Radiation Protection in the World

Harmonization in Radiation Protection and Safety —IAEA Programme in Radiation Protection—

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I INTRODUCTION

The International Atomic Energy Agency (IAEA) prepares safety standards based on its Statute. According to this, the IAEA is authorized “to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for the application of these standards.”

The IAEA safety standards consist of:

1. Safety Fundamentals, which present the fundamental safety objectives and principles of protection and safety;
2. An integrated and consistent set of Safety Requirements that establish the requirements that must be met to ensure protection of people and the environment, now and in the future; and
3. A set of supporting Safety Guides that provide recommendations and guidance on how to comply with the Safety Requirements.

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. The IAEA Statute makes the safety standards binding on the IAEA in relation to its own operations and also on States in relation to IAEA-assisted operations. Although not obligatory, many States adopt the IAEA safety standards as the basis of their governmental, legal and regulatory framework.

One of the most widely recognized IAEA safety standards is the International Basic Safety Standards (BSS). The BSS is a Safety Requirements document that applies to all facilities and all activities that give rise to radiation risks and covers all exposure situations and categories of exposure. The BSS was first published in 1962 and the most recent edition was approved by the IAEA Board of Governors in September 2011. In keeping with its statutory obligations and in view of the importance of radiation safety for other international organizations, the BSS is jointly sponsored by other international organizations.

A series of safety guides to provide guidance on implementing the requirements in the BSS are currently being developed. These safety guides present accepted international best practices and provide recommendations and guidance to help users in achieving a high level of safety. Three general safety guides deal with protection of workers, protection of patients and protection of the public and the environment, respectively. Other safety guides are also being developed, with some of key issues being addressed in these safety guides discussed below.

This article informs about the programme of the IAEA Radiation Safety and Monitoring Section of the Division of Radiation Transport and Waste Safety in the area of radiation protection. It describes several selected items in area of radiation protection of public, workers and patients from exposures received from activities using ionizing radiation.

Programme in radiation protection

In the Radiation Safety and Monitoring Section of the Division of Radiation Transport and Waste Safety, an extensive work programme is in place to develop radiation protection standards to protect people and the environment from both natural and artificial sources of radiation and to assist Member States with the application of these standards. The work programme also includes provision of radiation safety technical services to support the IAEA’s own operations as well as the provision of assistance to Member States.

Radiation protection of the public

Public exposure to both natural and artificial sources of radiation represents a large percentage of the worldwide collective dose from all sources. This exposure can be received as a result of planned exposure situations (such as from human imaging for non-medical purposes), emergency exposure situations (through unplanned releases of radionuclides to the environment) and existing exposure situations. Existing exposure situations most often involve exposure due to natural sources of radiation, but can also involve exposures due to artificial or man-made sources. The individual doses from natural sources of radiation can vary by several orders of magnitude, from a few tens of microsievert [μSv] from natural radioactivity in the diet up to several hundred millisierville [mSv], or higher, from radon in the home. Many of the exposures to natural sources of radiation are unamenable to control, except as a result of lifestyle choices. Thus the...
Radiation protection of patients

The exposure of patients is by far the largest type of exposure to the world’s population from man-made radiation sources. It has been estimated that the number of medical procedures using radiation grew from about 1.7 billion in 1980 to almost 4 billion in 2007. 4 Too little or too much absorbed dose is problematic and the risk of any given procedure ranges from negligible to potentially fatal. Radiation protection of patients must deal with the issues of not having dose limits, purposely exposing sensitive subgroups, and purposely using doses that could cause deterministic effects. Furthermore, radiation accidents involving medical uses have accounted for more acute radiation deaths than from any other source, including accidents involving nuclear facilities and industrial accidents. 5

There is no doubt that the application of ionizing radiation and radioactive substances in diagnostic, interventional and therapeutic procedures in medicine is beneficial for hundreds of millions of people each year. However, employing radiation in medicine has to involve a careful balance of the benefits of enhancing human health and welfare, and the risks related to the radiation exposure of people. In its programme and activities related to radiation protection of patients, the IAEA aims to help reduce unnecessary and unintended medical exposures in practice.

