

# A Proactive Approach for Improving Radiation Safety

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## Abstract

An unprecedented international cooperative effort has been launched by the International Atomic Energy Agency (the Agency) to improve radiation and waste safety infrastructure in more than 80 countries within the framework of its Technical Cooperation Programme through the so-called Model Project on Upgrading Radiation Protection Infrastructure. The Model Project aimed to facilitate the establishment of an adequate radiation and waste safety infrastructure, compatible with the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources<sup>1</sup> (the BSS), in countries receiving Agency assistance. This paper describes the Agency's proactive approach used to design, carry out and assess the achievements of the Model Project.

## Background

By its Statute, the Agency is authorized to establish or adopt safety standards for the protection of health and minimization of danger to life and property, and to provide for the application of these standards to its own operations as well as to operations making use of materials, services, equipment, facilities, and information made available by the Agency. One of the main components through which these standards are applied is the Agency's Technical Cooperation (TC) Programme.

Since 1984, information specifically relevant to radiation safety infrastructure was obtained through more than 60 expert team missions undertaken by Radiation Protection Advisory Teams (RAPATs), follow-up technical visits and hundreds of individual expert missions undertaken within the framework of national, regional and/or interregional TC projects. Building on this experience and subsequent policy reviews, the Agency took steps to evaluate more systematically the need for technical assistance in areas of radiation, transport and waste safety. The outcome was the development of an integrated and proactive strategy designed to assess more closely needs and priorities and optimize resources for upgrading radiation and waste safety infrastructures in Agency's Member States receiving its assistance. The main components of this strategy consisted of (a) collecting and evaluating information on the existing safety infrastructure, establishing and maintaining for each of these countries a Radiation and Waste Safety Infrastructure Profile (RaWaSIP); and (b) formulating and implementing Radiation and Waste Safety Action Plans customized per country. The latter has been applied to rectify safety gaps and to sustain an effective radiation and waste safety infrastructure.

To implement the aforementioned strategy, the Agency, in 1994, included in its TC programme a Model Project on Upgrading Radiation Protection Infrastructures in Member States receiving its assistance.

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<sup>1</sup> FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANISATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, WORLD HEALTH ORGANIZATION, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, IAEA, Vienna (1996).

## **Project's Objective and Magnitude**

The main purpose of the Model Project has been formulated to facilitate Agency assistance to those countries, which have an inadequate radiation protection infrastructure and which might have been receiving Agency assistance, so that they could comply with the BSS.

It was originally envisaged, in 1994, that some five to six Agency Member States would benefit each year from the Model Project. However, material gathered indicated that more than 50 countries were in need of assistance. Hence, programme and management adjustments had to be made. An integrated management approach was thus developed with the aim of achieving adequate national radiation and waste safety infrastructures in the participating countries. In support of this approach, the Agency appointed five 'Regional Project Managers' for each of the regions: African, East Asian, West Asian, Latin American, and European. By the end of September 2004, the number countries being assisted through the Model Project had increased from 52 to 91. Each of these countries had its specific Radiation and Waste Safety Profile and relevant Action Plans or Work Plans.

## **Radiation and Waste Safety Profiles (RaWaSIP)**

The Agency, pursuant to its remit of promoting effective and sustainable national radiation and waste safety infrastructures for the control of radiation sources and the associated practices has, in recent years, developed an information tool which provides a summary of such infrastructures in countries receiving Agency assistance for which the BSS and other related standards are binding. This tool, the RaWaSIP, has been prepared using various sources of information such as end-of-mission reports, internal travel reports, appraisal missions such as the Radiation Safety and Infrastructure Appraisal (RaSIA), the Occupational Radiation Protection Appraisal Services (ORPAS), the Emergency Preparedness Review (EPREV) and the Transport Safety Appraisal (TRANSAS) as well as other relevant information made available through official correspondence and the Agency databases. The RaWaSIPs are intended, primarily, as a tool for: a) prioritizing assistance to a country; b) basic reference material for the relevant Agency staff; and c) for briefing material.. The RaWaSIPs have been, thus, of invaluable use to both the Agency and the Member States in terms of the development and maintenance of an adequate and sustainable radiation and waste safety infrastructure.

