STRENGTHENING CAPABILITIES
SAFE USE OF RADIATION APPLICATIONS BEYOND 2000

BY PAULO M. C. BARRETTO

People are exposed to ionizing radiation in many different forms: Cosmic rays that penetrate earth's atmosphere, or radiation from soil and mineral resources, are natural forms of ionizing radiation. Other forms are produced artificially using radioactive materials for various beneficial applications in medicine, industry, and other fields.

The greatest concerns about ionizing radiation are tied to its potential health effects, and a system of radiation protection has been developed to protect people from sources of radiation. The promotion of radiation protection is one of the IAEA's main activities. Further, the application of Agency safety standards in bilateral or multilateral arrangements, such as through technical cooperation projects, is a statutory function. As a result, IAEA Member States have committed a great deal of financial resources and technical efforts in areas of radiation safety and protection.

This article provides an update of progress made through an IAEA Model Project.* It was designed to strengthen the infrastructures for radiation protection and the safety of radiation sources in its Member States. Included are perspectives on activities to date and challenges now facing the international community.

Historical Perspectives. From 1989 to 1998, the Agency disbursed over US $54 million in 97developing countries to assist them in strengthening their capabilities in radiation protection and safety of radiation sources. This effort represented the implementation of 1330 projects under which 4147 national scientists and technicians were trained in different aspects of radiation protection, hundreds of laboratories and calibration facilities were established, and a great deal of legislative and regulatory assistance was provided. The work to help build up national capabilities and infrastructures involved 2832 expert missions, training course lecturers, and consultants.

The overall investment since 1989 is higher -- US $78 million -- if assistance is included in related areas, such as the safe management of radioactive wastes and environmental protection associated with the design, construction, operation and decommissioning of nuclear installations.

Despite the investment, an Agency survey on radiation protection conducted in 1993 resulted in some disturbing conclusions. The survey, which covered Member States participating in the technical cooperation programme, found that at least 52 countries lacked an adequate radiation protection and safety infrastructure to meet Agency standards.

This finding particularly raised concerns since IAEA Radiation Protection Advisory Teams (RAPATs) had visited most of the 52 countries during the previous nine years. More than 60 missions were fielded from 1984-92. They not only assessed the prevailing conditions at the time, but also -- and more importantly -- advised national competent authorities on measures to strengthen their national radiation infrastructure. The findings made it clear that, for one reason or another, States were not following the Agency's advice. It was also evident that

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MEMBER STATES IN THE MODEL PROJECT ON STRENGTHENING RADIATION PROTECTION & SAFETY INFRASTRUCTURES

Africa	Europe	Latin America	West Asia	East Asia
Cameroon	Albania	Bolivia	Jordan	Bangladesh
Côte D'Ivoire	Armenia	Colombia	Kazakhstan	Mongolia
Democratic Rep. of the Congo	Belarus	Costa Rica	Lebanon	Myanmar
Ethiopia	Bosnia & Herzegovina	Dominican Republic	Qatar	Sri Lanka
Gabon	Cyprus	El Salvador	Saudi Arabia	Viet Nam
Ghana	Estonia	Guatemala	Syria	
Madagascar	Georgia	Jamaica	United Arab Emirates	
Mali	Latvia	Nicaragua	Uzbekistan	
Mauritius	Lithuania	Panama	Yemen	
Namibia	Former Yugoslav Rep. of Macedonia	Paraguay		
Niger	Moldova			
Nigeria				
Senegal				
Sierra Leone				
Sudan				
Uganda				
Zimbabwe				

the Agency's continuing provision of assistance and services, on its own, would not be enough to motivate countries to establish the basic legal and technical infrastructure in line with their use of nuclear applications. A new approach was needed, one that would ensure that factors which were posing stumbling blocks to the countries would be eliminated.

