National Infrastructures for Radiation Safety

Towards Effective and Sustainable Systems

Proceedings of an international conference
Rabat, 1–5 September 2003

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NATIONAL INFRASTRUCTURES
FOR RADIATION SAFETY:
TOWARDS EFFECTIVE AND
SUSTAINABLE SYSTEMS

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ORGANIZED BY THE
INTERNATIONAL ATOMIC ENERGY AGENCY
IN CO-OPERATION WITH THE
WORLD HEALTH ORGANIZATION,
INTERNATIONAL LABOUR OFFICE,
OECD NUCLEAR ENERGY AGENCY AND
EUROPEAN COMMISSION,
HOSTED BY THE GOVERNMENT OF MOROCCO
THROUGH THE UNIVERSITY MOHAMMED V, AGDAL
AND HELD IN RABAT, 1–5 SEPTEMBER 2003

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FOREWORD

The use of ionizing radiation is widespread and virtually indispensable to modern society. For example, over 2.5 billion X ray examinations are conducted annually in the world. About 7000 electron accelerators are used for medical applications and materials enhancement; about 7000 ion accelerators are used for ion implantation; and hundreds of ion accelerators are used for applications, such as medical isotope production and medical therapy. About 12 000 industrial radiography sources are supplied annually; more than 10 000 medical radiotherapy units are in use; and about 300 irradiator facilities containing powerful radioactive sources are used for industrial applications.

In addition to the many benefits afforded by the beneficial uses of radiation, there are also associated hazards, such as industrial accidents, medical overexposures, disposal of radioactive waste, environmental radioactivity, accidents from 'orphan' sources, and malevolent uses. For example, 'orphaned' radioactive sources have been melted accidentally into recycled metals on about 60 occasions in 20 countries, and accidental exposures to orphan sources have caused many accidents worldwide involving serious injury and loss of life. Even where there is a good infrastructure, such as in the United States of America and the European Union, hundreds of sources have been lost. Customs officials, border guards and police forces have detected numerous attempts to smuggle and illegally sell stolen sources. For example, the IAEA Illicit Trafficking Database includes over 280 confirmed incidents since 1993 that involved radioactive sources. In today's global societies, a problem in one country can have repercussions in many other countries. Therefore, it is essential for every country to have adequate infrastructures to ensure the safety and security of all radiation sources, including X ray machines, accelerators, sealed radioactive sources, radioactive waste and environmental radioactivity. A balance needs to be achieved whereby the hazards of radiation are controlled without severely reducing the benefits.

The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS) were developed by the Food and Agriculture Organization of the United Nations (FAO), the IAEA, the International Labour Organisation (ILO), the OECD Nuclear Energy Agency (OECD/NEA), the Pan American Health Organization (PAHO) and the World Health Organization (WHO). The BSS were published by the IAEA in 1996 as Safety Series No. 115, and they indicate to the IAEA what infrastructure is needed. National infrastructures would need to include:

- — Legislation and regulations;
- — A regulatory authority empowered to authorize and inspect regulated activities and to enforce the legislation and regulations;
- — Sufficient resources;
- — Adequate numbers of trained personnel.

In addition, national infrastructures need to provide:

- — Ways and means of addressing societal concerns which extend beyond the legal responsibilities of the legal persons authorized to conduct practices involving sources of radiation;
- — For the control of sources of radiation for which no other organization has responsibility;
- — Adequate arrangements to be made by those responsible for the education and training of specialists in radiation protection and safety, as well as for the exchange of information among specialists. A related responsibility is to set up appropriate means of informing the public, its representatives and the information media about the health and safety aspects of activities involving exposure to radiation and about regulatory processes;
- — Facilities and services that are essential for radiation protection and safety, but are beyond the capabilities required of the legal persons who are authorized to conduct practices.

The IAEA has been working intensively to help Member States establish proper infrastructures. For example, 88 Member States are participating in the IAEA's technical co-operation Model Project for Upgrading Radiation Protection Infrastructure.

In order to consolidate the gains of the Model Project and to provide a complete picture of the current situation around the world, the IAEA organized this international conference on National Infrastructures for Radiation Safety: Towards Effective and Sustainable Systems in Rabat, Morocco, from 1 to 5 September 2003, in co-operation with the WHO, the ILO, the OECD/NEA, the European Commission and PAHO.

The IAEA gratefully acknowledges the co-operation and support of the organizations and individuals involved in this conference and, in particular, His Majesty King Mohammed VI, the Government of Morocco through the University Mohammed V, Agdal, for hosting this conference which was

attended by 346 participants and 37 observers from 108 countries, including 11 non-Member States, who were supported by extrabudgetary contributions from the Government of the USA. The conference findings and recommendations are included in these Proceedings, along with the keynote addresses, rapporteurs' summaries of contributed papers and the discussions. The contributed papers and presentations are available on a CD-ROM that is attached to the back of this volume.

CONTENTS

FINDINGS AND RECOMMENDATIONS
(Closing Session)

FINDINGS AND RECOMMENDATIONS OF THE CONFERENCE PRESIDENT*

1. BACKGROUND

The International Conference on National Infrastructures for Radiation Safety belongs to a series of conferences and other activities aimed at implementing international standards for radiation safety and the security of radioactive sources.

In 1994, the IAEA Board of Governors and the corresponding bodies of five other co-sponsoring organizations approved the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the BSS; IAEA Safety Series No. 115), which established international requirements relating to, among other things, regulatory frameworks and the safety and security of radioactive sources. The BSS require governments to establish national infrastructures for the proper control of radiation sources, including systems of notification, authorization, inspection and enforcement. Also, the IAEA launched an unprecedented international technical co-operation effort, through the 'Model Projects on Upgrading Radiation Protection Infrastructure', to help Member States establish national radiation and waste safety infrastructures compatible with the requirements of the BSS. Through the Model Projects, the IAEA has been implementing a proactive and integrated approach to identifying and meeting Member States' infrastructure needs.

A prerequisite for the approval by the IAEA Board of Governors of technical co-operation projects involving sources of ionizing radiation are effective measures for ensuring "(t)he adequacy of proposed health and safety standards for handling and storing materials and for operating facilities" in recipient Member States (Article XI.E.3 of the IAEA Statute). Consequently, the Model Projects, in which 88 Member States are now participating, are essential for the peaceful utilization of ionizing radiation in recipient countries.

The *International Conference on National Infrastructures for Radiation Safety* was organized by the IAEA in co-operation with the World Health Organization (WHO), the International Labour Organization (ILO), the European Commission, the OECD Nuclear Energy Agency (OECD/NEA), and the Pan American Health Organization (PAHO)

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* The views and recommendations expressed in this summary are those of the President of the Conference and the participants, and do not represent those of the IAEA.

2. MAJOR FINDINGS AND RECOMMENDATIONS

(1) There was agreement among the participants that the Model Projects had assisted many countries in establishing appropriate laws and regulations and regulatory authorities empowered to authorize and control practices involving radioactive sources, but much more work needs to be done. The Model Projects have promoted a common understanding with regard to the need for sound radiation safety frameworks and strong regulatory authorities. They have also helped to minimize the possibility of illicit trafficking in radioactive materials in participating countries. The key challenges identified in the Conference were: the lack of human and financial resources in participating countries; delays in promulgating necessary laws; and institutional instability. Speakers indicated that, as the Model Projects move forward, there should be greater emphasis on the maintenance of radiation source inventories and on continued capacity-building, and that there was a need for greater political will to implement radiation protection requirements. The Model Project approach, which has proved to be so successful, should continue, with due consideration to the experience gained in the implementation of the Model Projects.

(2) Assistance should be provided not only to countries that are IAEA Member States but also to countries that have not yet joined the IAEA, so that all can ultimately have sound infrastructures for the safety and security of radiation sources. A new international initiative under the aegis of the IAEA may be needed in order to accomplish this, with the international community making the necessary extrabudgetary resources available to the IAEA. At the same time, the IAEA Secretariat should continue to encourage countries that are not Member States to join the IAEA, providing them with all necessary information.

(3) The conference recognized that the structure of the Model Projects was created nearly ten years ago and considered whether any major changes were needed in order to accommodate recent developments, the most important of these being increases in concern about the security of radioactive sources, the publication of the revised Categorization of Radiation Sources and the approval of the revised Code of Conduct. It was recognized that some clarification was needed as to the meaning of the concepts ‘safety’ and ‘security’; some speakers regarded them as almost synonymous, while others considered them to be different but complementary. Overall, it was concluded that compliance with many of the BSS requirements relating to the safety of sources had increased source security, but that compliance with new requirements in the revised

Code of Conduct was now necessary. There was strong support for the integration of additional security requirements, especially those emanating from the revised Code of Conduct, into the relevant IAEA programmes. At the same time, the opportunity should be taken to emphasize — in activities relating to Milestone 4 — the importance of the safety of radioactive waste management, and particularly the importance of the safe management of Category 1 and 2 sources throughout their lifetime, from manufacture to disposal. In this connection, with many countries storing conditioned radium sources there was a call for the concept of regional disposal facilities for such waste to be re-examined in the light of the new security implications of temporary storage at many different locations. The Conference noted the need to balance transparency requirements for safety and emergency preparedness against confidentiality requirements for the protection of sensitive security-related information. Advice to Member States on how to handle this issue is needed.

(4) The key request from all participants was that the IAEA manage the transition of radiation safety infrastructures to sustainability in a positive manner, so that there would be no loss of IAEA assistance. Preference was expressed for a regional or sub-regional approach, so that the benefits of synergism, harmonization and networking might continue and be increased. Throughout the conference, emphasis was placed on the importance of networking as an effective means of improving co-operation and fostering an integrated safety approach. Networks can facilitate exchanges of knowledge and experience among regulators, radiation protection personnel and professional societies, helping to create “critical masses” of professionals in individual countries.

Networks can also be used for communicating with workers. They can have databases such as the ISOE, they can be primarily scientific, like EURADOS, or they can focus on interactions among groups of specialists fostered through professional societies and the ALARA networks. Overwhelmingly, networking was recognized by participants as a very effective instrument for enhancing the sharing of knowledge and experience — a key to the prevention of accidents and to implementation of the ALARA concept. Networking can facilitate the transition from dependence to self-sufficiency and sustainability, so it should be promoted and become an integral part of international co-operation. Conference participants noted the importance of the relevant scientific and professional societies in supporting the IAEA’s efforts to promote the control of sources. To ensure the sustainability of networks, it is important to create an environment within which they can flourish; they should therefore be adequately supported by international organizations. Existing successful networks should be examined with a view to identifying ways of improving their coverage as regards regions, languages, topics and stakeholder involvement.

