

NATURAL RADIATION AT WORK: CURRENT AND FUTURE IAEA ACTIVITIES

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1 ABSTRACT

The International Atomic Energy Agency has two statutory safety functions : (a) establishment of standards of safety for protection of health and minimization of danger to life and property, and (b) the provision for the application of these standards to its own operations or at the request of a Member State. The Agency's Occupational Radiation Protection Programme aims at harmonizing occupational radiation protection infrastructures for the control of radiation exposure of workers and for optimizing radiation protection in situations of exposures due to external radiation and intakes of radionuclides from both artificial and natural sources of radiation.

Under its Regular and Technical Co-operation (TC) Programmes, the Agency has been assigning high priority to both the establishment of safety standards for "labour conditions" and for the application of these standards through, inter alia, direct assistance under the TC Programme, the rendering of services, the promotion of education and training, the fostering of information exchange and the coordination of research and development.

It has been recognized that further practical guidance is needed in IAEA Member States on the control of exposure to natural radiation, in particular, work with materials containing elevated levels of natural radionuclides. The purpose of this paper is to describe the current and future activities within the IAEA Occupational Radiation Protection Programme in answer to the needs for guidance on occupational radiation protection against natural radiation in workplaces in IAEA Member States.

2 INTRODUCTION

The International Atomic Energy Agency (hereafter referred to as the Agency or the IAEA) is unique among international organizations concerned with radiation protection issues as having a statutory function to "establish or adopt ... 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 basic requirements for radiation protection against exposure to ionizing radiation of workers, members of the public and patients are given in the *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources* (hereafter referred to as the BSS).

The objectives of the Agency's Occupational Radiation Protection Programme are to encourage the global harmonization and optimization of occupational

radiation protection in situations of exposures due to external radiation and intakes of radionuclides from both artificial and natural sources of radiation; and to have in place and ensure compliance with operational health and safety measures prescribed by the Agency on its premises and in occupational activities under its supervision or control.

The occupational radiation protection standards for restricting radiation exposures in the workplace are developed mainly in collaboration with the International Labour Office (ILO). The provision for the application of such standards is done, inter alia, through:

- providing direct safety assistance to Member States, mostly through the Agency's Technical Co-operation Programme;
- fostering the exchange of safety related information;
- promoting education and training in safety related subjects;
- supporting safety related research and development; and
- rendering, on request, a range of safety related services.

Historically the IAEA has conducted different activities related to occupational exposure to natural sources, such as international meetings, co-ordinated research programmes and development of safety publications, several of these activities in co-operation with other international organizations. In the 1980s several publications on radiation protection in the mining and milling of radioactive ores were issued. The following years the programme took into account the growing concern about radon exposure in all underground uranium and non-uranium mines, and also as a consequence of the processing of phosphate ore and monazite.

3 CURRENT ACTIVITIES

Safety Standards

The Agency's Safety Standards Series comprises three levels of documents: Safety Fundamentals, Safety Requirements, and Safety Guides.

The Safety Fundamentals, *Radiation Protection and the Safety of Radiation Sources* (1), explain the approaches to radiation protection and safety for persons in senior political or regulatory positions and persons who, although not safety specialists, make decisions relating to the uses of radiation in medicine, industry, agriculture and other areas. The Requirements, *BSS* (2), deal with the basic requirements which must be met in order to ensure the safety of particular activities. The written style of the BSS is of a regulatory nature so that States may adopt them, at their own discretion, as national regulations.

A set of three Safety Guides concerning the application of the BSS to the control of occupational exposures has been developed in a coordinated fashion. They are co-sponsored by the ILO and were published in English in Autumn 1999. They will be available in all IAEA official languages.

The Safety Guide on *Occupational Radiation Protection* (3) gives general advice on the exposure conditions for which monitoring programmes should be

set up in order to assess workers' radiation doses arising from external radiation and from intakes of radionuclides. It addresses the technical and organizational aspects of the control of occupational exposures, in situations of both normal and potential exposure.

The supplementary Safety Guide on the *Assessment of Occupational Exposure Due to External Sources of Radiation* (4) contains guidance on establishing monitoring programmes for external exposure, the appropriate dosimetric techniques to be used for individual and workplace monitoring and the interpretation of results. The second supplementary Guide on *Assessment of Occupational Exposure Due to Intakes of Radionuclides* (5) addresses the assessment of exposure due to intakes of radionuclides in the workplace.

While the recommendations in these three Safety Guides are intended for regulatory authorities, they are also useful to employers, to management bodies and their special advisers, to health and safety committees concerned with the radiation protection of workers and to those responsible for the operation of individual monitoring programmes. These Guides have also been published on CD-ROM together with the BSS (2) and the Safety Fundamentals (1) as an interlinked set of searchable documents, called ORPGUIDE (6).

