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FINDINGS AND RECOMMENDATIONS OF THE INTERNATIONAL CONFERENCE ON OCCUPATIONAL RADIATION PROTECTION: PROTECTING WORKERS AGAINST EXPOSURE TO IONIZING RADIATION

This first International Conference on Occupational Radiation Protection, hosted by the Government of Switzerland, was organized by the International Atomic Energy Agency (IAEA), which convened it jointly with the International Labour Organization (ILO). It was co-sponsored by the European Commission (EC) and held in co-operation with the World Health Organization (WHO) and the OECD Nuclear Energy Agency (NEA) and also with the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the International Commission on Radiological Protection (ICRP), the International Commission on Radiation Units and Measurements (ICRU), the International Electrotechnical Commission (IEC), the International Radiation Protection Association (IRPA) and the International Society of Radiology (ISR). It was held at the Headquarters of the ILO, Geneva, from 26 to 30 August 2002.

With so many organizations involved in the field of occupational radiation protection, it proved useful to clarify in a briefing session their interlocking responsibilities. The ILO has an overall responsibility for occupational safety and health which it discharges in the radiation protection context mainly through the promotion of Convention 115, which has been ratified by, and has thus become binding on, 47 countries; the ILO is also a co-sponsor of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS) and of other international radiation safety-related standards. The IAEA has a statutory responsibility for establishing standards of safety for protection against the negative effects attributable to radiation exposure, including such standards for labour conditions, and also for providing for the application of those standards. It has been establishing such standards, which have included the BSS, for more than 40 years. The standards are now at three levels - fundamentals, requirements and guides. In addition, it has a major programme for strengthening radiation protection infrastructure which now covers 82 countries. The EC also has competence in radiation protection, through the 1957 Euratom

Treaty, and issues basic safety standards through Directives that are binding on the Member States of the European Union. WHO is a directing and co-ordinating authority on international health within the United Nations (UN) system. Under its mandate and in collaboration with other UN bodies and with non-governmental organizations (NGOs), WHO conducts health risk assessments of radiation exposure, promotes research and provides advice to national authorities. NEA, although a co-sponsor of the BSS, does not issue standards but concentrates on building consensus in the development of international recommendations, and it operates the Information System on Occupational Exposure (ISOE) jointly with the IAEA. Another important organization is UNSCEAR, which estimates the levels and effects of radiation exposure for the UN General Assembly and thereby establishes the scientific basis for standards for the entire UN system. The ICRP is an NGO whose recommendations have been the basis for all the standards issued by the organizations mentioned earlier, and together with its sister organization, ICRU, it has developed definitions of quantities and units for basic and operational measurements. Professional societies are also important in this area, and both IRPA and the ISR co-operated in the Conference.

The overall message to come from the opening presentations was that, in general terms, occupational radiation protection over the past few decades has been a success story for the international radiation protection community. Global information from UNSCEAR and the ISOE, supported by many detailed national studies, has revealed solid downward trends in many key performance indicators, primary among which are the annual average dose and the annual collective dose, but also indicators such as the number of workers exposed to high doses and the number of accidents and overexposures. It is worth noting, however, that most of these data relate to the nuclear fuel cycle; the picture is not so clear or encouraging for exposures in medicine and industry, nor for exposures to natural sources, especially in the mining of ores other than uranium. This is important, as these are the principal types of exposure globally.

The main findings of the Conference were as follows:

On the topic of standards for radiation protection, the feeling was that the standards developed at the international level now in place are generally satisfactory as a framework for the control of occupational exposures in developed and developing countries. Changes to the standards should not be made for change's sake but only to fill gaps, to improve clarity, to facilitate application and to clearly improve protection. It was noted that changes can often have unexpected side-effects and can lead to lack of confidence in the radiation protection system.

With particular reference to the current consideration by ICRP of a revision of its recommendations and so far as occupational exposures are concerned, major modifications do not seem necessary. However, some problems should be addressed. A worldwide agreed standard for restricting individual radiation doses is essential, be it called "dose limit" or "action level", but optimization is the main tool for efficient dose reduction and could be strengthened by defining case-specific dose targets or reference dose levels. The management of occupational exposure to natural radiation deserves careful attention in the future system. Terminology, especially the definitions of "risk" and "detriment", should be clarified.

Risks to workers from typical levels of rates of exposure to radiation of a few mSv/a are comparable to those from exposures to other hazardous substances (including carcinogens) in the workplace and - due account being taken of differences in life-shortening impact - to other hazards at work. Continuous exposures near the dose limit would, however, involve risks comparable to those in recognized high-risk occupations. These circumstances justify the

attention being paid to the management of higher individual doses, but do not mean that attention to routine dose levels can be relaxed. It is also relevant that there is a general downward trend in exposures to other hazards. In this respect, the continued use and expansion of international mechanisms for facilitating application of the fundamental principle of optimization of occupational radiation protection (i.e. that such protection should be the best under the prevailing circumstances) - for example, ALARA[1] Networks - should be encouraged.