(5) It was noted that there are various strategies for building and strengthening radiation safety infrastructure, including strategies for education and training in the safety and security of sources. The Conference urged the international organizations concerned to ensure co-ordination in the implementation of those strategies, taking into account activities included in relevant action plans.

3. ADDITIONAL FINDINGS AND RECOMMENDATIONS

The additional findings and recommendations of the conference related to a number of specific areas, as follows.

3.1. Improving implementation of the Model Projects

An important issue was the continuity of assistance. Some countries may well in due course meet all the Model Project requirements and 'graduate', while some countries have started participating only recently and others will start participating if the plans to extend the benefits of the Model Projects to non-Member States of the IAEA come to fruition thanks to the availability of extrabudgetary resources. Most participating countries, however, are at an intermediate stage, having met some of the Model Project requirements, mainly those associated with Milestones 1 and 2. Given this situation, the importance of continuity was stressed. There will be a need to accommodate "new entrants", it being recognized on the basis of lessons learned from implementation of the Model Projects, regarding, inter alia, the time taken to promulgate enabling legislation or establish regulatory authorities, that the time frame will probably have to extend for 5–10 years after the "new entrants" start participating. As regards 'graduating' countries, there will be a need for a mechanism to ensure that the achievements in building adequate safety infrastructures are not allowed to decay. This mechanism could involve, inter alia, regular peer reviews and involvement in regional seminars.

With regard to Milestone 3 (the establishment of medical exposure controls), there already exists in every participating country a strong and highly professional medical fraternity accustomed to controlling its own standards of behaviour. Thus, in improving safety it is important to inform and involve the medical profession and those working as health physicists. It was suggested that efforts be made to involve international professional organizations such as those which were involved in the Málaga conference and that the regulatory authority in each participating country foster links with the national bodies of medical professionals.

The conference noted that progress was slower in workplace monitoring than in individual monitoring. The workplace monitoring programme might benefit from some more specific assistance material such as classification of areas, model local rules, schemes of work, and establishment of investigation levels. Provided that there is a system of inspection in place (which is the case in most participating countries), significant progress could perhaps be made relatively easily by emphasizing these matters in the inspection programme.

While acknowledging that exposures to natural radiation sources may at the moment not be a first priority issue, the conference noted that some activities involving naturally occurring radioactive material (NORM) can result in such significant exposures of workers and members of the public that they should not be totally disregarded. In some countries, NORM industries — and radon in workplaces — are the most significant source of occupational exposure.

With regard to the operation of regulatory authorities, interdepartmental co-operation is one of the areas to which not enough attention has been paid. It is now clear that, even if there is a single regulatory authority, strong links must be established with other governmental departments for such matters as control of imports, prevention of illicit trafficking, and emergency response planning.

To accommodate changes related to security and the categorization of sources, the IAEA should make available a standardized format for national registries, using an upgraded version of the Regulatory Authority Information System (RAIS).

The costs of technical services could be reduced through the provision of some technical services on a regional basis. Internal dosimetry and analytical services were mentioned in this connection, and in addition there were calls for efforts to find regional solutions to the problem of managing disused sources.

The IAEA should encourage Member States to incorporate quality assurance into their regulatory infrastructures. The Agency is already issuing quality management guides for regulatory bodies, for radiation users and for service providers.

Member States should develop strategies and action plans for identifying potential orphan sources and locating and establishing control over high-risk orphan sources. Most existing systems for the security of radioactive sources are based on preventing inadvertent access. Given the increased likelihood of malevolent actions carried out by terrorists, Member States should conduct threat reviews and adjust their security measures, drawing on, inter alia, the guidance provided in Annex 1 to the revised Code of Conduct on the Safety and Security of Radioactive Sources or the Categorization of Radioactive Sources as appropriate.

The safety and security of radioactive sources is a major objective of Model Project Milestone 1, which deals with authorization, inspection, enforcement and the establishment of radioactive source inventories. Every Member State importing or exporting radioactive sources should do so in a manner consistent with the Code of Conduct on the Safety and Security of Radioactive Sources, and transfers of radioactive sources in Categories 1 and 2 should take place only with prior notification by the exporting State and, as appropriate, with the consent of the importing State, given in accordance with its laws and regulations.

The conference welcomed the development by the IAEA of a two level scheme for assessing national infrastructures quantitatively, with the generic grading of performance indicators and a set of infrastructure components and assigned parameters that are assessed. Member States were encouraged to perform self-assessments of their safety and security infrastructures, particularly for high-risk radioactive source control. Attention was drawn to the IAEA's recently created Radiation Safety Infrastructure Appraisal (RaSIA) service.

3.2. Networking

Networking is an effective way for less experienced persons to rapidly improve their knowledge and benefit, through feedback, from the greater or wider experience of others. Networking can also be a very effective instrument for involving stakeholders and increasing their willingness to accept responsibility for the management of radiation safety.

Networking should complement other mechanisms which have proved to be effective for sharing experience, such as co-operation between institutes, conferences and workshops, scientific and expert visits and professional societies. Outputs from networks should be accessible to a large audience and serve as a basis for informing the public, workers and patients. Whenever possible, the outputs should be put into perspective through reference to similar activities involving harmful substances.

The relevant international organizations should, by providing sufficient human and financial resources, facilitate the creation and support the maintenance and improvement of networks. It was recognized that the ingredients for successful networks include the commitment of the participants, the recognition of mutual benefit, a common language, a shared objective, a critical mass, access to appropriate technology and the ability to adapt to the evolution of techniques.

3.3. Furtherance of stakeholder involvement

Public confidence in the regulatory process can be promoted by appropriately involving the public and other stakeholders in regulatory decision-making. Member States should integrate public involvement into their regulatory approaches, tailoring it to the significance of the regulatory decisions. The IAEA, in collaboration with other relevant international organizations, should produce and disseminate a document on good practices as regards public involvement in regulatory decision making.

The relevant international organizations were called upon to analyse stakeholder involvement case studies and disseminate to all countries the lessons learned from them, pointing out what is generic and what is country-related, and to provide guidance on how to implement the existing techniques in specific local and regional situations. Also, they were requested to stimulate ‘bottom up’ approaches as a complement to ‘top down’ procedures and to further support the methodological development and practical applications of stakeholder involvement theory in the radiation safety domain.

3.4. Education and training

There is a broad spectrum of radiation applications (energy, medicine, industry, agriculture, petroleum, mining, biological research, etc.), of radiation sources (reactors, accelerators, radioactive sources) and of future activities to be embarked upon by trainees (equipment maintenance, radiology, radiobiology, radiation protection, etc.). Therefore, education and training should continue to be made available in order to meet the diverse needs of Member States through the use of appropriate tools. They should convey understanding of how to use IAEA safety documents such as the BSS and related safety guides.

The IAEA should continue implementing its “Strategic Approach to Education and Training in Radiation and Waste Safety” with the aim of establishing, by 2010, sustainable education and training programmes in Member States. In Resolution GC(45)/RES/10.C, the General Conference urged the Secretariat to implement this approach, to strengthen its efforts in this area (subject to the availability of resources), and to assist national and regional training centres and collaborating centres in conducting education and training activities in relevant official languages of the IAEA.

The ‘train the trainers’ concept should continue to be supported, in order to increase the number of skilled people in Member States and thereby promote infrastructure sustainability.

The IAEA should, in accordance with its Strategic Approach, continue helping Member States to organize postgraduate educational courses leading to a diploma in radiation protection, developing and disseminating standardized curricula and modules for specialized training and public education in radiation safety and security, and organizing training courses where needed (when possible in local languages).

A long-term agreement with the IAEA is essential for hosting postgraduate education at regional training centres. Postgraduate educational courses help to create a core of qualified experts in different countries, but in order to create a radiation safety culture it is essential that the qualified experts soon become involved in the training of radiation protection officers. This is not the role of the IAEA, but of the different countries. Nevertheless, in order that sustainability is achieved as soon as possible, the IAEA should, when implementing the Strategic Approach, prepare training packages specifically for radiation protection officers, particularly those working in medicine and industry. The IAEA and Member States should conduct appraisals of radiation safety education and training consistently to help ensure high quality and compliance with IAEA standards.

Member States should educate occupationally exposed workers (such as medical staff, irradiator facility operators and regulators), potentially exposed workers (such as source distributors, police officers, firemen, scrap dealers, customs officers, and border guards), news media staff, and the general public about radiological hazards, radiation protection, radioactive waste safety, the security of radioactive materials, and radiological emergency response.

The IAEA should enlarge its glossary of nuclear, radiation, waste and transport safety terminology, have it translated into all official United Nations languages, and include it in its training packages. The definition of “Qualified Expert” should be clarified with other international organizations in order to meet the need for mutual recognition.

Member States should take advantage of the information in IAEA publications such as Training in Radiation Protection and the Safe Use of Radiation Sources (IAEA Safety Reports Series No. 20) and the Safety Guide Building Competence in Radiation Protection and the Safe Use of Radiation Sources (RS-G-1.4).

3.5. Emergency preparedness

Member States should ensure that their regulatory bodies and emergency response organizations have the resources necessary for dealing with nuclear or radiological emergencies. Member States should establish adequate arrangements for responding to nuclear or radiological emergencies at the local and national levels, and integrate them with arrangements for response to conventional emergencies.

Member States should adopt legislation that clearly allocates the responsibilities for preparing for and responding to nuclear and radiological emergencies and for meeting the requirements established in the IAEA Safety Requirements document Preparedness and Response for a Nuclear or Radiological Emergency (GS-R-2).

Regulatory bodies and emergency response organizations should organize training exercises for first responders and local officials and co-ordinate public information activities.

Local and national emergency response arrangements should be supplemented by preparations at the international level, which necessarily require a global/regional approach consistent with international standards and the relevant conventions providing for information exchange and the rendering of assistance.

Member States should ratify the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency if they have not already done so. Member States should strengthen their mechanisms for exchanging information and for the rendering of assistance, as stated in IAEA General Conference Resolution GC(46)/RES/9.D and as envisaged in those two conventions.

3.6. International co-operation

Networking could enhance international co-operation in all aspects of infrastructure development directed towards increasing, through education and training, the number of radiation safety professionals, so that even in small countries there could be a self-sustaining critical mass of such professionals.

The IAEA should continue to facilitate international co-operation in all areas important for radiation safety and security, including information exchange, networking, knowledge management, the provision of assistance by one country to another, the maintenance of international databases, border monitoring, and the disposal or long-term storage of disused sources.

Continuing the series of conferences held in Dijon, Buenos Aires, Málaga, Stockholm, Geneva, Vienna, and Rabat, the IAEA should organize further conferences dealing with radiation safety and security, as information exchange through such conferences is recognized as a highly effective means of improving radiation safety and security in countries facing similar problems and of facilitating the development of action plans and the assignment of priorities.