For each participating country, the RaWaSIP have been developed and updated as appropriate. The RaWaSIP covers the following main sections: i) regulatory infrastructure and activities of the regulatory authority; ii) occupational radiation protection; iii) radiation protection in medical exposures; iv) radiation protection of the public; v) transport safety; vi) emergency preparedness and response; and vii) education and training. The RaWaSIP have also recently been revised to include elements related to Country's implementation of the Code of Conduct<sup>2</sup>.

## **Assessment tools: Performance Indicators**

The Agency has identified the need for a concise, but nonetheless comprehensive scheme for the quantitative assessment of radiation safety infrastructure. The scheme is designed as a tool to evaluate the progress made in upgrading the safety and security infrastructure in a Member State, including the overall effectiveness of the regulatory framework. The objective is to enable a quantitative comparison of the infrastructure status in

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<sup>2</sup> INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2004, IAEA, Vienna (2004).

the participating Member States, with reference to the principal requirements of the BSS. A set of infrastructure-related parameters has been identified for this purpose. Quantifiable performance indicators have been introduced to measure the level of achievement for each infrastructure parameter. Assessment criteria have been adopted for each parameter in relation to the relevant requirements of the BSS and other related Agency safety requirements. The level of detail of these parameters and the corresponding performance indicators have been cross-referenced with information contained in the profiles and used for a qualitative assessment of the radiation safety infrastructure. In assigning a performance indicator to each parameter of a given milestone, the following scheme has been applied:

- Grade 0 = Criterion not met
- Grade 1 = Criterion partially met
- Grade 2 = Criterion partially met and an action plan is being implemented
- Grade 3 = Criterion met

Meeting the criterion is equivalent to full compliance with the BSS and related Agency safety requirements. This new methodology is currently being used for validation and follows the updated guidelines to achieve the given milestones.

### **Country's Radiation and Waste Safety Work Plans**

For all the participating Member States, Country Radiation and Waste Safety Work Plans have been developed from an analysis of the above-mentioned profiles against the requirements for an adequate safety infrastructure in accordance with the BSS. Work plans cover the following five milestones:

***Milestone 1: The establishment of a legislative and regulatory framework*** - the most time consuming activity, involving the drafting, approval and/or promulgation of radiation and waste safety legislation and regulations; the creation and empowerment of a national regulatory body; the establishment of a working system of notification, authorization and control of radiation sources together with the inventory of radiation sources and installations;

***Milestone 2: The establishment of occupational exposure control*** - that includes, *inter alia*, individual and workplace monitoring, dose assessment, quality management, ...etc;

***Milestone 3: The establishment of radiation protection in medical exposure*** - aiming at controlling exposure of patients in diagnostic radiology, radiotherapy and nuclear medicine, including the establishment of an appropriate quality assurance programme;

***Milestone 4: The establishment of public exposure control*** - covering radiation protection of the public and the environment. It includes programmes for the registration, control and safe disposal of radioactive waste, the control of consumer products containing radioactive substances, and environmental monitoring.

***Milestone 5: The establishment of emergency preparedness and response capabilities*** - involving the development of plans and the allocation of means to ensure the effectiveness of the national regulatory authority and other relevant organizations in dealing with different radiological emergency scenarios.

The implementation of milestones 2, 3, 4 and 5 is heavily dependent on the effective establishment of the first milestone. The work plans include tasks that are the responsibility

of the Member State, and tasks that are the responsibility of the Agency with an agreed timetable. The work plans cover both generic and specific activities. Generic activities apply to all countries and, as a first priority, cover notification, authorization, and control of all radiation sources including their inventory — whatever their use — within the country. Specific activities are tailored to each country's particular needs, such as staff training or the provision of necessary equipment.

The development of human resources through training is an important component of the model project. It involves not only training in nuclear technologies but covers administrators, regulators, radiation protection specialists, and medical personnel. The establishment and sustainability of a sound infrastructure for assuring radiation and waste safety depends to a considerable extent upon national capabilities in these areas.