As conceived, the new approach would have to:

- go far beyond providing advice, training and equipment - which is the traditional way of delivering technical cooperation programmes and services. This meant that the Agency would work shoulder- to-shoulder with the counterpart in the Member State, and jointly undertake tasks such as drafting legislation, visits and briefings to ministers and members of the parliament, conducting training inspections, and developing training material.
- be effective in terms of implementation time - since it was advisable that the current situation should not persist for too long. Five years was taken as an adequate time in which to achieve major objectives, provided that the government would maintain its support throughout the implementation phase.
- be comprehensive enough to simultaneously cover, in an integrated manner, all necessary aspects of radiation protection and safety in the 52 countries.

This was certainly a formidable challenge to the Agency. Above all, since many actions would have to be taken at the national level, it was imperative to have a firm commitment at the highest governmental level from each participating country to adhere to both the time schedule and agreed action.

PUTTING INTO PLACE SOLUTIONS

The approach selected for putting solutions into place was a Model Project. These Agency technical cooperation projects must meet tough criteria --for example, they must respond to priority national and regional needs; they must receive strong government commitment; and they must produce clear benefits in line with national development objectives.

Within the IAEA technical cooperation programme, the Model Project approach is coupled with "Country Programme Frameworks" that identify priority activities in each developing country, and with "Thematic Planning" that singles out the most significant technical solutions for duplication across several Member States.

Significantly, the Model Project to strengthen radiation protection infrastructures was the first thematic plan to become operational. It originally started with six Member States. However, the 1993 survey had indicated that many more countries, about 52, needed help to build up their infrastructures for radiation protection and safety. Programme and management adjustments had to be made, or else it would simply take too

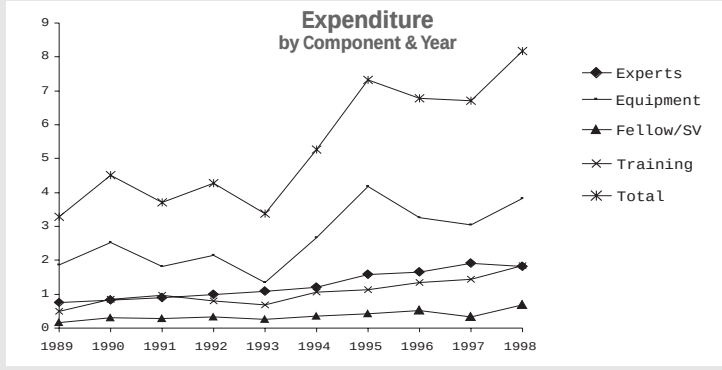
PROGRESS THROUGH TECHNICAL COOPERATION

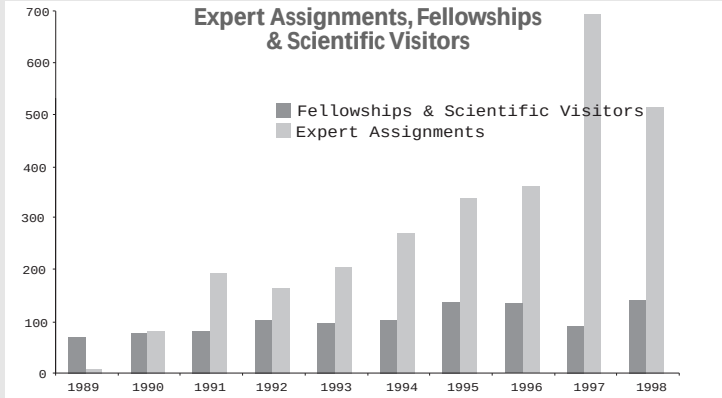
Percentage of States Implementing Elements of the Action Plan for the Model Project to Strengthen Radiation Protection and Safety Infrastructures