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[1] The Model Projects were originally conceived as a series of steps which would, when all completed, ensure that all infrastructure features for protection against ionizing radiation and for the safety of radiation sources required by the BSS were present in participating Member States. The scope of the Model Projects is best described in terms of five milestones.

Milestone 1: The establishment of a regulatory framework — the most time-consuming activity — involves the drafting and promulgation of radiation protection laws and regulations, the designation and empowerment of a national regulatory authority and the establishment of a system for the notification, authorization and control of radiation sources (including the preparation of an inventory of radiation sources and installations). Attainment of this milestone can be regarded as one of the main indicators of progress by a participating country in meeting Model Project obligations.

Milestone 2: The establishment of occupational exposure controls with individual and workplace monitoring, dose assessments, systematic record-keeping and quality assurance programmes. The effectiveness of the control system is strongly dependent on the soundness of the regulatory framework.

Milestone 3: The establishment of medical exposure controls aimed at controlling the exposures of patients in diagnostic radiology, radiotherapy and nuclear medicine. It includes the establishment and implementation of quality assurance programmes.

Milestone 4: The establishment of public exposure controls involving programmes for the control and safe disposal of radioactive waste, for the control of consumer products containing radioactive substances, and for environmental monitoring.

Milestone 5: The establishment of emergency preparedness and response capabilities, which involves the development of plans and the allocation of resources to ensure the effectiveness of national regulatory authorities and other relevant organizations in dealing with different radiological emergency scenarios.

[2] Other relevant conferences include the following.

The International Conference on Occupational Radiation Protection, organized by the IAEA and ILO, was held in Geneva in 2002, and led to the formulation of an Action Plan for Occupational Radiation Protection, which was approved on 9 September 2003 by the IAEA Board of Governors for implementation by the IAEA in co-operation with ILO.

In co-operation with many other international organizations, the IAEA organized the International Conference on the Radiological Protection of Patients in Diagnostic and Interventional Radiology, Nuclear Medicine and Radiotherapy held in Málaga, Spain, in 2001. That conference led to the formulation of an International Action Plan for the Radiological Protection of Patients, which is in the process of being implemented.

In 1998, the IAEA held an International Conference on the Safety of Radiation Sources and the Security of Radioactive Materials in Dijon, France. This conference led to the formulation of an initial Action Plan for the Safety of Radiation Sources and the Security of Radioactive Materials (in Attachment 2 to IAEA document GOV/1999/46-GC(43)/10). At the same time, the IAEA Board of Governors requested the Director General to initiate exploratory discussions relating to an international undertaking in the area of the safety and security of radiation sources. With such international action in mind, the IAEA developed a Code of Conduct on the Safety and Security of Radioactive Sources and a supporting publication, Categorization of Radiation Sources (IAEA-TECDOC-1191).

In 2000, the IAEA held an International Conference of National Regulatory Authorities with Competence in the Safety of Radiation Sources and the Security of Radioactive Materials in Buenos Aires. The Buenos Aires Conference recommended that States establish strategies for the education and training of regulatory staff, including the on-the-job training of regulators and radiation source users, and that regulatory authorities ensure the continuity of control over radiation sources from manufacture through use to disposal. This conference led to the formulation of a Revised Action Plan for the Safety and Security of Radioactive Sources (in the Attachment to IAEA document GOV/2001/29-GC(45)/12).

In May 2001, the IAEA, in co-operation with the World Customs Organization, Interpol and Europol, organized an International Conference on Security of Materials — Measures to Prevent, Intercept and Respond to Illicit Uses of Nuclear Material and Radioactive Sources, which was held in Stockholm and which produced a number of results relevant to the strengthening of national infrastructures for radiation safety.

Following the attacks of 11 September 2001, the IAEA Board of Governors approved a 'Nuclear Security Plan of Activities' that included actions relating to the security of radioactive material other than nuclear material and designed to ensure that significant uncontrolled radioactive sources are brought under control and properly secured.

In March 2003, the IAEA held an International Conference on Security of Radioactive Sources which produced two major findings:

(1) An international initiative should be launched under the IAEA's aegis to locate, recover and secure "orphan" sources.

(2) An international initiative should be launched under the IAEA's aegis to help governments establish effective national infrastructures for radiation safety and the security of radioactive sources, including implementation of the Code of Conduct on the Safety and Security of Radioactive Sources.

This conference also produced findings relating to the recovery of high-risk sources, strengthening the long-term control of sources, the interdiction of illicit trafficking, roles and responsibilities, emergency response, and public information.

In July 2003, the IAEA published a revised Categorization of Radiation Sources (IAEA-TECDOC-1344), which provides underpinning for a revised Code of Conduct on the Safety and Security of Radioactive Sources which was approved on 9 September 2003 by the IAEA Board of Governors for implementation within the framework of the IAEA's approved programme.

OPENING SESSION

Chairperson

H.J. BOUTALEB
Morocco

OPENING ADDRESS

O.F. Fihri
Minister Delegate for Scientific Research,
Scientific Research Department,
Rabat, Morocco

It is indeed a pleasure for me to be here among you in the prestigious College of Science of Rabat to attend the opening meeting of the International Conference on National Infrastructures for Radiation Safety: Towards Effective and Sustainable Systems. I would like to start by recalling the honour bestowed by His Majesty Mohammed VI on this conference by accepting that it be held under his high patronage. This symbolizes the importance and interest that His Majesty grants to science and scientists as well as his determination to promote scientific research in our country, especially in the field of nuclear science and technology.

Likewise, I would like to extend my thanks to the International Atomic Energy Agency for holding this important scientific event in our country, and I welcome its staff — in particular Deputy Director General T. Taniguchi. I am sure the conference will be crowned with success. I would also like to take this opportunity to express my appreciation to the World Health Organization, International Labour Office, European Commission and OECD Nuclear Energy Agency for their valuable co-operation. My thanks go as well to all the participants who came from different and remote parts of the world, extending to them a warm welcome and wishing them a pleasant stay in our country.

The convening of this conference in Rabat constitutes, without doubt, a new step towards the promotion of scientific research in the fields of nuclear energy and radiation safety. Indeed, we are pleased to see among us actors in different stages of the production of basic scientific knowledge, dissemination of this knowledge through research, technological innovations, and assimilation of expertise and engineering in such a crucial area as making radiation safety infrastructures meet international standards and norms of protection. We are all the more pleased to know that the main objective of this gathering is to ensure better protection for humankind and the environment, as well as ensuring sustainable development through the utilization of nuclear techniques.

The themes to be considered by this conference are among the priorities of the Scientific Research Department in its endeavour to promote scientific research in the field of nuclear science and technology for peaceful uses in Morocco. By so doing, this Department is following and supporting the efforts being made by our country to provide training, and elaborate rules and regulations, and to create infrastructure, acquire material and, equipment and encourage qualified and active researchers.

Hence, the convening of this conference responds to a strategic interest of our country, which, similar to other countries, is committed to the achievement of comprehensive and sustainable development for the protection of humankind and the environment. This is considered nowadays as a strategic and vital objective as it entails the protection of people from radiation and against all kinds of professional risks and health hazards.

Morocco attaches great importance to radiation safety issues. Our country adhered to all international conventions related to nuclear safety. It is in the process of adapting its internal regulations to international norms and standards, and it is making progress towards the establishment of a national safety body which meets those norms and standards, with the assistance of the IAEA. For this purpose, a standing committee for the follow-up of nuclear affairs has been created on the basis of Royal Instructions, and placed under the authority of the Prime Minister. Its task is to serve as a think-tank on nuclear safety issues and to make proposals on ways and means of reinforcing radiation safety measures.

It goes without saying that the peaceful uses of nuclear energy must meet the safety standards elaborated by the IAEA. However, we are convinced that the elaboration of safety standards would not be enough unless they are understood and applied by all. In order to attain this objective, the IAEA should spare no effort for the provision of training. Thus, Morocco has put at the disposal of the IAEA the National Centre for Nuclear Energy, Science, and Techniques for the organization of a post-graduate training course on radiation safety and the safety of nuclear waste for African French-speaking countries. Morocco has also elaborated, with the assistance of the IAEA, a law aimed at unifying and harmonizing the existing legislation and creating a regulatory body. We avail ourselves of this opportunity to express our sincere thanks to the IAEA Secretariat for the assistance extended to us in this endeavour. In addition, Morocco has acquired scientific know-how and technical expertise in the field of nuclear research that allow him to serve as a centre of excellence for Africa.

Your conference is an excellent opportunity to generate a debate on the progress made on the application and harmonization of national infrastructures on safety according to IAEA standards. The conference will , I am sure:

— Promote the exchange of information on national infrastructures, radiation safety and their evolution towards effective and sustainable systems;

— Enhance international coherence and strengthen the international co-operation in this domain;
— Strengthen the effectiveness and the efficiency of regulatory authority activities by ensuring adequate resources for creating and effective infrastructure and sustainable radiation safety with the infrastructure needs relating to security of radioactive sources, monitoring occupational exposure and to elaborate and apply the intervention plan in emergency cases.

I conclude by congratulating the University Mohammed V – Agdal and its President, Professor Hafid Boutaleb, for the organization and success of this event.

I would like once again to thank all the participants, researchers, engineers and professors for the interest they are showing in the promotion of knowledge in the domain of nuclear science and techniques in our country, and to express the wish that we will fulfill the aspirations nurtured by His Majesty King Mohammed VI, God bless Him, not only for his people and country but also for the promotion of international co-operation and peace in the world.

OPENING ADDRESS

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Honourable Representatives of His Majesty King Mohammed VI and of the Government of Morocco, representatives of sponsoring organizations, distinguished participants, on behalf of the Director General of the IAEA, it is my pleasure and privilege to welcome you to this International Conference on National Infrastructures for Radiation Safety: Towards Effective and Sustainable Systems.

I would like to express my sincere appreciation to His Majesty King Mohammed VI for his patronage, to the Government of Morocco and the University Mohammed V, Agdal, for hosting this conference in the beautiful and historic city of Rabat, and to the local organizers for their diligent planning and gracious hospitality. I would also like to thank the four organizations that are co-operating with the IAEA in holding this conference: the World Health Organization, the Pan American Health Organization, the International Labour Organization, the European Commission and the OECD/Nuclear Energy Agency.

National infrastructure for radiation safety has emerged as an issue of international concern over the last two decades. Systematic and strategic consideration of infrastructure has become widely recognized as an essential prerequisite for safety. The first IAEA conference to address the topic was in Munich, Germany, in 1990. The 1996 edition of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (known as the Basic Safety Standards or BSS) highlighted the issue, and the IAEA's technical co-operation Model Project for Upgrading Radiation Protection Infrastructure was introduced to help address it.