In addition a Safety Guide on *Occupational Radiation Protection in the Mining and Processing of Raw Materials* is in the process of being finalized. This Safety Guide presents guidance on the principles and requirements for the establishment of occupational radiation protection programmes in the mining and processing of raw materials, and is based on these three Safety Guides. It is a joint publication of the IAEA and the ILO, updating and expanding on the contents of the joint IAEA/ILO/WHO Code of Practice and Technical Addendum on Radiation Protection of Workers in the Mining and Milling of Radioactive Ores which was published by the IAEA in 1983 as Safety Series No. 26 (7).

The 1983 edition of Safety Series No. 26 covered only administrative and practical radiation protection aspects, and was aimed principally at uranium and thorium mines and processing facilities. The present Safety Guide also includes provisions for the authorization of mining and processing activities involving radioactive ores, for inspection and compliance, and for necessary measures in the event of non-compliance with the conditions of authorization. In addition, more coverage is given to mines and processing facilities other than those exploiting uranium or thorium which, for radiological reasons, may require some form of regulatory supervision.

The main purpose of this Safety Guide is to provide practical guidance for regulatory authorities on meeting the requirements for the radiation protection of workers involved in the mining and processing of raw materials. This Safety Guide will also be useful to employers, licensees and registrants, to management bodies and their specialist advisers, and to safety and health committees concerned with the radiation protection of workers. It may also be used by workers and their representatives in support of safe working practices.

As with the BSS, the guidance in this Safety Guide should be interpreted to take account of the scale and complexity of installations (in this case mining and ore processing facilities), of technical resources, and of other factors that will determine the potential for application, such as the levels of activity of the ore body and the particular minerals extracted. The scope of the radiation protection program should be commensurate with the nature and extent of the radiation hazards involved. It is also recognized that radiation protection is only one component that should be addressed to assure the overall health and safety of the worker. The radiation protection program should be established and managed in close co-operation with those responsible for other health and safety disciplines such as industrial hygiene, industrial safety and fire safety.

The provisions of this Safety Guide apply in the first instance to the mining and processing of radioactive ores, to mines and processing facilities extracting uranium or thorium as by-products, and to uranium and thorium underground exploration and activities for mine development. The provisions of this Safety Guide also apply, as appropriate, to other mining and associated processing operations where exposures due to external radiation, radon or thoron progeny, or dusts may require control. For example, analogous problems may arise in parts of the phosphate industry. The provisions of this Safety Guide in the case of other mining and processing operations apply to occupational radiation hazards, especially in underground mines and also in processing of other minerals and raw materials where radiation exposures to workers require control. Public exposure is not within the remit of this Safety Guide.

The provisions apply specifically to the occupational radiation hazards arising from operations such as exploration, removal and excavation of ore; siting, construction and operation of a mine or of a facility for physical and chemical processing of ore; and decommissioning or close out of a mine or processing facility. They may also be applied to other secondary processing facilities, where the concentrations of uranium, thorium and their progeny in the ore or waste streams are deemed likely to give rise to occupational exposures requiring control. The management of waste from the mining and milling of uranium and thorium ores is subject of another IAEA publication under development.

Other guidance

Complementary advice on specific topics is published as Safety Reports (previously called Safety Practices). Three Safety Reports related to occupational exposure from natural sources of radiation are at present under development. One of these, the Safety Report on *Radiation Protection against Radon in Workplaces other than Mines* will be presented in another paper given at this Conference.

A Safety Report on *Protection from Occupational Radiation Exposure due to Thorium in Industrial Operations* has been developed to provide practical guidance to those with responsibilities for the management of employees potentially exposed to thorium and thorium containing materials, and also for

relevant regulatory authorities. The emphasis in the present draft of this Safety Report is on radiation protection in industrial operations where exposure to thorium may occur, typically including applications such as gas mantle production, processing of monazite to produce rare earths, the production of thorium compounds, the processing and use of titanium and zirconium bearing minerals (commonly referred to as heavy mineral sands), and the separation and concentration of tin and tantalum minerals. This Safety Report was recently reviewed by a Technical Committee Meeting, which proposed some restructuring (see below).

A Safety Report on *Radiation and Waste Safety in the Oil and Gas Industry* is close to being submitted for publication. The purpose of this Safety Report is to outline the issues associated with radiation and waste safety in the oil and gas industry and to promote a common understanding between the industry and regulatory authorities. It is intended to propose guidelines based upon best practice in the industry and the application of the BSS (2).

