enhancing Radiation Protection

Over the past ten years, more than 90 countries—and the IAEA— reaped benefits from targeted efforts to safely expand use of nuclear technologies.

When a new radiotherapy center in Gezira, Sudan, delivers its first therapeutic dose to a cancer patient, two things happen: A young man begins to regain his health and looks forward to being better able to support his family and contribute to his community; and a developing nation realizes an important step toward deriving the social and economic benefits of nuclear science.

The strategic application of nuclear technology in particular fields—human health, industry, food and agriculture, energy, water resources and environmental protection—has enormous potential to help shape the future of developing countries. But past radiological incidents, several of which involved high levels of exposure or death (Bolivia, Brazil, Cost Rica, Georgia, Ghana, Morocco, Panama and Thailand), underscore the inherent and very serious risks.

For this reason, the IAEA's Departments of Technical Cooperation and Nuclear Safety and Security partner closely, particularly in the area of radiation protection.* They strive to consider every minute detail in the equation that brings together radiation sources, modern technologies, people and the environment.

Launched in 1996, the *Model Project on Upgrading Radiation Protection Infrastructure* (the Model Project) aimed to help Member States:

- achieve capacities that underpin the safe and secure application of nuclear technologies;
- establish a legislative framework and regulatory infrastructure;
- develop exposure control mechanisms to protect workers, medical patients, the public and the environment; and
- achieve preparedness and planned response to radiological emergencies.

In fact, the hospital scenario above typically marks several years of intense collaboration amongst scientists, legislators, regulators, politicians and administrators from both Member States and the IAEA, orchestrated and aided by regional managers and technical experts from the IAEA.

As radiation protection team members can attest, every application of nuclear technology carries special considerations and unique challenges. And each country is equally distinct in terms of needs, technical capacity, availability of financial resources and adequately trained personnel (at both regulatory and user organizations), and overall infrastructure. In reality, a task that initially seemed manageable turned out to be monumental and created steep learning curves for all parties involved.

Laying the foundation proves to be the biggest challenge

When the Model Project was launched, it was anticipated that a five-year implementation period would provide enough time for each participating country to achieve the five Thematic Safety Areas identified. It quickly became clear that both the IAEA and the participating States had seriously under-estimated the scope and scale of the work involved—particularly in terms of achieving Thematic

***Radiation protection** can be defined as the protection of people against exposure to ionizing radiation or radioactive substances and the safety of radioactive sources, including the means for achieving such protection and safety. It encompasses the various procedures and devices for keeping people's doses and risks as low as can be reasonably achieved and below prescribed dose constraints, as well as the means for preventing accidents and for mitigating the consequences of accidents, should they occur.

All told, more than 25 million nuclear imaging procedures were carried out across the world in the year 2000 for the diagnosis of disease. Optimizing patient protection is an on-going objective.

Safety Area 1: Establishment of a legislative framework and regulatory infrastructure.

Drafting legislation and corresponding regulations, navigating through parliamentary procedures, enacting new laws and establishing regulatory authorities that would hold responsibility for authorization, inspection and enforcement—for many Member States, building the infrastructure for nuclear technology was a very long walk through uncharted territory. To improve efficiencies and outcomes, the IAEA established a set of *Model Legislation and Regulations*—sample procedures for notification, authorization, inspection and enforcement, as well as for creating an inventory of radiation sources and installations. These models gave Member States with little or no infrastructure an important 'head start'; rather than starting from scratch, they could adapt these laws and regulations to meet their specific needs. At the same time, the models supported a consistent, harmonized and integrated approach on the global level.

Still, this phase of the project required continuous attention and action by senior officials in various ministries or government agencies; in many cases, these individuals might not have had any prior knowledge of or experience in nuclear science and technology. Even though formal government commitment was in place, there simply were not enough trained people on the ground to carry out the tasks or enough financial resources available to purchase necessary equipment or build the required facilities.

Moreover, the longer the process dragged on, the more obstacles it was likely to encounter. In some countries, political elections led to a change in administration. At a minimum, this meant bringing new ministers and officials on board; but the worst-case scenario—a complete realignment of government priorities that left radiation protection low on the list—was not uncommon. In other instances, instabilities related to social, economic or political issues, including national and/or regional conflicts and war, sidetracked initiatives that were already well underway. Sometimes, the regional managers even found themselves starting again from square one, with an entirely new team of players.