Action Plan Elements	1		2	3	4	5	6	7	8	9	10
Region (Countries)	**Legislation** *(in effect/ being approved)*	**Regulations** *(in effect/ being approved)*	**National Regulatory Authority** *(in place)*	**Notification Authorization, & Inspection** *(system in place)*	**Occupational Exposure Control***	**Medical Exposure Control****	**Public Exposure Control**	**Waste Management**	**Emergency Response Plan**	**Technical Support**	**Human Resource Development**
Europe (11)	82/-	46/9	73	63	73 (27)/55 (45)	55/64/55	45	64	45	45	63
Lat. Amer. (10)	89/11	78/11	78	89	78 (11)/44 (33)	22/45/12	63	11	11	44	78
West Asia (9)	33/56	22/44	22	11	67 (22)/- (89)	-	-	-	-	-	-
East Asia (5)	80/20	20/60	80	40	100 (-)/- (100)	-	-	-	-	-	-
Africa (17)	65/-	29/18	41	41	53 (18)/18 (59)	6/12/-	18	12	-	47	35
	1ST MILESTONE				***2ND MILESTONE***			***3RD MILESTONE***	***4TH MILESTONE***		

*Established or being implemented (% in parenthesis) for individual monitoring/workplace monitoring. **Established and fully operational for diagnostic radiology/radiotherapy/nuclear medicine. Additionally, medical controls exist but need upgrading in all regions to varying degrees, ranging from 4% of States in Africa for radiology to 100% of States in East Asia for radiotherapy.

TRENDS IN TECHNICAL COOPERATION FOR RADIATION PROTECTION & SAFETY, 1989-98





long to achieve improvements in all participating countries. The project today includes seventeen countries in Africa, eleven in Europe, ten in Latin America, nine in West Asia, and five in East Asia. *(See box, page 33.)*

Setting Milestones. The main elements of a national safety infrastructure include radiation protection laws and regulations; a clearly defined and independent regulatory authority, a system of notification, authorization and control; a national programme for monitoring of radiation workers; laboratories and methods for control of public exposures from environmental radiation and other sources; an inventory of radiation sources; radioactive waste management; a system of emergency preparedness and response plans; and a system of human resource development and training.

Once these elements were considered together with the requirements of the IAEA's *Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources* (BSS), an "action plan" was prepared for each Member State. Four

milestones were set to measure progress towards achieving the overall project objectives. They were:

- Regulatory control of radiation sources (covering inventory of sources, installations, laws and regulations, regulatory authority, supporting services, training of personnel, and system of notification, authorization, inspection and enforcement);
- Control of occupational, public and medical exposure (including individual dosimetry, environmental monitoring, and optimization of medical exposure);
- Radioactive waste control (including handling, transport, storage and disposal of radioactive waste, and monitoring and surveillance of radioactive waste management facilities);
- Emergency preparedness and response (including the establishment of a national programme for response to radiological emergencies).

The first milestone was expected to be the most difficult to be achieved and the one which would require longer time, since it involved drafting of legislation and approval by each country's Parliament and/or Congress. However it was essential to have a clear and unequivocal definition of responsibilities and authorities regarding nuclear matters and safety in the country to allow enforcement. Hence, legislative assistance was emphasized in these first three years of the project.

Although development of a mature infrastructure requires years of effective national implementation and continuous government support, action plans were prepared in such a way that the requirements of the BSS could be met within the time frame of five years or less.

Action Plans. Action plans are tailored to the individual needs of the participating Member States. Missing or deficient aspects in their safety infrastructures have been identified and documented, and the relevant corrective action introduced as one step in the country's action plan.

Hence the action plans have become a powerful management tool to identify radiation protection needs, obligations and responsibilities of each Member State and the actions needed from the IAEA. Each action plan assumes that governments and national authorities are prepared to comply with their obligations as described in the BSS. For this reason, firm commitments were sought and obtained and action plans were individually discussed and finalized. A formal approval of the respective action plan by the Member State was a pre-condition to start implementation. In this way, Member States would be firmly committing themselves not only to the legislative aspects but also to the requirements for human resources and financing.