The emphasis in this Safety Report is on describing the advanced technologies associated with the various oil and gas industry sectors as well as some of the most common applications of radioactive materials and radiation generators. It is thus intended to provide guidance: to ensure the radiological health, safety and welfare of workers; regarding the management of radioactive waste; and regarding training in radiation safety. It relates to matters affecting public health and environmental concerns and forms a framework within which the regulatory authorities of Member States, oil and gas field operators, service companies and workers will have a common understanding.

This Safety Report presents applications of ionizing radiations to work at onshore and offshore oil and gas industry facilities, transport and distribution systems, and service company bases. The equipment, facilities and working methods appropriate to the following work are discussed: industrial radiography, including underwater radiography; installed gauges including those used to make level and density measurements; portable gauging equipment; well logging including measurement while drilling techniques and wireline; work with radiotracers; NORM (naturally occurring radioactive material) accumulation, decontamination and disposal; radioactive waste management; and accidents.

Training

The Safety Report on *Radiation and Waste Safety in the Oil and Gas Industry* formed the basis for a group Training Course, held in Syrian Arab Republic in October 2000, with the participation of 41 persons from 12 countries and representing regulatory authorities as well as the industry.

Services

Several international and regional intercomparison exercises have been completed and in 2001 an intercomparison of measurements of *activity* of radionuclides in simulated human organs and an intercomparison for the determination of the *activity* of alpha-emitting radionuclides in human urine samples started. The intercomparison exercises have highlighted the need to

harmonize occupational radiation monitoring approaches and methodologies. The Agency is therefore developing a service for the appraisal of the monitoring of occupational radiation protection in Member States.

4 FUTURE ACTIVITIES

It was concluded by the Agency's International Conference on Topical Issues in Nuclear, Radiation and Radioactive Waste Safety in 1998, that further practical guidance is needed on the control of exposure to natural radiation, in particular work with materials containing elevated levels of natural radionuclides and exposure of air crews to cosmic rays. Also, a Peer Review Group recommended in 1999 that a review be carried out in Member States to provide the information needed to decide which industries are primarily affected and which industrial processes and materials require control as a priority. These recommendations are supported by the data presented in the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2000 Report, estimating that occupational exposure from natural radiation contributes to more than 80 percent of the worldwide annual collective dose from occupational exposure, uranium mining excluded (8).

Recommendations of a Technical Committee Meeting May 2001

In May 2001 an IAEA Technical Committee Meeting on *Assessment of Occupational Protection Conditions in Workplaces with High Levels of Exposure to Natural Radiation* was organized. The meeting, attended by 23 participants from 16 countries, produced a comprehensive inventory of problem areas, made an assessment of the magnitude of the problem and proposed a draft action plan for the Agency, taking into account the available Agency publications on this issue as well as services provided to Member States.

The final recommendations of the meeting are summarized as follows:

1 The IAEA should review their approach for dealing with the NORM issue as a sector approach. The meeting suggests the development of a sector based comprehensive approach, including waste management, transport, and downstream uses.

2 The IAEA should create, in priority order, individual sector specific Safety Reports for: Metals (including Thorium), Zircon, Phosphates, Pigments (TiO₂), Coal and Coal Ash, Fluorospar. The existing Safety Report on Protection from Occupational Radiation Exposure due to Thorium in Industrial Operations should be edited to refocus on Monazite and Rare Earth ores.

Each Safety Report should have a similar format and deal with the following issues: Ore/feedstuff grades (radionuclide content); radiation protection aspects of mining, processing and maintenance; waste management and waste recycling; decommissioning; public/environmental aspects of mining and processing; transport of waste/products; and downstream uses. The target audience for the Safety Reports should primarily be the user, but should also

include the regulator. They should be created as a co-operative venture between the regulator, industry, consultants, industry associations and the IAEA. It is proposed to include data collection projects, where no data is presently available, by Co-ordinated Research Programmes.

3 The Agency should provide guidance in the following areas:

- Identification of potential problem workplaces, including the conduct of surveys to identify radon prone areas;
- Measurement techniques, protocols, occupational exposure assessment and assessment of the need for remedial measures (including optimization of actions);
- Remedial and preventive actions;
- Establishment of a regulatory framework for the control of radon in workplaces, including allocation of responsibilities of the employer and the national authority.

4 The Agency should develop a training program for regulatory authorities and experts, targeted at Member States that have not yet taken action on radon control.

5 The Agency should develop a program of support action in relation to radon control, as follows:

- Co-ordination of international radon intercomparison exercises
- Provision of a regionally based calibration support service
- Provision of technical assistance in relation to: development of a regulatory framework; and identification of potential problem areas/surveys/interpretation of existing data.

Technical assistance given to developing countries for the development of radon measurement techniques and needed facilities should be based on the principles of sustainable development. It is noted that track etch detectors are widely used throughout the world and involve relatively little technology. With spot sampling techniques for measurement of radon and radon daughters, surveys of larger areas can be covered in a short period.