The Model Project has helped, and continues to help, more than 85 IAEA Member States to work towards the goal of a radiation safety infrastructure in accordance with the Basic Safety Standards. A great deal has been achieved, but this work is not complete. Furthermore, not all States are members of the IAEA or the Model Project, and there are around 50 non-Member States that may need similar assistance. I would, therefore, like to extend a special welcome to representatives of those States that are not members of the IAEA, and to thank the United States of America for providing extrabudgetary support to make possible the participation of these States in this conference.

The issue of orphan sources has been instrumental in stirring the international community into action. Initially, orphan sources were seen primarily as a safety issue. However, since the terrorist attacks of 11 September 2001 in the USA, the security dimension has brought an increased sense of urgency. Security considerations have also led to a greater recognition that national systems for the control of sources can only be fully effective if all States have effective systems, that is, if there is an effective global system of control.

But there is a broader underlying reason why we need to continue to strengthen national infrastructures for radiation safety. Technologies that make use of radiation and radioactive material — in medicine, in research, in industry, in agriculture and water resource management — have expanded and spread all around the world, and continue to grow. These technologies bring great benefits — often desperately needed — but those benefits cannot be fully enjoyed unless the technologies can be used safely. Effective national infrastructures provide the foundation for the safe use of these technologies.

I hope that the sharing of knowledge and experience at this conference will contribute to a 'virtuous circle' of continuous improvement. I look forward to the conference providing deeper and broader ideas for how the IAEA can be more effective in assisting in this very challenging area. I wish you well in your deliberations this week, and I look forward to hearing your findings.

I invite the representatives of the four co-operating organizations to make their opening remarks, and I give the floor firstly to Mr. Repacholi, representing the World Health Organization.

OPENING ADDRESS

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The International Labour Organization (ILO), is very pleased to be associated with this International Conference on National Infrastructures for Radiation Safety. On behalf of the Director General, Mr. J. Somavia, I would like to congratulate the national organizer and host, the University Mohammed V, Agdal, and the Government of Morocco, the IAEA and the other co-operating organizations: the World Health Organization, the Pan American Health Organization, the European Commission and the OECD/ Nuclear Energy Agency for taking this initiative.

When flying here to Morocco yesterday, I read newspaper reports about the results of the investigations related to the disaster of the Columbia space shuttle. The findings were as follows: the United States National Aeronautics and Space Administration (NASA), must establish a *safety culture within itself.* NASA was well aware of the problem of falling insulation material but did not take it seriously before the disaster.

The workers in the Chernobyl power plant knew the hazards and safety rules but did not take them seriously.

Every day, more than 5000 people die from occupational accidents and work related diseases as the hazards are not taken seriously. Some of them are caused by ionizing radiation.

We in the ILO expect enterprises and workplaces to follow proper occupational safety and health management systems so as to avoid accidents, diseases and other problems at work.

Equally, we must expect national leadership, *sound nationwide management,* for radiation safety, which means:

— National policy setting, which usually results in national standards and laws;
— National structures and mechanisms, that is, who is in charge of what;
— Responsibilities and accountabilities set, and resources allocated;
— National action plans, a national programme;

— Implementation of these plans;
— Follow-up, monitoring, review, feedback to enhance the process using selected indicators;
— Continuous improvement in measurable steps at national level.

The ILO adopted, two months ago, a new global strategy to prevent workplace hazards — such as radiation — from causing death, disability and disease. We would be pleased to encourage related infrastructures in national workplaces to do their share in our concerted efforts for achieving the required safety culture. The labour inspectorates worldwide, the employers and the workers, as well as their organizations, professionals and scientists — all of them can contribute.

We need well organized, systematic and continuous collaborative efforts that end up in progressive and stepwise improvement which covers all those at risk.

Ladies and gentlemen, I am convinced this conference will be one step in that direction.

OPENING ADDRESS

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I have the pleasure to welcome you, on behalf of the OECD Nuclear Energy Agency to this important International Conference on National Infrastructures for Radiation Safety.

Let me congratulate the organizers of this conference for their decision to approach the Government of Morocco to host this meeting in the beautiful city of Rabat but, first of all, let me thank our host, His Majesty King Mohammed VI and the Government of Morocco, and the University Mohammed V, Agdal, for the kind hospitality and the beautiful setting here in Rabat, and for making this dream become a pleasant reality.

We are convening here to discuss 'radiation safety infrastructure', a term which for outsiders — and probably also many of us — seems to be a bit fuzzy. Over the last decades, considerable progress has been made in radiation safety techniques, in measurement, monitoring, exposure prevention, and intervention techniques. In general, occupational exposure for workers has dropped continuously, as data from the Information System on Occupational Exposure (ISOE) system can demonstrate.

Today, it is becoming clear that further progress cannot rely on improving hard techniques alone, but also has to focus on the soft issues: on institutional aspects, on aspects of information, organization, and finally, a safety culture — in a word, on infrastructure.

On one side, sustainable infrastructures — at both the international and the national level — are essential in order to maintain the positive trend in radiation safety, in occupational exposure and, thus, to support the safe use of nuclear energy and radiation. On the other hand, effective national and international infrastructures are required to ensure the radiation safety and security of radioactive sources, and to avoid incidents and accidents with 'orphan' sources, which have become a major concern in recent years.

The OECD/NEA is happy to provide the experience of its 28 member countries from Europe, North America and the Pacific area, and to inform you about the various initiatives taken that are relevant to sustainable infrastructures for radiation safety. In many aspects, infrastructure is not only a technical issue: it is based on cultural backgrounds, history and socio-political settings. These might differ from country to country, but I am sure there are a lot of ‘golden nuggets’ of experience which could be easily shared among the international community as a whole.

Ladies and gentlemen, I am looking forward to this interesting conference, to thought provoking presentations, to lively and fruitful discussions, and to useful conclusions and recommendations.

BACKGROUND SESSION

Chairpersons

C.L. MILLER
United States of America

J.R. CROFT
United Kingdom

Keynote Address

ENHANCING REGULATORY INFRASTRUCTURES THROUGH INTERNATIONAL CO-OPERATION

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1. INTRODUCTION

I am honoured to have this opportunity to present a keynote address on behalf of Chairperson Diaz of the Nuclear Regulatory Commission, to this International Conference on National Infrastructures for Radiation Safety: Towards Effective and Sustainable Systems. The United States Nuclear Regulatory Commission (NRC) believes strongly that maintaining an effective and sound radiation safety infrastructure is of paramount importance to the sustainability of the civilian uses of nuclear materials and indeed to everyone involved in the nuclear community. Chairperson Diaz has asked me to convey to the IAEA his perspectives and thoughts on this important topic. We commend the organizers of this conference for providing such a beautiful venue for senior nuclear officials and policy makers to exchange key information on these issues of global importance.

Our purpose today is to present an overall framework for the series of presentations that are scheduled this week which describes the ideal components of an effective regulatory infrastructure, to discuss the challenges and opportunities presented before us with regard to the safety and security of radioactive materials, and to explain what we are doing to achieve progress in this area. With participation from more than 320 individuals representing over 115 countries, this conference represents the importance of continuing to strengthen international consensus and information exchange in this area.

2. EFFECTIVE REGULATORY INFRASTRUCTURES

Looking back upon the past several conferences that the IAEA has conducted in this area, a common overarching theme has been to strengthen the safety and security of radioactive materials by establishing and upgrading regulatory infrastructures in its Member States. Indeed, it was the IAEA's Basic Safety Standards (BSS) [1], published in 1996, that marked the culmination of international efforts towards harmonization of both radiation protection and safety standards. These Safety Standards have helped to assist Member States in widely adopting accepted radiation protection and safety principles. The BSS were intended to ensure the safety of all types of radiation sources and, in doing so, complemented regulations already developed for large and complex radiation sources, such as nuclear reactors and radioactive waste management facilities. It is generally agreed that the regulatory infrastructure in place for nuclear safety makes it better prepared than most other similarly regulated programmes for responding to events of theft or sabotage. Of course, further enhancements can always be made.

Independence of a regulatory authority is one of the essential elements in a sound national infrastructure; independence ensures that the regulatory authorities of Member States function independently of industry and those they regulate, yet have the authority, competence and sufficient resources to function effectively. The NRC has benefited greatly by being an independent regulatory agency and embraces its independence as one of its 'principles of good regulations' [2]. Independence also means that available facts and opinions must be sought openly from licensees and other interested members of the public, and that once obtained, resolution of these issues must be based on an objective, unbiased assessment of all information, and must be documented with the reasons explained.

Legislation is a necessary tool in providing the regulator with sufficient authority to establish a strong infrastructure. Having the authority to develop requirements that ensure 'reasonable adequate protection' of individuals from the potential hazards of radiological facilities and radioactive materials is critical. Regulatory infrastructures specifying the type of safety standards, risk thresholds and security requirements for radioactive materials have proved to be key components of an effective safety framework. This includes both the licensee's programmes for conducting safe operations and the Government's clear role in providing independent analysis and oversight for the assurance of safety. Regulators are obligated to protect and ensure the public's health and safety through effective and efficient regulatory programmes. And, as experience has shown, it allows the regulator to depend on licensees to maintain the responsibility for the safe operation of their facilities, while the national regulatory authority focuses on having very clearly defined licensing and regulatory processes that provide predictability in what is required, inspected, reported and enforced.

In every respect, regulatory policies need to be grounded in realism. Where events are well understood and well managed, they should be treated accordingly: not as a crisis, but as part of the process of operating a complex technology. By the same token, extremely low probability events, which have never happened and are unlikely to happen, should not be driving public policy. Speaking as a regulator, probabilities have to be dealt with, not possibilities. Worse case scenarios or regulations intended to cover every possibility of potential wrongdoing with respect to radioactive materials are only good as vehicles to achieve the proper bounding of realistic scenarios. Worse case assumptions can be used for preliminary estimates of the importance of an issue, but they are not a good basis for policy or decision making, and are especially bad when addressing consequences. With the sharing of international operational experience, aided by risk informed insights, the quantitative tools of a regulatory framework can be developed based on realism, including realistic consequence analysis.

The NRC's regulatory framework is moving away from prescriptive to performance based regulations by establishing performance goals to assist those who are regulated and those who monitor the NRC's performance in the regulatory arena. Simply put, this means regulating outputs and outcomes, rather than inputs. It is a matter of monitoring performance rather than programmes; of monitoring what is achieved, rather than what is attempted. For an effective regulatory infrastructure, it is important to regulate in a manner that corresponds to the actual risk presented, and that must be realistically conservative. For the nuclear arena, regulations and the overall regulatory infrastructure have to be balanced to be really effective. There is a saying about the benefits of regulation that is important to state here: "Regulations need to result in a benefit or they will result in a loss."