Unnecessary exposure of patients can arise from medical procedures that are not justified for a specified objective, from the application of procedures to individuals whose condition does not warrant such intervention, and from medical exposures that are not appropriately optimized for the situation in which they are being used. Unintended exposure of patients and medical staff can arise from unsafe design or inappropriate use of medical technology.

In order to form a coherent strategy for strengthening radiation protection of patients globally, an international conference was held in 2001 in Malaga, Spain. On the basis of the conference, an action plan for international work was established.6 The IAEA has progressed several important issues included in this action plan over the last number of years, such as the long-term tracking of individual patient exposures (the SmartCard/SmartRadTrack project), the international campaign on strengthening justification of medical exposure in diagnostic imaging (AAA-Awareness (effective communication about risk), Appropriateness (up-to-date referral guidelines), and Audit (clinical audit of justification)), Retrospective Evaluation of Lens Injuries and Dose (RELID) in interventional cardiology, and reporting of safety related events in medical applications through the web-based reporting systems Safety in Radiation Oncology

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2 As well as the IAEA, the Working Group consists of representatives of the European Commission (EC), the Codex Committee on Contaminants in Foods (CCCF), the Food and Agriculture Organization (FAO) of the United Nations, the OECD NEA and WHO; the ICRP participates as an observer.
Radiation protection of workers

The objectives of the IAEA occupational radiation protection programme is to promote an international harmonized approach for optimizing occupational radiation protection through developing safety standards for reducing radiation exposures in the workplace and providing for the application of these standards.

The Safety Guide on Occupational Radiation Protection is under development jointly with ILO. This Safety Guide will follow the revised BSS 7) and the 2007 recommendations of the ICRP 8) and combines five existing safety guides on occupational radiation protection. The draft version of the Safety Guide was presented to the Radiation Safety Standards Committee for review in November 2013.

Radiation protection on Naturally Occurring Radioactive Materials (NORM) is an important part of occupational radiation protection. Recently, two Safety Reports on NORM have been published: one on Radiation Protection and NORM Residue Management in the Phosphate Industry; and the other on Radiation Protection and NORM Residue Management in the Titanium Dioxide and Related Industries. The International Conference on Radiation Protection on NORM (NORM VII) was held in April 2013, Beijing China with the cooperation of IAEA. The proceedings of the Conference will be published in 2014.

Networking is one important approach for enhancing occupational radiation protection. Currently, IAEA and OECD NEA jointly operate the Information System on Occupational Exposure (ISOE). ISOE is a forum for experience exchange for occupational radiation protection in nuclear power plants. The ISOE-IAEA Technical Centre represents the non-OECD Member States with nuclear power plants. Based on the principle of ISOE, an Information System on Occupational Radiation Protection in Medicine, Industry and Research (ISEMIR) is under preparation. The development for an information system on uranium mining has been initiated.

Regional ALARA networks are also an effective way to facilitate the radiation protection optimization in different regions. Currently, the IAEA supports the following regional ALARA networks:

- Asian Region ALARA Network (ARAN)
- Regional East European and Central Asian ALARA Network (RECAN)
- Latin American ALARA Network (ReProLaM)

The current challenge for the ALARA networks is to continue to guide stakeholders over the next number of years on the efforts that are necessary to strengthen radiation protection in medicine.

