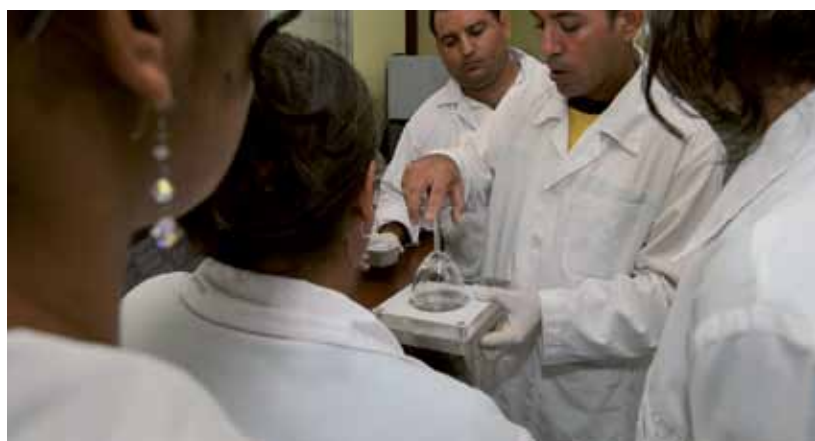
7 Surface sediments samples are immediately packed and labelled for easy referencing.



8 Scientists first check that the quantity and quality of the samples are adequate for laboratory testing. Should the sediments contain impurities, they are returned and the process begins anew. Once the sediment samples are determined to be of good quality, the process of removing the corer from the plastic cylinder begins.



9 The Honduran naval boat returns to port at the end of a full day of work collecting sediment samples along the coasts of Puerto Cortes, Honduras.



10 At the CESCO laboratory in San Pedro Sula, Miguel Gomez Batista demonstrates how best to slice the sediment samples from the vertical core.



11 Dr. Karhen Rodriguez-Waleska, head of CESCOO Laboratory in San Pedro Sula, then weighs the sediment samples.



12 Preparing the samples for analysis is a complex process that requires varied tasks. Here, Dr. Dennys Canales-Cruz, Honduran project team leader, carefully removes a slice of the sediment sample from the vertical core.



13 Other members of the team then label and tag the sediment sample according to color, texture, smell, etc. Later, samples are dried at controlled temperature in an oven before being shipped to participating laboratories that will analyze them.



By donating substantial equipment to laboratories in the participating Caribbean countries, the IAEA has helped improve the technical and analytical capability in the region on the use of nuclear techniques for coastal pollution studies.



14 The Caribbean coastal pollution project, also known as RLA/7/012, has built up a network of talented individuals, institutions and laboratories across the region which are actively sharing information, resources and capabilities.

Photos: D.Calma/IAEA • Text: R.Quevenco • Design: Ritu Kenn

Member States

1957	Afghanistan , Albania, Argentina, Australia , Austria , Belarus , Brazil , Bulgaria, Canada , Cuba, Denmark , Dominican Republic, Egypt, El Salvador, Ethiopia, France , Germany, Greece, Guatemala , Haiti, Holy See, Hungary, Iceland, India , Indonesia, Israel , Italy, Japan , Republic of Korea, Monaco, Morocco, Myanmar, Netherlands, New Zealand, Norway , Pakistan , Paraguay, Peru, Poland, Portugal , Romania , Russian Federation , Serbia, South Africa , Spain, Sri Lanka, Sweden , Switzerland , Thailand, Tunisia, Turkey , Ukraine, United Kingdom , United States , Venezuela, Vietnam
1958	Belgium, Ecuador, Finland, Islamic Republic of Iran, Luxembourg, Mexico, Philippines, Sudan
1959	Iraq
1960	Chile, Colombia, Ghana, Senegal
1961	Lebanon, Mali, Democratic Republic of the Congo
1962	Liberia, Saudi Arabia
1963	Algeria, Bolivia, Côte d'Ivoire, Libyan Arab Jamahiriya, Syrian Arab Republic, Uruguay
1964	Cameroon, Gabon, Kuwait, Nigeria
1965	Costa Rica, Cyprus, Jamaica, Kenya, Madagascar
1966	Jordan, Panama
1967	Sierra Leone, Singapore, Uganda
1968	Liechtenstein
1969	Malaysia, Niger, Zambia
1970	Ireland
1972	Bangladesh
1973	Mongolia
1974	Mauritius
1976	Qatar, United Arab Emirates, United Republic of Tanzania
1977	Nicaragua
1983	Namibia
1984	China
1986	Zimbabwe
1992	Estonia, Slovenia
1993	Armenia, Croatia, Czech Republic, Lithuania, Slovakia
1994	The Former Yugoslav Republic of Macedonia, Kazakhstan, Marshall Islands, Uzbekistan, Yemen
1995	Bosnia and Herzegovina
1996	Georgia
1997	Latvia, Malta, Republic of Moldova
1998	Burkina Faso, Benin
1999	Angola
2000	Tajikistan
2001	Azerbaijan, Central African Republic
2002	Eritrea, Botswana
2003	Honduras, Seychelles, Kyrgyz Republic
2004	Islamic Republic of Mauritania, Togo
2005	Chad
2006	Belize, Malawi, Montenegro, Mozambique,
2007	Republic of Palau, Cape Verde
2008	Nepal, Papua New Guinea
2009	Bahrain, Burundi, Congo, Lesotho, Oman, Cambodia*, Rwanda

Total Membership: 151 (as of March 2010)

Eighteen ratifications were required to bring the IAEA's Statute into force. By 29 July 1957, the States in bold — as well as the former Czechoslovakia — had ratified the Statute.

*Year denotes year of membership. Names of States are not necessarily their historical designations. For States in *italic*, membership has been approved by the IAEA General Conference and will take effect once the necessary legal instruments are deposited.*

Note:

♦ The Democratic People's Republic of Korea (DPRK), which joined the IAEA in 1974, withdrew its membership on 13 June 1994.

*Cambodia, which joined the IAEA in 1958, withdrew its membership on 26 March 2003. It reapplied for membership in September 2009.



1959-Present

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