Exposures of workers in conventional radiology, both radiodiagnosis and radiotherapy, are generally well controlled. There are, however, new areas of medical practice, especially interventional radiology, in which very high exposures are received. Ensuring that sufficient attention is paid to the control and reduction of such exposures requires continued efforts in post-graduate education and in awareness-raising of the medical professionals involved. The participation of health physicists in the implementation of optimization programmes in interventional radiology is strongly recommended.

Natural radiation is an inescapable feature of life on earth to which everyone is exposed while at work. It is necessary, therefore, to decide which exposures to natural radiation need to be considered from a radiation protection viewpoint by defining what exposures are amenable to control by the employer. Once this has been decided, workers exposed to natural radiation should be given the same level of protection (optimized) as those exposed to artificial radiation. As with artificial radiation, the focus should be on those exposed to the higher levels. Clearer guidance is needed to assist regulatory authorities in deciding what activities to regulate and how to apply a suitable graded approach to regulation, and here a clear international definition of "radioactive substance" is needed.

In industrial and research facilities, the average occupational doses are generally quite acceptable. There are, however, specific types of work that involve both high routine exposures and a number of accidents; predominant among this is industrial radiography, which is often carried out in difficult environments by unsupervised workers and where safety relies largely on procedures and human performance. Analyses of accidents have identified the major cause as failure to follow procedures, especially to use alarm dosimeters and source position monitors. This has been known for many years, but the message is not getting across to the persons responsible. Some key factors that might improve the situation are: the targeting of regulatory pressures; more involvement on the part of qualified experts (see the relevant requirement in the BSS); appropriate and continuing training of operators; and wide availability of information on accidents and lessons learned. As regards the last-mentioned factor, the completion and improved availability of publications and databases such as the Radiation Events Database (RADEV) are strongly encouraged.

Occupational radiation protection in the nuclear fuel cycle has received more attention than occupational radiation protection in any other practice. The main driving force for occupational exposure control has been application of the optimization (ALARA) principle, which is now part of normal job planning and almost second nature. The results over the past few decades in terms of reductions of all indicators - average doses, collective doses per unit energy generated and numbers of people receiving high individual doses - are well documented. International databases and mechanisms such as the ISOE and ALARA Networks are very important in maintaining this situation. Concern is still warranted over the

[1] "ALARA" is used here as an acronym for the ICRP recommendation on the optimization of radiation protection – namely, that radiation doses be kept as low as reasonably achievable, social and economic considerations being taken into account.

control of exposures of itinerant workers and contractors. They are subject to divided responsibilities as between employers and licensees, and may even work across national boundaries. It was noted that there is a move towards more personal control of workers over their own working arrangements, including radiation protection, facilitated by personal alarm dosimeters. Both of these aspects make the inculcation of optimization or ALARA awareness at the individual level even more important. It may be "eye-catching" to add it to the three traditional protection considerations so that they become "time, distance, shielding and awareness". More emphasis should also be given to the aspect of optimization relating to the prevention of accidents. A potential problem may arise because of the delays in decommissioning, which will result in loss of direct knowledge of facilities. Demonstration of compliance with international standards could be facilitated by international guidance on what represents good compliance in the nuclear industry, and indeed in other industries.

The decreases in average and collective doses may not be sustainable in the face of changes in work requirements, especially those associated with the termination of practices currently being performed, with the decommissioning of facilities and with end-of-life provisions. Note should be taken of the increasing age of workers in many areas and of the need to manage the generation change through the recruitment and training of younger workers.

Radiation protection should be seen as an integral part of general health and safety regulation and management systems in the workplace.

There should be no difference in standards of protection between developed and developing countries. Differences could impose higher occupational risks on populations already subject to high risks and allow promoters of practices to relax protection. In addition, for the sake of credibility, international standards must be applied uniformly.

The principle of the optimization of protection (ALARA) is the cornerstone of radiation protection in the workplace. It is important to recall that it relates not only to engineering or physical protection measures, but also to aspects such as safety organization and management, safety culture and safety training, many of which are associated with minimal costs and improvements in other areas - "win-win optimization". It is not in line with optimization to devote substantial resources to the reduction of small risks. In this respect, occupational doses below 1-2 mSv/a may not warrant regulatory scrutiny. As optimization necessarily involves social and economic factors, its objectives are related to local circumstances.