Regional managers also had to quickly adapt to other obstacles of a more general nature including institutional instability, general infrastructure weaknesses, inadequate support at the decision-making level, inability to recognize the magnitude of certain problems, and failure to mobilize necessary human and financial resources. On average, it took Member States six years just to achieve Thematic Safety Area 1, stretching the limits of both work schedules and budgets.

When it became apparent that establishing the legislative and regulatory infrastructure would require much more time than anticipated, the Model Project adapted again. Technical officers and regional managers began to undertake parallel activities in other areas, particularly the achievement of the control of occupational exposure, so that some technologies could be delivered quickly—and safely put into operation — once legislative and regulatory issues were resolved.

Measuring progress: Assessment and evaluation

As the Model Project expanded, it became increasingly obvious that the Agency needed to assess not only outcomes, but progress along the way. Technical officers and regional managers jointly developed and implemented a number of tools to provide both qualitative and quantitative measures, as well as to balance Agency and independent evaluations.

Approximately three years into the programme, the IAEA added a peer review to its assessment toolkit, primarily as a means of obtaining an independent evaluation. A typical peer review involves a team of four to six international experts who visit a country for several days and examine

all of the available information. The peer review is distinct in that it is: a) performed only at the request of a Member State; and b) directly linked to the provision of radiation sources. In essence, the peer review is an incentive for a country to meet principal requirements of the *International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources* (*Basic Safety Standards*) as a prerequisite for assistance in acquiring radiation-based technology. It is also a means by which a Member State proclaims that it is confident of having reached an adequate level of sustainability.

The IAEA introduced a comprehensive Radiation and Waste Safety Infrastructure Profile (RaWaSIP), which includes information on the country's infrastructure for safety in radiation waste and transport. First established in the late 1990s, these profiles collate findings from a number of sources (appraisal services, project monitoring missions, expert and self-assessment reports, data from official communication with counterparts, etc.). All of this material is fed into the RaWaSIP database from which it is possible to extract either country specifics or a regional overview of achievements in particular areas such as regulatory authority, occupational, medical and public exposure, transport of radioactive material and planning and preparedness for radiological emergencies.

Each profile also contains a narrative of the infrastructure status, as well as copies of relevant information (laws and regulations, mission reports, Country Safety Action Plans, etc.). The profiles provide the most accurate picture of any Member State's current status and feed into all the other assessment and evaluation exercises.

As time passed, the IAEA recognized the need to strengthen existing assessment tools by introducing more quantitative measures. In 2003, the IAEA established performance indicators that quantify specific aspects of progress achieved and link them directly to the criteria of the *Basic Safety Standards*. Take the example of creating an inventory of radiation sources. Previous evaluations might have noted that work in this area had "started" or "progressed", or was "complete". In contrast, the performance indicators assigned a numerical rating (zero to three) that clearly identifies precisely which "parameters" within inventorying have been achieved.

Performance indicators make it easier to track a Member State's progress in a particular area but are equally useful on the regional and global level. Statistical analysis can quickly reveal a general weakness within a particular Thematic Safety Area that requires attention.

But evaluation tools do much more than measure: Ongoing assessment creates the capacity for ongoing adaptation of action plans. Each time a project manager or a peer review team returns to a Member State, it is possible to quickly evaluate progress since the last visit and identify the next steps required.

Radiation Protection Model Project

Key Achievements , 1995-2005

% of participating countries achieving key steps

Promulgation of legislation compliant with *Basic Safety Standards* —or in the final stage of implementation	>80%
Adoption of regulations covering the most hazardous practices and compliant with principal requirements of *Basic Safety Standards*	>75%
Establishment of independent and duly empowered regulatory authority	65%
Recruitment of sufficient qualified personnel to discharge regulatory authority functions	60%
Established system of notification and authorization, operational for major practices and sources	>50%
Up-to-date inventory of radiation sources, covering major sources including Category 1 and 2	>70%
Established system for inspection, operational and covering major sources	>50%
Established system for occupational monitoring, at least for workers at higher exposure risk	>80%
Capability of (or access to) calibration of radiation monitoring instruments	>60%
Workplace monitoring in place	~50%
Central dose record system, at least for external occupational exposures	~80%
National strategy and programme for capacity building in the field of radiation and waste safety	>60%