### **Commitment by the Governments**

The Model Project presumes that governments and national authorities are prepared to comply with their obligations as described in the Preamble of the BSS. For this reason, firm commitments were obtained from all participating countries, while all countries work plans were discussed and finalized with, and then approved by relevant counterparts and authorities in each participating Member State. The implementation of the Country's Work Plan only starts after official approval from the Member State concerned has been obtained. As a result of this approach, Member States firmly committed themselves to establishing a national infrastructure, which includes *inter alia*: a) appropriate national legislation and/or regulations; b) a regulatory authority empowered and authorized to inspect radiation users and to enforce the legislation and/or regulations; c) sufficient resources and technical services and d) adequate numbers of trained staff.

### **Peer Reviews**

As the implementation of the work plans progresses, the Agency, at the Member States request, appraises the effectiveness of the measures taken at the different stages in order to facilitate the identification and correction of weaknesses as well as to optimize resources. For this purpose, a draft Safety Report entitled Assessment by Peer Review of the Effectiveness of Regulatory Programmes for Protection against Ionizing Radiation and for the Safety of Radiation Sources was developed. This document provides basic advice on the conduct of peer reviews using a methodology to obtain qualitative and quantitative information and on its analysis against performance criteria and indicators. The Peer Review missions were implemented during 1999 - 2003. During this period, 50 Model project countries were visited. The terms of reference for these missions were:

- to determine the status of radiation safety and assess the national regulatory infrastructure, in particular how it is established, organized and implemented;
- to determine how effective the Model Project has been in improving the situation in the country; and
- to submit findings, conclusions and recommendations, if any, for further strengthening of the national infrastructure for radiation protection and safety.

Based on the experience developed through the provision of safety services/appraisals and the Agency's Safety Series and technical guidance, new sets of appraisals were developed such as the RaSIA, the ORPAS and the EPREV.

### **Progress Achieved**

During implementation, project activities were continuously monitored, *inter alia*, through regular coordination and planning meetings with participating countries in each of

the five regions. The meetings provided opportunities for direct contact with persons having political responsibilities (ministers, deputy ministers, members of parliament, etc.) and executive responsibilities (chairmen of atomic energy commissions, directors of regulatory authorities, project counterparts, etc.) in their countries with a view to facilitating the implementation of the project. As a result of the peer review missions and project monitoring activities, the implementation status by the end of June 2004 (for 87 participating countries<sup>3</sup>) can be summarized as:

- A. Activities relating to milestone 1 were implemented with varying degrees of success:
  - i) more than 80% of the participating countries had promulgated legislation compliant with the BSS, or were in the final stage of implementation; ii) more than 75% had adopted regulations, covering the most hazardous practices, and compliant with principal requirements of the BSS; iii) 65% had established an effectively independent and duly empowered regulatory authority; iv) 60% of the participating countries had recruited a sufficient number of qualified personnel to discharge the regulatory authority functions; v) more than half had established a system for notification and authorization, operational for major practices and sources; vi) more than 70% had an inventory of radiation sources in place, covering major sources, including those of category 1 and 2; and vii) more than half had established a system for inspection, which was operational and covered the major sources. From the above figures, it may be concluded that about 60% had achieved the regulatory level of compliance presumed in the Preamble to the BSS by completing all activities foreseen under milestone 1. Considering the nearly six years of implementation, this specific level of achievement is much lower than originally expected. The time necessary to overcome some of the difficulties, already identified at the time of project design, was underestimated. Many countries did not attain milestone 1 for one or all of the following reasons:
    - long duration of legislative and regulatory procedures and institutional instability;
    - budgetary constraints, resulting among other things in a high turnover of qualified staff;
    - unfocused regulatory structures (overlapping of responsibilities);
    - limited regulatory independence and empowerment;
    - inadequate supplementary documentation;
    - authorization and inspection procedures and regulatory guides; and
    - insufficient financial and technical resources, trained staff, and support services.
- B. Where possible, some activities relating to other milestones, particularly milestone 2, were initiated in parallel with the implementation of activities for attaining milestone 1. The progress towards milestones 2 by the end of June 2004 can be summarized as follows: i) more than 80% of the participating countries had established a system for individual monitoring, covering workers at least at the higher exposure risk; ii) more than 60% had the capability of or access to calibration of radiation monitoring instruments; iii) around 50% had operational workplace monitoring in place; iv) nearly 80% had a central dose record system, at least for external occupational exposures; and v) more than 60% had a national strategy and programme for capacity building in the field of radiation and waste safety (however, in some instances, although such a programme was formally in place, significant national activities had been carried out in on an ad hoc basis).