Neither under-regulation nor over-regulation serves anyone's interests. Under-regulation puts the public safety and the licensee's investment at risk; over-regulation increases costs to licensees and thus to consumers, without a matching safety or security benefit. Regulators need to make sounds decisions based on the best technological facts, bounded by law.

3. MAINTAINING CORE COMPETENCE

In addition to resources that must be devoted to the development of the regulatory system, education is an important and often overlooked component of the regulatory authority's mandate. Especially in today's global climate, where an incident in one part of the world will almost certainly bring into question the regulatory framework of other regulatory programmes, the need to educate both the users and the media of benefits and safe uses of radioactive material is imperative.

Core competence and ensuring a knowledgeable staff for the future is probably the fundamental challenge to be faced in the area of nuclear regulation. The essential ingredient that must underpin all actions is the core technical competence of staff. It is in the interest of both the public and those that are regulated that the regulatory authority should be able to reach sound technical judgements in an efficient manner. In order to respond and adapt to the changing world — not just change in the nuclear industry, but also in other civilian uses of radioactive materials, such as in industrial uses of radioactive material — staff has to be both knowledgeable and flexible.

The staff's reputation for technical competence is also a crucial element in building public confidence and trust. In short, for any regulatory agency to continue to be effective and efficient into the future, the agency's core competence must be ensured and enhanced. Not only is it important to plan for turnovers and retirements, as any employer would, there is also a need to judge carefully what expertise is required in the skill mix of employees. The NRC is actively engaged in strategic workforce planning and related human capital initiatives on a high priority basis. There is a programme in place to identify current skills, future needs and strategies to fill any gaps. The NRC is aggressively seeking to recruit new staff in critical technical areas and to retain existing staff. In short, the NRC is seeking to address the human capital challenge that is in front of everyone. This issue is raised here because the current situation deserves careful attention and it is supportive of the IAEA's strategy on education and training which is aimed at establishing, by 2010, sustainable education and training programmes in Member States. It is an issue that is before all of us and must be supported to ensure the future health of the regulatory programmes.

4. CHALLENGES

A few challenges to be faced include radioactive materials safety which, like reactor safety, has become more disciplined over the years. With the events of 11 September 2001, a number of increasing challenges have come about, presenting safety and regulatory challenges for everyone. Although security against threats of diversion at nuclear fuel facilities or sabotage at nuclear power plants is a 25-year-old business for the NRC and its licensees, there are improvements and changes that need to be made. NRC actions and programmes must now address the possible malevolent use of sources as weapons of terror, which presents a new focus when re-examining its regulatory framework. As a result, past practices need to be modified to reflect new circumstances. To provide a proper context for other challenges to be faced, it is useful to focus on three issues of major concern: the changing environment for the security of nuclear materials, nuclear safety and the need of the public for sound information about nuclear safety and security issues.

5. A CHANGING ENVIRONMENT

National security is now a dominant concern of the United States of America, and could remain so for quite some time. In the nuclear area, there is a need to achieve a new balance between security, operational initiatives and safety activities. National security does not depend on any one component, but rather on multiple layers of systems, infrastructures and structures, as well as other protective elements. Achieving the proper balance among them is the present challenge.

The enhanced security constructs that have been established for the defence of nuclear facilities and radiological sources include three strongly interdependent elements, all of these directed to one fundamental goal: how to best protect people, with the appropriate resources positioned at the right places. These three elements are:

— *Enhanced access controls:* to prevent unauthorized entry of persons and materials to nuclear facilities;
— *Enhanced work hour and training requirements:* for security personnel, to increase their capacity to detect and respond to threats;
— *A revised 'design basis threat':* describes those adversary characteristics that are credible and reasonable for a private sector organization to protect against, based on the current threat, demonstrated terrorist attributes and intelligence.

This new security framework must include both strengthened security beyond the licensee's capabilities, while maintaining the ability of these industries and users to fulfil their intended functions.

It is useful to look at some of the specifics of what has been achieved in the area of physical security of nuclear facilities and radiological sources in the USA. For many years, nuclear power plants were among the best defended and most hardened facilities of the USA's critical infrastructure. That being said, however, many additional actions have been taken on to enhance physical security even further. The NRC first issued Advisories and then binding Orders to each operating nuclear power plant licensee, specifying actions they must take to continue and improve the level of security to protect the plants. Subsequently, the NRC has issued Orders to research and test reactors, fuel conversion facilities, decommissioned reactors, transporters of spent fuel and gaseous diffusion plants. In addition to these enhancements, the NRC has also taken actions to enhance security, on a risk informed basis, at those facilities that possess large quantities of radioactive materials and sources.

In a public forum, the classified details of the actions required cannot be disclosed; however, they include increased patrols, augmented security forces and capabilities, additional security posts, installation of physical barriers, vehicle checks at greater stand-off distances, enhanced co-ordination with law enforcement and military authorities, and more restrictive access controls. It has been a fairly large, necessary burden on both the NRC and the industry to develop and implement these measures, but the belief holds that global events now require it.

6. NATIONAL RESPONSE AND EMERGENCY PREPAREDNESS

Integration of US security and emergency preparedness policies and the integration of their implementation is a national need that has become the statutory responsibility of the Department of Homeland Security (DHS). For example, the NRC is one of several key federal agencies involved in a DHS senior level working group which will help to refine the nation's National Response Plan (NRP) to address the management of domestic incidents, whether they are terrorist events or natural disasters. This NRP provides the framework from which over 15 federal agencies and departments can work together and, with our licensees, work closely in the event of an accident or emergency to ensure an integrated, co-ordinated system of protection. In addition, the NRP recognizes the roles that states and local authorities play in responding to all the hazards to be faced. The NRC encourages all national regulatory authorities to revisit their NRPs and encourage assistance and participation by local responders in making amended changes.

The NRC itself has undergone a number of changes. Last year, a new Office of Nuclear Security and Incident Response was established to bring into focus the NRC's new responsibilities and increased oversight for security, incident response, vulnerability assessments and emergency preparedness. In addition, in June 2003, the position of a new Deputy Executive Director for Homeland Protection and Preparedness was established to have the authority to go across agency lines of authority, to seek and resolve protection and preparedness issues, no matter where they reside in the agency. Thus far, the new office has streamlined the multitude of decision making processes in this fast paced area, resulting in more timely actions.

Lastly, emergency preparedness, like security, has also become an area of concern. In response to the attacks of 11 September 2001, the NRC initiated new studies of the security and vulnerability of nuclear power plants, including assessments for land-based, water-born and aircraft terrorist attacks. Although the studies will not be fully completed until the fall of this year, it is already clear that the planning basis for off-site emergencies remains valid in terms of timing and magnitude for the range of potential radiological consequences that could occur. Nevertheless, the NRC continued to work aggressively with federal and state agency counterparts to ensure that the right plans are in place, off-site communications are secure, and that the right messages are conveyed to the US Congress and the public.

7. EFFECTIVE COMMUNICATION

A key area within a regulatory framework that is needed in order to develop and keep public trust in the regulatory infrastructure is effective communication. Communicating well is not an easy task. The world is defined in terms of sound bites, where sometimes, with a bit of luck, there is a whole sentence available to make a point. Until recently, public attention was often more closely focused on the radiation and environmental hazards associated with nuclear reactors, rather than with radioactive sources. In the aftermath of the events of 11 September 2001, however, the phrase ‘radiological dispersion devices’ (RDDs) or ‘dirty bombs’ have become household words, raising many questions regarding the overall control and security of radioactive sources.

To compound this issue, in the USA as in most other countries, the operations of nuclear facilities and the terms ‘nuclear’ or ‘radiological’ are a controversial subject to many. Some worry about the amount of radiation emanating from their homes in the form of radon, while others worry about their Government’s collective ability to safeguard nuclear materials and technologies so that illicit uses of radioactive sources are avoided. Whatever their worry in these areas, the nuclear regulator has the responsibility of addressing their concerns. It is widely agreed that this is often a difficult task.

When members of the public are looking to the regulatory authority for solid information about real life issues that concern their safety and their families’ safety, it is best to be truthful! A disservice is done if the risks are understated; equally, overstating them is as bad a disservice. Although regulatory decision making typically involves technical analyses of a proposed requirement or process, underneath they usually implicate embedded social judgements about the acceptability of risk and the balance of cost and benefits. Thus, there is a need for the regulator to involve the public in its decision making process, and to communicate effectively those decisions. If there are problems and gaps in the regulatory infrastructure, they can and should be acknowledged. At the same time, it is not necessary to bend over backwards and exaggerate dangers just to demonstrate the seriousness of the commitment to public safety. And the responsibility of licensees and operators should not be forgotten: "There is no credible regulator without a credible industry and there is no credible industry without a credible regulator."

8. INTERNATIONAL CO-OPERATION

It is widely recognized that now more than ever, nuclear regulation has become international in scope. Co-operation among the national regulatory agencies has grown, and it is imperative that these types of discussions continue and expand. As this conference highlights, for countries that have succeeded in developing good infrastructures, exchanging information on operating experiences, regulatory issues and approaches helps to promote good safety practices. Good technical know-how has no frontiers. Information on emerging safety or security issues with regard to a particular radioactive device type or design may be relevant to many other countries. More important, however, are international co-operative efforts involving countries with small programmes, those considering acquiring nuclear materials and processes for the first time, or those with relatively weak or inexperienced regulatory organizations. For these countries, international co-operation can help develop the regulatory infrastructure and strong safety culture that are essential to ensuring the safe use of radioactive materials.

Since 1994, the IAEA's unprecedented international co-operative effort through its technical co-operation Model Project for Upgrading Radiation Protection Infrastructure, has demonstrated that Member States can establish national radiation and waste safety infrastructures that are compatible with BSS requirements. The ability of Member States to maintain and, where necessary, to improve the safety and security of radioactive materials has paid real dividends, particularly in Western nations. The development of the database of unusual radiation events (RADEV) to capture international data on radiation incidents and accidents has been an important tool in assessing and addressing the breadth of the problem to be faced. It is important that the Model Project approach be continued.

With regard to the safety and security of radioactive materials, in the USA, the NRC has been working with the US Department of Energy (USDOE) to strengthen the overarching regulatory infrastructure in the USA to increase the protection of high risk radioactive sources which could be used to make a radioactive dispersal device. It was realized that for large nuclear facilities and high risk radioactive sources, where the current potential threat is terrorism or sabotage, security must become an integral part of safety. However, it is important that security not overwhelm the safe operation and regulation of these types of nuclear facilities. Security must be established and integrated with all the safety objectives and safety features consistent with the overall requirements of national security. Consideration should be given to the diversity of radioactive sources and the relative hazards the sources pose to the public if loss of control occurs. In this way, the level of regulatory rigour applied to various devices can be commensurate with the hazard they pose.