6 The Agency should co-ordinate international and regional initiatives for the exchange of information and experience. Such initiatives might include: meetings on occupational radon control (combined with NORM issues); and the use of internet for the dissemination and exchange of information and training.

7 The meeting recommended the Agency to address a number of common issues, including the need to define radioactive ore for the purpose of determining the applicability of radon action level in mines and to provide an action level for Thoron. The IAEA should also consider developing guidance on intervention and practices as applicable to NORM and review existing publications, to investigate as to whether dose assessment techniques and

strategies are adequate to cover all mining situations, and if not to provide further guidance. The Agency should provide guidance on how quality control for ensuring reliability of doses should be carried out in a real mine environment.

8 The Agency should, in co-operation with the ILO, develop a single guidance document to address the following:

- The regulatory system should recognize radiation hazards that could occur at mines other than uranium mines. There could be more than one way of accommodating this into a regulatory system, and guidance is needed in doing this.
- Need for guidance on how Member States will identify, by means of surveys or by other appropriate means, work activities which may be of concern, and on who should be responsible for carrying out such surveys and assessments. This in turn implies a need for data on exposure levels in mining and processing worldwide.
- Need for education, training and awareness on radiation protection principles.

9 The meeting supported the proposal made by a previous meeting that the Agency should provide guidance on exposures to air crews and strongly recommended that this be done in co-operation with the European Commission.

10 The IAEA should encourage the harmonization of the use of practical/pragmatic dose criteria for NORM.

The report of the Technical Committee Meeting is being brought to the attention of the IAEA Board of Governors and the IAEA General Conference in 2001. Based on the recommendations an action plan will be formulated and it is expected that the occupational radiation protection programme will change to accommodate the proposed activities.

Conference on Occupational Radiation Protection in 2002

The complex issue of controlling occupational exposure to natural sources of radiation will also be addressed during the first International Conference on Occupational Radiation Protection, which will be held at the Headquarters of the ILO in Geneva, Switzerland, from 26 to 30 August 2002. The Conference is convened jointly with the ILO, hosted by the Government of Switzerland, cosponsored by the European Commission and held with the co-operation of the OECD/NEA and the WHO.

The objective of the Conference is to foster the exchange of information on current issues related to the exposure of workers to ionizing radiation in the course of their work and to formulate recommendations, as appropriate, regarding measures to strengthen international co-operation in occupational radiation protection. The Conference will address the issue of establishing occupational radiation protection standards and providing for their application. It

will focus on a number of specific problems.

The Conference is aimed at: governmental officials involved in occupational radiation protection matters including representatives of regulatory authorities; workers and employers involved in the use of radiation sources and in the operation of installations containing or handling radioactive materials; radiation protection experts, researchers and persons responsible for occupational monitoring services; and manufacturers of radiation emitting apparatus and other radiation sources. Representatives of workers' and employers' organizations as well as other interested parties would also find this conference of interest. More information can be found under:

<http://www.iaea.org/worldatom/Meetings>

5 CONCLUSIONS

It is expected that the recommendations made by the Technical Committee Meeting held in May 2001 will lead to changes in the IAEA Occupational Radiation Protection Programme to include more activities on natural radiation sources. Also the outcome of the International Conference on Occupational Radiation Protection to be held in 2002 will impact on this programme change.

Further information on the IAEA radiation protection programmes can be found in the webpage:

www.iaea.org/ns/rasanet/

6 REFERENCES

1. 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, Radiation Protection and the Safety of Radiation Sources, Safety Series No. 120, IAEA, Vienna (1996).
2. 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).
3. INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR
4. OFFICE, Occupational Radiation Protection, Safety Standards Series

No. RS-G-1.1, IAEA, Vienna (1999).

5. INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, Assessment of Occupational Exposure Due to External Sources of Radiation, Safety Standards Series No. RS-G-1.3, IAEA, Vienna (1999).
6. INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, Assessment of Occupational Exposure Due to Intakes of Radionuclides, Safety Standards Series No. RS-G-1.2, IAEA, Vienna (1999).
7. ORPGUIDE, Safety Standards Series, IAEA, Vienna (2000) (CD-ROM).
8. INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANISATION, WORLD HEALTH ORGANIZATION, Radiation Protection of Workers in the Mining and Milling of Radioactive Ores, 1983 Edition, Code of Practice and Technical Addendum, Safety Series No. 26, IAEA, Vienna (1983).
9. UNITED NATIONS, Sources and Effects of Ionizing Radiation (2000 Report to the General Assembly with Scientific Annexes), Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2000).