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<sup>3</sup> By end of 2004, 91 Member States participate in the Model Projects but the status of the implementation in four countries acceding recently does not permit their inclusion in this evaluation.

Substantial parts of the activities relating to milestones 3, 4, and 5 are still to be implemented by most of the participating countries. Furthermore, tools are still being developed for the appraisal of the progress made in the areas of medical and public exposure control, as well as in the development of national plans for response to radiological and nuclear emergencies.

## **Current and Future Activities**

A substantial benefit resulting from the Model Projects has been the development and strengthening of regional expertise, networking, and postgraduate educational and training courses in radiation safety. The interest in and the awareness of the Model Projects have led to the unprecedented active engagement of governments, at the government and regulatory authority levels, and of end-users in efforts to comply with the principal requirements of the BSS. The Agency is and will continue building on the success of the Model Projects approach in order to ensure the sustainability of radiation protection infrastructures in Member States and will expand this proactive approach in response to new guidance stemming from the Code of Conduct and recent developments related to safety standards. .

To this end, the Agency has defined a vision to guide the design, planning, prioritization and delivery of future projects and actions to realize this vision. The vision is to achieve effective and sustainable national regulatory infrastructures for the control of radioactive sources in all Agency Member States. This requires a strategy for the systematic strengthening and acceleration of ongoing work, focused on: encouraging Member States to engage in periodic appraisals and self assessments; strengthening the education and training of regulatory staff; and encouraging stakeholder involvement, networking and information exchange. By expanding regional cooperation, self-reliance and networking, and further promoting the “train-the-trainer” approach, the success and sustainability of infrastructures for the control of radiation sources should be greatly enhanced.

## **Conclusions**

Substantial progress has been made in upgrading the radiation safety infrastructures in most participating countries. The establishment and development of regulatory frameworks and a system for occupational exposure control in the majority of participating Member States is indicative of the Model Projects’ success. With respect to the results achieved, the participating countries may be divided into the following groups:

- (a) Countries, which have participated in the Model Projects since the inception, and have further advanced in project implementation. These countries, which account for a vast majority of the original group of 52 Member States, have attained milestones 1 and 2 and have succeeded in implementing several activities related to milestones 3, 4 and 5.
- (b) Countries, which have participated in the Model Projects since the inception, where there have been some implementation delays. These countries still need to complete the revision of existing legislation and to establish or restructure the existing radiation regulatory framework or upgrade a national programme for occupational exposure control.

(c) Countries, which joined the Model Project in 1996, with persisting major implementation delays. The delays were attributed to several reasons, such as difficulties due to institutional instability, severe general infrastructural weaknesses, inadequate support at the decision-making level, changes in national programme priorities, inability to recognize the magnitude of certain problems, and failure to mobilize the necessary national human and financial resources. These countries, which account for a very small fraction of the original 52 countries, have not attained even milestone 1.

(d) Countries, which joined the Model Projects in January 2001, with seemingly more developed infrastructure. Model Project activities for these countries have focused primarily on attaining milestones 3, 4 and 5. In several cases, however, gaps have been identified in essential elements of infrastructure, relating to milestones 1 or 2. Such gaps continue to be bridged by authorities of the Member States concerned through their increased commitment and project assistance. Country specific work plans, relating to milestones 3, 4 and 5, for this group, were initiated and endorsed in 2001.

(e) New Member States of the Agency, which joined the respective regional Model Projects in 2001 or later. Project activities for these countries have focused on essential elements of infrastructure (milestones 1 and 2).

The new vision of the Agency in this context is to achieve effective and sustainable national safety infrastructures in all Agency Member States compatible with the BSS and other Agency Safety Guidance. The strategy is being focused on key elements such as: i) encouraging the States to engage in periodic appraisals and self-assessments; ii) by expanding regional cooperation, self-reliance and networking; and iii) further promotion of the “train-the-trainer” approach.