It was this graded risk based approach to the control of radioactive sources that helped frame the NRC's international work with the IAEA earlier this year by reaching a consensus on the thresholds and radioisotopes of concern in IAEA-TECDOC-1344, Categorization of Radioactive Sources [3]. That document, which is referenced as Annex 1 of the IAEA's revised Code of Conduct on the Safety and Security of Radioactive Sources [4], states that priority must be given to high risk sources that represent a threat to human life from acute exposure if they are lost, misused or disposed of improperly. It provides Member States with a standardized list of high risk radioactive sources and threshold quantities so that collectively, all Member States implementing the Code of Conduct can collaboratively develop strategies and appropriate controls to secure these types of radioactive materials from unauthorized transfer. The IAEA's efforts in developing sustainable national radiation safety infrastructures and, in particular, the regional Model Project approach, is a cornerstone for enabling Member States to implement the Code of Conduct. The NRC looks forward to the presentation and discussion of the revised Code of Conduct at the General Conference of the IAEA in a few weeks. It is anticipated that this document will be sufficiently well received by the conference participants such that it can be presented to the Board of Governors of the IAEA for approval. The USA endorses the use and subsequent implementation of the Code of Conduct by its Member States, as well as those working towards fulfilling the requirements of Milestone 1 of the IAEA Model Project.

9. CONCLUSIONS

In summary, a convergence of positive factors in the area of national infrastructures for radiation safety can be seen. There is progress and international co-operation in the area of safety and security of radioactive sources; progress in establishing the groundwork for implementation of the IAEA's Code of Conduct; progress in continuance and completion of the Model Project approach for Member and some non-Member States, as well as progress in communicating the message to legislatures, the media and the public. In my view, the assurance of safety is the foremost obligation; achieved safety has a fringe benefit: it is usually a most economical outcome.

The job of regulation requires a thoroughness, toughness, a willingness to set priorities, and the readiness to move forward expeditiously, as necessary, in a time of crisis. Regulation should be a *positive* force, a pathway to both helping the industry accomplish its goals and to achieve a better, safer and more secure existence to the people of each country. Part of being a positive force means a willingness to take the initiative and press ahead to resolve issues. I know we are all prepared to do our best. Increasingly, the achievement of this objective will require international co-operation. I hope that this view is shared, and that this conference will help in redoubling the global efforts to enhance nuclear safety in the coming years.

The work of a regulator is, in a microcosm, a reflection of a nation as a whole. There are competing interests and different points of view, strongly held, but what unites us is far greater than what divides us. All of us — as regulators, policy makers, licensees, interested stakeholders and the public — have a common interest in nuclear safety and security, as well as the well being of each nation. All of us have different perspectives and insights to contribute; the best can be obtained from divergent viewpoints and applied to common purposes.

Thank you for the opportunity to talk with you today. I look forward to our continuing discussions as the conference progresses this week.

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AN IAEA PERSPECTIVE ON NATIONAL INFRASTRUCTURES FOR RADIATION SAFETY AND SECURITY OF RADIOACTIVE MATERIAL

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Technologies that make use of ionizing radiation continue to expand and spread all around the world, bringing a wide range of benefits. Radiation sources have become essential for many common applications in medicine, industry, agriculture, water resource management and research, as well as the more obvious application of nuclear power generation. These sources are potentially harmful if not properly controlled, and society will only accept the risks if it sees a benefit being gained, and if the risks are restricted as far as possible. Safety and security are, therefore, preconditions for the use of these technologies. Indeed, the IAEA's Statute stipulates that it can transfer technology only to States that have an adequate infrastructure to use it safely.

Millions of sealed radioactive sources have been distributed worldwide, with hundreds of thousands currently being used. Most of these sources pose little radiological risk. However, there are substantial numbers — probably tens of thousands at least — of highly active sources that, if not properly controlled, could cause severe harm. Since these sources actually need to be used for their beneficial purpose, they cannot simply be locked away: indeed, many types of sources have to be used in public or semi-public places, such as hospitals, factories, oilfields or laboratories.

In order to make sure that sources can be used in these ways without posing unacceptable risks to people, one of the first essential measures is to establish and maintain an effective national safety infrastructure. In the last two decades, the IAEA has started to look for a more systematic and strategic approach to the establishment of such infrastructures.

Although the IAEA organized a conference on radiation safety infrastructures in Munich, Germany, as early as 1990, the main focus of the IAEA's efforts in this field dates from the mid-1990s, in particular, the publication of the International Basic Safety Standards for Protection against Ionizing

Radiation and for the Safety of Radioactive Sources (BSS) and the initiation of the technical co-operation Model Project for Upgrading Radiation Protection Infrastructure. The BSS defined the essential elements of a national radiation safety infrastructure. The Model Project aimed to help Member States in establishing and strengthening these elements, and the milestones for the Model Project closely reflect the BSS definition of infrastructure.

As suggested in the opening address, the issue of orphan sources has been a dominant driving force in the discussion of radiation safety infrastructures since the mid-1990s, initially from a general safety perspective and, more recently, with specific security concerns. And the control of radioactive sources is certainly one of the main reasons why effective radiation safety infrastructures are needed. However, it should not be forgotten that radiation safety infrastructures must provide for all aspects of radiation protection, and the safety and security of radiation sources. Recent IAEA conferences on occupational radiation protection, on the radiological protection of patients and on the safety of transport of radioactive material have all highlighted the importance of radiation safety and security infrastructure.

So what is meant by national infrastructure for radiation safety and security?

The Preamble to the BSS describes the essential elements of a national infrastructure for radiation safety. It is instructive to review these elements, because the scope of the BSS concept of infrastructure is perhaps wider than the common everyday understanding. It should be noted here that the BSS treats the security of radiation sources as an essential part of their safety and so, for conciseness, when safety is referred to here, it is on the understanding that this includes security.

The first group of infrastructure elements makes up the legal and regulatory framework for safety: legislation and regulations that provide a basis for control; and a competent and effectively independent regulatory authority, empowered to enforce the legislation and regulations, and with the financial and human resources to fulfil that function. A vitally important feature of the legal and regulatory framework is the clear allocation of responsibilities related to safety.

As well as the direct routine regulatory oversight of activities, the infrastructure must also provide a means of addressing wider societal concerns, such as detecting any buildup of radioactive substances in the general environment; disposing of radioactive wastes safely; intervening to protect the public in the event of emergencies; and controlling natural sources and radioactive residues from past practices.

Another group of infrastructure elements might be termed technical support: the scientific and administrative facilities and services that support safety. This includes things like dosimetry services, environmental monitoring services, facilities for calibrating equipment, registries for exposure records, and so on.

All of this has to be designed and implemented competently, and so it cannot be complete without competent people. The essential infrastructure that supports this human contribution to safety is knowledge, both individual and collective. The foundations for this knowledge are effective education and training. One of the IAEA's major areas of focus is to support the establishment of sustainable and effective national programmes for safety related education and training. As part of that effort, the IAEA has produced standard packages of educational and training materials covering the most important topics.

While education and training is an important part of the story, it is not the whole of it. Individual knowledge is a product of experience as well as education and training. But different individuals have very different experiences, and so collective knowledge requires the pooling and sharing of experience, for example, through local and national networks, and through international co-operation.

Finally, radiation safety — and particularly the security aspects — cannot be separated from the broader social and economic context. Many radioactive sources are used in the public domain, and it is often the public that would be at risk if something were to go wrong. Therefore, in a modern society, national infrastructures for radiation safety must provide for the involvement of members of the public in decision making processes which affect them. This includes informing the public and the media about radiation exposure and regulatory processes, but also taking account, where possible, of their wishes and concerns. The 'knowledge infrastructure' needs to extend to include the public, so that so-called 'stakeholder participation' can be an informed process, but also so that members of the public are in a position to contribute towards their own safety.

Finally, in order for these different elements to make up a true national infrastructure for safety, they must be well integrated. On the one hand, this reinforces the need for responsibilities to be clearly defined and understood so that all elements are covered, with minimal overlap of responsibilities. On the other hand, it means that interdependences between the elements need to be recognized and managed so that the different elements complement one another.

Those are the main elements of national safety infrastructure, as defined by the BSS, and that infrastructure is the subject of this conference. It should be remembered, however, that even in this comprehensive form, infrastructure itself does not provide safety: it provides the foundations on which safety is built. Infrastructure is an essential prerequisite but is not sufficient. The infrastructure needs to provide the framework in which organizational and national safety culture can develop and flourish at all levels of operating organizations, regulatory bodies and the organizations that support them. The concept of safety culture was first applied to the safety of nuclear installations. This scope now needs to be expanded to other radiation technologies; however, since this conference is about safety infrastructure, I will not elaborate here. Suffice to say that, just as the different infrastructure elements need to be integrated together, so the infrastructure needs to be integrated with the other elements of safety.

Although national infrastructures provide the framework for safety on the ground, they are supported by an international infrastructure. In this international infrastructure, the role of legislation is mirrored by intergovernmental safety related agreements, such as conventions. To mention just one example, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management sets out obligations based on commonly accepted safety objectives and principles for the management of spent fuel and radioactive waste. Contracting States make a commitment to fulfil those obligations, and to submit their actions to 'peer review' by the other Contracting States. But the convention also serves as a forum for the exchange of knowledge and experience between States. Relatively few of the States represented here have spent fuel to manage, but I would suggest that all States have radioactive waste and, therefore, all States are potential parties to the Joint Convention. I would urge all those States that have not yet ratified the Joint Convention to consider doing so.

The role of regulations in national infrastructure is filled at the international level by internationally agreed safety standards, and it is primarily the IAEA that issues such standards. The IAEA also supports national technical infrastructure through such mechanisms as advisory missions, co-ordinated research projects (CRPs) and international 'intercomparison' exercises. And the IAEA's information exchange and outreach activities can contribute at the international level to broadening awareness and understanding of radiation safety issues.

Again, the cement that holds this infrastructure together is knowledge, and an international infrastructure needs to provide for the pooling and exchange of a wider range of knowledge — and particularly experience — at the international level. The IAEA supports the building of regional information networks, centres of excellence, networks on education and training, and on emergency response. It also promotes and facilitates information exchange on safety using advanced information and communications technology, providing technical support and feedback to the Safety

Standards and their application. At present, the IAEA is working to support the establishment of regional networks of knowledge in Asia, eastern Europe and Latin America, and the intention and hope is that eventually these will be building blocks for a global network of safety knowledge. Just as national infrastructures have to be integrated, so an integrated safety approach is an important part of the international safety infrastructure. From the IAEA's point of view, the Safety Standards are central to the integrated approach. The IAEA's safety related activities, such as providing technical assistance, rendering review and appraisal services, and promoting education and training, should work together to — in the words of the Statute — "provide for the application of the standards" in Member States. At the same time, the experiences gained in applying the Safety Standards around the world can provide valuable feedback to improve the quality, relevance and user-friendliness of the Standards themselves, thus the IAEA aims for a 'virtuous circle' of continuous improvement. The integrated safety approach provides for integrated management, and effective and efficient planning and delivery of the IAEA's programme in line with the Safety Standards, managing the knowledge base and allowing for consistent public communication.