The second International Conference on Occupational Radiation Protection will be held in Vienna, 1–5 December 2014. The conference is organized by IAEA and co-sponsored by ILO and in cooperation with OECD/NEA, EC, WHO and other international organizations. A decade after the first conference which held in 2002 in Geneva, challenges still remain on occupational radiation protection in general, and especially in the fields of medicine and in NORM industries. This second Conference has the following objectives:

- To exchange information and operating experience
- To review advances, challenges and opportunities since the 1st Conference
- To identify areas for future improvement
- To formulate conclusions and recommendations
Radiation safety technical services

Through its laboratory programmes and worldwide networking capabilities, Radiation Safety Technical Services Unit (RSTSU) functions as a technical platform for individual and workplace monitoring in support of the IAEA Technical Cooperation (TC) with Member States. There are several focal points in the programmes including:

- Technical Services
- Training packages
- Laboratory accreditations
- Back-up agreements between laboratories

RSTSU provides Technical Services as Technical Officers (TO) for TC projects in Member States and regions. Professional services are provided to a variety of workers and managers that include regulators, service providers, and radiation protection staff. Technical areas for assistance encompass power generation, mining and materials processing, waste management, and emergency and remediation actions. IAEA cooperation efforts make use of different modalities including expert advice, fellowships, meetings, training courses, workshops, standardized training material, and IAEA publications. Each of these may be implemented at all levels from specific workplaces to national and regional bodies.

Training courses and packages promote the implementation of IAEA safety standards. Training packages include lecture plans and notes, teaching slides and other aids, practical exercises, exam questions, references, a bibliography, and, if applicable, materials for on-the-job training. Some training packages are available on CD, others are on-line and they are available in different languages.\(^1\) Examples of training packages include:

- Assessment of Occupational Exposure Due to Intakes of Radionuclides
- Assessment of Occupational Exposure Due to External Radiation Sources
- Neutron Monitoring
- Workplace Monitoring
- Quality Management Systems
- Safety Culture in Radiation Safety

Specialized training courses are also available for presentation by IAEA staff members in the subject areas of quality management and regulatory oversight. Training courses are usually held over one to two weeks.\(^2\)

The IAEA radiation monitoring and protection services maintain accreditation in accordance with the quality management requirements of ISO/IEC 17025.\(^3\) The Quality Management System has been developed and subsequently accredited so that it may serve as a model for services in Member States. Accredited areas include individual monitoring, workplace measurement techniques and equipment calibration. The IAEA offers Member States inter-comparison exercises for radiation monitoring techniques.

Reciprocal back-up agreements are maintained with laboratories in the event of loss of services at the IAEA or at the back-up laboratory. Those laboratories must maintain the same level of Quality Management as in the IAEA laboratory. These agreements also serve to promote and contribute to accreditation and intercomparison activities.

As an example of current activities, there is a regional project “Strengthening National Capabilities for Radiological Protection of Workers and Occupational Exposure Control” that includes 32 European countries. The project was initiated following a self-assessment by Member States that revealed a need to ensure competencies and capabilities were available to fully comply with IAEA requirements.

The project encompasses major components of a radiation protection programme including regulatory infrastructure, technical capabilities, and trained staff. In the frame of this project the IAEA role is to:

- Conduct regional workshops on the basic requirements of a quality management system and accreditation program;
- Conduct a regional training course and workshop to raise awareness, interact, exchange information and promote modernization of protection frameworks;
- Provide training to experts from Member States on the health and the safety of radiation workers occupationally exposed to ionizing radiation;
- Conduct expert mission services to Member States;
- Assist in evaluating:
  - Individual monitoring programmes for external and internal radiation.
  - Workplace monitoring programmes.
  - Quality management systems and the accreditation programme.

This example provides a reasonable summary of the cooperation opportunities available in RSTSU since it encompasses many of the programme areas.

III CONCLUSIONS

The programme and activities of the Radiation Safety and Monitoring Section aim to contribute to the strengthening of radiation protection safety in Member States and to contribute to the harmonization of radiation protection nuclear safety approaches worldwide. The existing programme covers all facilities and activities of use of ionizing radiation and sources, in any human activity that may cause people to be exposed to radiation risk due to exposure to naturally occurring or man-made sources. The aims of this programme can only be effectively achieved through recognition of safety standards and guides, and through their implementation in legislation of Member States. This effort will also significantly benefit from the cooperation with other specialized international organizations as well as other parties involved in application of the standards in particular practices.

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