Achievement to date facilitates a more strategic future

The programme reports high levels of achievement. Ninety-one Member States are participating, including four that have recently joined. Of the 87 countries participating at the time of the last report to the IAEA Board of Governors (9 November 2004), 48 (55%) had achieved essen-

Lithuania

A Model of Success and a Willing Mentor

When Lithuania emerged from the former Soviet Union in 1991, it faced a challenge common to other Eastern European countries: namely, that the mechanisms needed to support radiation protection were virtually non-existent. The regulatory system suffered from the lack of necessary facilities, equipment for regulatory activities and trained staff.

Mr. Albinas Mastauskas, director of Lithuania's Radiation Protection Center, credits the IAEA with helping his country identify needs and develop an action plan, which was implemented in 1995. A few years later, the country passed laws for radiation protection, environmental protection, nuclear energy, and radioactive waste management.

Safety in the nuclear energy sector is a particularly high priority for Lithuania: The Ignalina nuclear power plant produces 80% of the country's electricity. The Radiation Protection Center has a well-established radiation monitoring system, which includes environmental monitoring for radon — a naturally occurring radioactive gas that emanates from the ground into the air. Monitoring activities carried out in 1995–1998 identified some regions in which radon levels were higher than the national average. Since the gas is a risk factor associated with lung cancer, the homes, offices and public places in these regions are being carefully examined.

Linked to these initiatives is growing awareness that the Centre needs to improve communications regarding nuclear technology.

"Informing the public is a key part of our work and we are taking steps to bolster our public relations capabilities," says Mr. Mastauskas. This need came to the fore when a Russian fighter crashed in Lithuania in September 2005. "The public was demanding information as to the potential risks of depleted uranium surrounding the crash. They wanted to know: *What happened? Are we at risk? What are the authorities doing?"*

Mr. Mastauskas also encourages dialogue within the nuclear technology community. He hosts visitors from around the world, many from other small countries, who want to learn from Lithuania's experience. In each instance, Mr. Mastauskas emphasizes one particular need and one key message. "Without strong government support, the IAEA cannot render assistance. In a small country like Lithuania, collaboration is the key. We must work together," he says. "But you can never say you've finished; it's an ongoing process of problems and progress."

—Linda Lodding/Managing Editor

tial parameters signifying compliance with the requirements for attaining a regulatory structure and occupational exposure control. On a regional basis, the figures reported in November 2004 were as follows: Africa–12 countries (40%); Asia and the Pacific–15 countries (63%); Europe–13 countries (68%); and Latin America–8 countries (57%). These results herald the overwhelming success of a philosophical change and a more proactive approach in the IAEA's mode of operation.

"In the first 40 years of IAEA history, we held all the technology and we made all the decisions: we assessed technologies and told countries it would be a good idea for them to have such-and-such a piece of equipment," says Ana María Cetto, Deputy Director General, Department of Technical Cooperation. "Today, our main focus is on establishing the infrastructure for nuclear technology, period. That creates an opportunity for countries to come to us and demonstrate the strength of their infrastructure, describe their development goals and seek support for nuclear technologies that can contribute. The programme is no longer technology-driven, it's driven by identifying and addressing needs."

For most Member States and for the IAEA, the ultimate goal is still on the horizon. Although efforts are ongoing, most participating countries have yet to achieve desired results in all safety areas (exposure control of patients and the public, and capabilities for emergency preparedness and response).

But more than 90 countries around the world are now better prepared to shape their own futures through the safe and secure application of existing and emerging nuclear technologies. This will enable IAEA to better fulfil its mandate of promoting nuclear technology for peaceful purposes.

This new level of capacity allows the IAEA to direct more of its energy to the vital task of ensuring that safety and security standards and protection measures keep pace with the rapid advance of technology. Thus, the partnership between the IAEA Departments of Technical Cooperation and Nuclear Safety and Security is more critical than ever—and the potential for Member States to contribute knowledge they gain through experience in applying nuclear technologies adds an exciting new dimension to the future.