Implementation Standards. The implementation of such a large and diversified project -- one involving the use of more than US $15 million -- demanded a balance between standardized measures and requirements and the particular considerations for each Member State. A number of procedures and methods were standardized on this basis. They included:

- Understanding and respect for national legal traditions to allow for local adaptation when establishing legal national infrastructures. For this purpose, the IAEA has prepared a guidance technical document. Others are being prepared. *(See box.)*
- Preparing and disseminating forms for notification, authorization, inspection and control of radiation practices, and associated checklists and procedures;
- Developing and disseminating a computer-based information system to be used by regulatory authorities and for the inventory of radiation sources. This was developed and implemented simultaneously in all 52 Member States.
- Training of personnel in a standardized manner, through national, regional, and interregional training events, taking into account the training being planned under the regional cooperative agreements for Africa, Latin America, and Asia and the Pacific to avoid duplication;
- Evaluating the effectiveness of measures taken in order to correct weaknesses and if necessary, adjust the action plans accordingly to maintain project momentum.

INDICATORS OF PROGRESS

The Model Project's implementation so far reflects consistent progress. Indicators show an increase of activities from 1995-98. *(See table and graphs, page 34.)*

For example, the level of expenditure in this field, which was US $3.5 million before 1994, has doubled to US $7 million. Similarly the assignments for experts, lecturers, and consultants increased from 200 per year before 1994 to more than 500 in 1998.

When evaluated by achievement of milestones, many Member States have already achieved the first milestone and have started implementing the other three. Accordingly, these States are the ones expected to achieve requirements of the BSS by yearend 2000.

Other Member States have had difficulties in implementing the project. These difficulties include economic problems, local and/or regional conflicts, political instability, lack of efficient organizations, lack of resources, weak national infrastructures, complex existing laws, and the failure of national authorities to recognize problems. These States have not yet been able to comply with their obligations, and it is not likely they can meet the minimum BSS requirements by yearend 2000.

The percentage of Member States that have completed the main elements of the Action Plan covers a wide range. Generally, the first four elements have been achieved or are being implemented across the board. Others, however, such as waste management regulations, transport regulations, codes of practices, and quality assurance programmes, have yet to be implemented in most of the participating countries. *(See table, page 34.)*

ACCELERATING THE PACE

In summary, significant progress has been made by States in establishing and/or upgrading the level of radiation protection through this Model Project. To date, about 70% of participating States have achieved at least the first milestone.

The extent to which other milestones can be accomplished through the year 2000 fully depends on each State's commitment to carrying out its responsibilities under the project.

Progress made so far is welcome. Clear, however, is that the pace of national actions needs to be accelerated so that more national capabilities will be improved to strengthen radiation safety in all participating States before the end of the year 2000. ❑

RADIATION SAFETY GUIDANCE

In support of the Model Project, the IAEA, through its Department of Nuclear Safety, is developing guidance documents covering key aspects ot radiation safety. Some have been published and others are in preparation, issued at this time in draft form. They include:

■ *Organization and Implementation of a National Infrastructure Governing Protection against Ionizing Radiation and the Safety of Radiation Sources* (TECDOC-1067, February 1999). It is oriented towards infrastructures concerned with the protection and safety of radiation sources used in medicine, agriculture, research, industry, and education. The document was jointly sponsored by the IAEA, Food and Agriculture Organization of the United Nations, Nuclear Energy Agency of the Organization for Economic Cooperation and Development, Pan American Health Organization, and World Health Organization.

■ *Establishing a National Regulatory Infrastructure for Radiation Safety*, a new Safety Guide being developed. It will specify the essential requirements of an appropriate regulatory infrastructure, with particular reference to the national regulatory authority. It also takes into account relevant matters contained in other planned guidance documents, including a Safety Requirement on legal and governmental infrastructures for nuclear, radiation, radioactive waste, and transport safety; and a Safety Requirement on preparedness and response for nuclear and radiological emergencies.

■ *Safety Assessment Plans for Authorization and Inspection of Radiation Sources*, a draft technical document in preparation. It describes methods and plans to facilitate safety assessments for the purpose of obtaining authorizations and for conducting safety inspections of operations involving radiation sources.

■ *Assessment by Peer Review of the Effectiveness of Regulatory Programmes for Protection Against Ionizing Radiation and for the Safety of Radiation Sources*, a draft safety report in preparation.