In conclusion, the concept of safety infrastructure has come a long way and has helped to produce substantial improvements in radiation safety worldwide. Now that there is a pool of experience from the work done to date, that experience should be used to further refine and clarify the concept. If a common understanding can be reached of the definition and function of radiation safety infrastructure and how it relates to other aspects of safety, then they can be used as a basis for continuously striving to improve safety overall.

OVERVIEW OF WORK AT THE OECD NUCLEAR ENERGY AGENCY RELATING TO NUCLEAR INFRASTRUCTURE AND SUSTAINABLE DEVELOPMENT

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1. INTRODUCTION

The Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD) was created in 1957 in order to:

> "…further the development of the production and uses of nuclear energy, including applications of ionising radiation, for peaceful purposes by the participating countries, through co-operation between those countries and a harmonisation of measures taken at the national level."

Since the OECD/NEA's inception, radiological protection has been at the centre of its work. Initially developing and promulgating radiation protection norms, the OECD/NEA today focuses on the discussion and understanding of emerging radiological protection issues, and the consolidation and exchange of best practices and lessons learned.

In this context, the member countries of the OECD/NEA have for some time been interested in the issues touching the infrastructures needed to support the safe use of nuclear power. To be more specific, infrastructure refers to many areas and things, such as teaching, facilities, people, industry, know-how, and laws and regulations. To support this infrastructure, there is a need for personnel such as scientists and technologists, designers, builders, operators, regulators, decommissioners and waste managers. Governments are interested in ensuring that such infrastructures and their support personnel are available such that nuclear power and the use of ionizing radiation can be regulated and operated in a safe and environmentally correct fashion. The OECD/NEA's programme of work reflects this national interest.

The work of the OECD/NEA is addressed by the following seven Standing Technical Committees, each dealing with one of the key areas of nuclear energy:

— Nuclear Safety,
— Nuclear Regulation,
— Radioactive Waste Management,
— Radiation Protection,
— Nuclear Development,
— Nuclear Law,
— Nuclear Science.

Questions of infrastructure have been mostly dealt with from the perspective of nuclear development, nuclear safety and regulation, and radiation protection. From these studies, a level of concern has developed that nuclear infrastructures are degrading. Several general conclusions have been drawn:

— Education, training and staffing are significant concerns in the next decade;
— For nuclear energy and nuclear technologies to be sustainable they need:
  - An active safety culture in both industry and regulation;
  - A steady stream of trained and educated workers in both industry and regulation;
  - An ongoing and active R&D aspect;
  - Effective international co-operation in regulation, industrial experience, and R&D;
— Modern concepts of risk governance will have effects on national policy and regulatory structures to carry out that policy.

This paper provides a brief overview of the recently completed and ongoing work in these areas, and describes the OECD/NEA work that is intended to help OECD/NEA member countries address the consequences of these conclusions.

2. NUCLEAR DEVELOPMENT

The OECD/NEA's Nuclear Development Committee (NDC) has long been involved in the issue of maintaining a suitable nuclear infrastructure to assist governments to ensure the safe use of nuclear power and technologies in those countries with such interests. Two significant works in this area have been published recently, and a third is currently in progress.

2.1. Nuclear education and training: cause for concern?

Many OECD NEA member countries enjoy the benefits from nuclear related technologies, however, there is growing concern that nuclear education and training is decreasing, perhaps to problematic levels. The study, Nuclear Education and Training: Cause for Concern [1], presents the results of a pioneering survey on nuclear education and training in almost 200 organizations in 16 countries. A general decline in the number of institutions and number of students interested in nuclear technologies is noted, and the report suggests several strategic initiatives that could be undertaken by governments, universities and industry to reverse such trends.

2.2. International collaboration to achieve nuclear support excellence

As a continuation of the above work, the objective of this study, International Collaboration to Achieve Nuclear Support Excellence, is to identify mechanisms and policies for promoting international collaboration in the area of nuclear education and R&D. While previous OECD/NEA studies focused on separate aspects of issues related to nuclear infrastructure, this study aims to address the question as a whole in order to identify good practices and help governments in the process of integrating nuclear R&D and education in an international setting. This work will result in a summary report in 2004.

2.3. Nuclear energy in a sustainable development perspective

The report, Nuclear Energy in a Sustainable Development Perspective [2], investigates nuclear energy from a sustainable development perspective, and highlights the opportunities and challenges that lie ahead. It provides data and analyses that may help in making trade offs and choices in the energy and electricity sectors at the national level, taking into account country-specific circumstances and priorities. The maintenance of an appropriate educational and training infrastructure is one of the keys to the sustainability of nuclear energy and nuclear technologies.

3. NUCLEAR SAFETY AND REGULATION

The Committee on Nuclear Regulatory Activities (CNRA), and the Committee on Safety of Nuclear Installations (CSNI) have also been concerned with nuclear infrastructure issues for some time. They have focused their activities on nuclear safety research and research facilities, and on regulatory and industrial competence maintenance in general. Several recent reports in this area summarize the results of this work.

3.1. Assuring future nuclear safety competencies: specific actions

Based on a 1999 workshop in Budapest, the CNRA created a Task Group to explore the critical question of maintaining competence in nuclear technologies in the face of declining student enrolment, decline in the number of university programmes, deterioration of research facilities and retiring university teaching staff. The Task Group reviewed the recommendations from the Budapest workshop, and studied best practices at the national level to develop a set of recommendations to assist OECD/NEA member countries to better ensure the needed nuclear technology competence for regulation, industrial application and research.

As a result of these recommendations, which were published in 2001 and entitled Assuring Future Nuclear Safety Competencies: Specific Actions [3], the CRNA has established a follow-up with a survey of how recommendations are being applied in member countries, and plans a workshop in Sweden in 2004.

3.2. Nuclear safety research in OECD countries: major facilities and programmes at risk

Major nuclear research facilities are a key part of the nuclear infrastructure. As budgetary constraints increase in many countries, many of these essential facilities and research programmes are in danger of being closed or terminated. The CNRA study, entitled Nuclear Safety Research in OECD Countries: Summary Report of Major Facilities and Programmes at Risk [4], identifies the most important and unique research facilities around the world, and makes recommendations as to how they might be helped to continue operation through the use of international frameworks or joint undertakings.

3.3. Future nuclear regulatory challenges

In a context of growing competition and market deregulation, it is becoming increasingly important to reconcile commercial interests with safety requirements. For nuclear regulatory bodies, the first challenge will be to ensure that economic pressures do not erode nuclear safety. In their efforts to maintain a nuclear safety culture, regulatory bodies will also need to adapt to an increasingly market oriented environment and new working relationships with operators. The 1998 CNRA report, Future Nuclear Regulatory Challenges [5], identifies several specific challenges, including the need to maintain competence.

3.4. Regulatory and industry co-operation on nuclear safety research: challenges and opportunities

A key, sustainable element of the nuclear infrastructure is the relationship between the regulator and the nuclear industry. Regulator-industry co-operation in nuclear safety research has potential advantages as well as disadvantages. The 2003 report from the CRNA, Regulatory and Industry Co-operation on Nuclear Safety Research: Challenges and Opportunities [6], provides research managers in industry, regulatory organizations and research centres with information on current practices in collaborative safety research in OECD member countries.

3.5. The role of the nuclear regulator in promoting and evaluating a safety culture: regulatory response strategies for safety culture problems

Another essential aspect of a sustainable nuclear infrastructure is a safety culture. Defining and establishing an effective safety culture and recognizing related trends is still a recent initiative, undergoing development and review within operator organizations and regulatory bodies. As more studies are performed and experience is gained in this area, the role of the regulator in promoting and evaluating a safety culture will continue to evolve and mature. The 1999 CNRA report, The Role of the Nuclear Regulator in Promoting and Evaluating Safety Culture [7], describes the regulatory role in promoting and evaluating safety culture. As a follow-up to this report, the CNRA developed a strategy entitled Regulatory Response Strategies for Safety Culture Problems [8], for regulatory response based on levels of performance: early signs of safety problems; persistent signs of safety problems; and clear operational safety problems.

4. RADIOLOGICAL PROTECTION

Infrastructure issues have long been of interest in the area of radiological protection, under the auspices of the OECD/NEA's Committee on Radiation Protection and Public Health (CRPPH). Work directly on the current status of radiation protection education, as well as studies of related issues have been undertaken.

4.1. Survey of university-level education programmes in radiation protection

The 1994 CRPPH Collective Opinion, Radiation Protection Today and Tomorrow, identified the maintenance of radiological protection competence as a key issue for the future. To begin to clarify this issue, the CRPPH performed, in 1996 and 2000, surveys of university-level programmes around the world that grant degrees in radiation protection. The summaries of these surveys, CRPPH Sponsored Survey of University-level Education Programmes in Radiation Protection [9], show that the number of students entering radiation protection programmes is declining.

4.2. Better integration of radiation protection in modern society

The way in which modern society manages risk is changing. Increasingly, stakeholders would like to have their views heard and taken into account when making protection decisions that may affect public health and/or environmental quality. This is particularly true of radiological risks. The Second Villigen Workshop, in 2001, addressed these issues broadly, and concluded that governments and regulatory bodies may have to effect policy and structural changes to appropriately fit with these new concepts of risk governance [10].

4.3. Stakeholder participation in decision making involving radiation

As a follow-up to the previous workshop, the CRPPH will hold the Third Villigen Workshop to better identify the processes of stakeholder involvement, and the possible policy and structural implications of such processes. The projected title of its findings is Stakeholder Participation in Decision Making Involving Radiation: Exploring Processes and Implications: The 3rd Villigen Workshop.

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NATIONAL INFRASTRUCTURES FOR RADIATION SAFETY
Towards effective and sustainable systems

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1. INTRODUCTION AND HISTORICAL BACKGROUND

The Pan American Health Organization (PAHO) is an international public health agency with 100 years of experience working to improve health and living standards of the people of the Americas. It enjoys international recognition as part of the United Nations system, serving as the Regional Office for the Americas of the World Health Organization (WHO), and as the health organization of the Inter-American System.

PAHO is based in Washington, D.C., and has scientific and technical experts at its headquarters, in its 27 country offices, and its eight scientific centres, all working with the countries of Latin America and the Caribbean in dealing with priority health issues. The health authorities of PAHO member States set PAHO's technical and administrative policies through its governing bodies. PAHO member States include all 35 countries in the Americas; Puerto Rico is an Associate Member. France, the Netherlands and the United Kingdom are participating states, and Portugal and Spain are observer states.