There remain problems in both the formulation and the application of standards for the protection of pregnant workers and the embryo and foetus. International attention to this very important practical area is needed.

Dosimetry for monitoring occupational radiation doses from external X and gamma radiation is well developed thanks, to a considerable extent, to international intercomparison programmes. There are still technical difficulties in neutron dosimetry, but these have been under study for some time. In the monitoring of internal contamination dosimetry, some difficulties could be overcome if laboratories concentrated on estimating intakes - as required by standards - using internationally agreed protocols to then estimate committed doses.

Because scientific advances can be rapid, even though changes in the scientific consensus may evolve more slowly, it is important that regulatory structures for occupational radiation protection be able to respond. Often, political procedures and changes in primary legislation are very slow, so primary legislation should be "enabling" rather than numerically detailed.

The regulatory authority for occupational radiation protection should be effectively independent. This means that it should be adequately staffed and funded, have the necessary knowledge and autonomy in taking regulatory decisions and not be subject to inappropriate influence from any side - particularly promoters and politicians. Nonetheless, the regulator may need to become involved with employers and workers in developing solutions to radiation protection problems.

There should be more and better involvement of stakeholders[2] - including workers, employers, regulators and professionals - in arriving at occupational radiation protection decisions and in their implementation in the workplace. In some cases, stakeholders, especially workers, may require training and assistance so as to be able to play the role that corresponds to their importance. Mechanisms for assessing stakeholder satisfaction should be developed and used. Stakeholders' problems of understanding are exacerbated by the complexity of the terminology and by terminological differences among different organizations, conventions, standards, etc.

For nuclear power plants, the ISOE is a very useful mechanism for disseminating information, examples of good practice and lessons learned. There are no similar mechanisms in other areas, and it would be helpful to develop complementary systems.

A substantial proportion of all occupationally exposed workers will develop diseases similar to those developed by members of the general public, including cancers. The vast majority of those diseases will not be attributable to radiation exposure at work, and some mechanism to decide on attributability is essential. In several countries, mechanisms using probability of causation schemes based on dose records and agreed risk factors are in use. These schemes, which need to be agreed between employers and workers, can provide for rapid and appropriate compensation to workers or their dependents. At present they are piecemeal, often not covering all the workers even in countries where they are operating. International guidance on the formulation and application of probability of causation schemes is clearly needed. Dose reconstruction is an essential component of compensation schemes, which must address the problem of uncertainty regarding doses and must be evidence-based. The international organizations need to continue discussions directed towards the preparation of guidelines for assisting countries that are interested in establishing compensation schemes, in the establishment of which stakeholder involvement is highly desirable. The international organizations also need to encourage international co-operation in epidemiological studies of workers.

In the light of the above findings, a number of specific recommendations for action emerged from the Conference. They are as follows:

- The international organizations should avoid unnecessary changes in standards of occupational radiation protection, so that regulatory stability can be maintained and implementation carried through.

- The international organizations should harmonize and, if possible, simplify their terminologies and their interpretations of requirements, especially those set out in conventions (including ILO Convention 115) and standards. Given the statutory responsibilities and the long tradition of the IAEA in the relevant field, this organization may wish to take the lead in an international harmonization effort. As

[2] The word "stakeholder" is used to mean all parties interested in occupational radiation protection.

part of this effort, the internationally recommended quantities and units should be used worldwide.

- To achieve the goal of better integrating radiation protection with general health and safety, the IAEA, with its specific radiation safety remit, and the ILO, with its overall worker safety remit, should consider collaborating more closely, especially in establishing and strengthening occupational radiation protection in developing countries.

- To achieve better dissemination of information and lessons learned into the medical, industrial and mining areas, the international organizations should consider whether systems similar to the ISOE could be established for these areas.

- The international organizations should consider producing a package of information and training material designed to enable workers to fully participate as stakeholders in all aspects of radiation protection.

- The international organizations are encouraged to make widely available in appropriate forms, including via the internet and in local languages, analyses of and lessons learned from accidents in industry to increase awareness and encourage responsible and safety-conscious behaviour among management and workers.

- The IAEA should initiate the formulation of detailed practical guidance to assist regulators in deciding what occupational exposures are unamenable to control. This guidance should be incorporated into recommendations for establishing which industries involving exposures to natural sources of radiation should be subject to control as practices, including advice on graded approaches to regulatory requirements that are nonetheless compatible with protection from artificial sources.

- The international organizations should develop guidance on the formulation and application of probability of causation schemes for the compensation of workers for radiation-induced occupational diseases.

- Many of these recommendations, and also a number of measures to strengthen occupational radiation protection globally, could be implemented if the international organizations, especially the IAEA and ILO, formulated and implemented an international action plan for occupational radiation protection.

6 September 2002