PAHO/WHO initiated radiological health activities in the 1950s, promoting public health aspects of radiation and providing fellowships for the training of physicians and other professionals in radiation medicine. According to official records, a Radiation Protection Unit was established at the regional level in 1960 to oversee "the peaceful applications of nuclear energy". The objectives of this unit were:

> "to encourage national health services to develop procedures and regulations and to adopt international standards for radiation protection connected with the use of X rays and radioisotopes and for the disposal of radioactive wastes; to promote the teaching of basic

> health physics, radiobiology, and radiation protection in medical, dental, veterinary public health and other professional schools…"

In 1991, PAHO joined the Inter-Agency Committee of Radiation Safety (IACRS), formed by the European Commission, the Food and Agriculture Organization of the United Nations (FAO), the IAEA, the OECD/NEA, the International Labour Organisation (ILO), PAHO, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the WHO. The purpose of this network is to harmonize radiation safety standards worldwide.

In 1994, the XXIV Pan American Sanitary Conference endorsed the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS) co-sponsored by the FAO, IAEA, ILO, OECD/NEA, PAHO and WHO [1]. PAHO also contributed to related IAEA publications [2–4].

Guidelines for patient radiation protection were given at the 2001 International Conference on the Radiological Protection of Patients in Diagnostic and Interventional Radiology, Nuclear Medicine and Radiotherapy, organized by the IAEA and held in Malaga, Spain [5]. In 2002, the Board of Governors of the IAEA approved an International Action Plan for Radiological Protection of Patients to be carried out in co-sponsorship with PAHO and the WHO.

Regarding radiological emergencies, in 2002, PAHO joined the Inter-Agency Committee on Response to Nuclear Accidents (IACRNA) and has also contributed to the IAEA's new requirements published in Preparedness and Response for a Nuclear or Radiological Emergency, jointly sponsored by the FAO, IAEA, ILO, OECD/NEA, United Nations Office for the Coordination of Humanitarian Affairs (OCHA), PAHO and WHO [6]. PAHO joined the Joint Radiation Emergency Management Plan of the International Organizations in 2002, convened by the IAEA and co-sponsored by the European Commission, FAO, International Civil Aviation Organization (ICAO), OECD/NEA, PAHO, OCHA, the United Nations Office for Outer Space Affairs (OOSA), WHO and World Meteorological Organization (WMO) [7].

2. RADIOLOGICAL HEALTH PROGRAM

The Radiological Health Program is currently located in the Area of Technology and Health Services Delivery within PAHO/HQ. Its main purpose is to advise in the field of radiological health, with particular emphasis on the orientation of policies and programmes towards strengthening the process of development, production, assessment, incorporation and utilization of appropriate technologies in the areas of diagnostic imaging, radiotherapy and radiation protection for the provision of comprehensive health services.

Based on the strategic and programmatic orientations, the current expected results contemplate three lines of work:

(1) *Radiology Services:* dealing with health services for diagnostic and interventional imaging, and for radiation therapy.
(2) *Radiation Protection:* involving the three types of exposures to both ionizing and non-ionizing radiation: occupational, medical and public.
(3) *Radiological Emergencies:* covering radioactive waste management programmes and emergency plans.

3. REGIONAL FACTS FOR RADIATION SAFETY

The lack of financial resources and the inefficient allocation of the available financial resources directly affect the radiation safety infrastructures in the region. This is manifested by inadequate and deteriorating physical resources, minimally trained staff, insufficient salaries for personnel and a lack of discipline in working habits. Consequently, there are unsafe radiation conditions for patients, the staff and the public. The need for physical infrastructure, equipment and supplies, human resources, maintenance, as well as quality control and quality assurance programmes must be appropriately addressed.

Only 19 PAHO member States have radiation regulatory authorities, and in some of them the responsibility is located at the Ministry of Health. In the other member States, the regulatory responsibilities are divided between two (or more) governmental agencies. Twelve PAHO member States are not Member States of the IAEA.

Abandoning spent radioactive sources seems common in countries in Latin America and the Caribbean region. Governments of the region need to develop national policies regarding radioactive waste from medical, industrial, research and educational activities.

There is an increasing concern of a terrorist attack in the region, using radioactive material as a component, which must be given special attention in the immediate future.

Several radiation accidents/incidents and patient overexposures involving deaths have occurred in the region:

— In February 1989, there was a radiological accident in El Salvador with a cobalt-60 industrial irradiator affecting three workers. The main operator died six months later, the second one needed to have both legs amputated and the third one may develop cancer later in his life.
— In the early 1990s, there were several accidents/incidents in some Caribbean countries involving discarded brachytherapy sources. In Trinidad and Tobago, the encapsulation of some caesium-l37 tubes had broken when they were removed from the disposable rubber Manchester applicators. In the Dominican Republic, a radiation oncologist had cut a radium-226 needle to fit it in the tandem of a gynaecological applicator. In Haiti, spent radium sources had been buried for safety purposes in a hole in the hospital garden in a room without a door to prevent access. In Guyana, radium sources were found jammed in an old storage vault.
— Two serious accidents involved stolen abandoned radiotherapy sources. In Ciudad Juarez, Mexico, in 1984, more than 4000 people were exposed when a cobalt-60 source was removed from its encapsulation and sold to a junkyard as scrap metal. The other accident, involving the theft of an abandoned caesium-137 radiotherapy unit, occurred in 1987 in Goiânia, Brazil. The number of people that had to be monitored was over 100 000; four people died.
— In the early 1990s, industrial as well as medical sources were found in a hole in the garden of a Nicaraguan facility, near an incompletely built radioactive storage area.
— From August to October 1996, in San Jose, Costa Rica, 115 patients were overexposed when a cobalt-60 unit used for cancer radiotherapy treatment was erroneously calibrated. By July 1997, 42 had already died; at least 7 of them due to the excess radiation. Of the surviving patients, 46 showed radiation related symptoms that ranged from severe to mild.
— Another patient overexposure occurred in Panama, also involving a cobalt-60 unit used for cancer therapy treatment. From August 2000 to March 2001, the treatment planning system was improperly used, affecting 28 patients. By October 2002, 19 patients had died, at least half of them from the overexposure.

4. PAHO POSITION IN RADIATION SAFETY

According to the PAHO constitution, the governing bodies set the organization's mandates. Regarding radiation safety, the following resolutions were approved:

— “To endorse the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources.”
— “To urge the Member States to draw on the guidance provided by the International Basic Safety Standards when establishing regulations and operational criteria in the field of radiation safety.”
— “To ask the Director, in accordance with the availability of resources from the Organization, to continue to cooperate with the Member States in the development and implementation of national plans on radiation safety.”

The PAHO Radiological Health Program will continue:

— Providing technical co-operation in radiation safety, in collaboration with the responsible national authorities (Ministries of Health, Radiation Regulatory Authorities, Standards Laboratories); international organizations; PAHO/WHO Collaborating Centers; and national, regional and global scientific, professional and technical societies and co-operative groups;
— Visiting countries, for the purpose of assessing national policies and resources, and advising on the role to be played by the health authorities;
— Collecting information on radiation protection legislation and regulations, and sending comments to national authorities as appropriate;
— Responding to radiation incidents/accidents and patient overexposures according to the national and international framework;
— Strengthening radiation safety services through the dissemination of information, the promotion of national policies and standards, the development of human resources, the provision of guidance and methodologies, by fostering the co-operation of national bodies to achieve local solutions and by developing relationships with international and multilateral partners;
— Organizing, co-sponsoring and supporting educational activities, such as courses, seminars, workshops, congresses and conferences at the national, regional and global levels;
— Reviewing technical documents prepared by national authorities, other international organizations and the scientific community at large;
— Serving as an official observer to the IAEA’s Radiation Safety Standards Advisory Committee (RASSAC);
— Providing consultation upon official request on planning radiological services, radioactive waste disposal in medical facilities, development and implementation of quality assurance programmes;

The concern about radiological emergencies caused by medical radioactive sources no longer in use is driving PAHO to work on a joint co-operation with the IAEA to help countries in the Americas in the safe management, replacement, conditioning and safety storage of spent or disused radioactive sources. In countries without an infrastructure in radiation protection, the latter task is difficult.

The region has obtained benefits from the collaboration between PAHO and the IAEA. However, there are some PAHO member States which are not Member States of the IAEA. Although PAHO is giving them technical co-operation in radiological health, should they possess or wish to possess any radiation source, PAHO suggests that they apply for IAEA membership for additional technical co-operation.

Since the application of radiation in the medical field is a health issue, PAHO encourages the ministries of health for full participation involvement in the development of national policies regarding radiation safety. Thus, a closer relationship between the atomic energy commissions (where applicable) and ministries of health is desirable in each country.

Finally, PAHO is willing to exchange information and collaborate in joint activities with international organizations, for example, in the IAEA's technical co-operation Model Project for Upgrading Radiation Protection Infrastructure.

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[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Organization and Implementation of a National Regulatory Infrastructure Governing Protection Against Ionizing Radiation and the Safety of Radiation Sources: Interim Report for Comment, IAEA-TECDOC-1067, IAEA, Vienna (1999).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiological Protection for Medical Exposure to Ionizing Radiation Safety Guide, Safety Standards Series No. RS-G-1.5, IAEA, Vienna (2002).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiological Protection of Patients in Diagnostic and Interventional Radiology, Nuclear Medicine and Radiotherapy (Proc. Int. Conf. Malaga, 2001), IAEA, Vienna (2001).
[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Preparedness and Response for a Nuclear or Radiological Emergency: Requirements, Safety Standards Series No. GS-R-2, IAEA, Vienna (2002).
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BACKGROUND SESSION

DISCUSSION

A. HASAN (USA): How does the IAEA assess the effectiveness of the education and training that it provides?

K. MRABIT (IAEA): The IAEA has established a mechanism for systematically assessing the effectiveness of education and training. I shall describe the mechanism in Topical Session 6 on ‘Needs for education and training at the international level (including IAEA programmes assisting in establishing adequate infrastructures)’.

C. SCHANDORF (Ghana): The IAEA has developed and is developing action plans which — like, for example, the draft action plan for the safety and security of radioactive sources and the draft action plan for occupational radiation protection to be considered by its Board of Governors next week — require additional efforts on the part of the radiation protection bodies in Member States. In most developing Member States, however, these bodies are already fully extended in performing their day to day radiation protection tasks. Is there any mechanism by means of which the IAEA can help them to cope with the additional demands arising out of action plans that it is implementing?

P.M.C. BARRETTO (IAEA): The basic mechanism is assistance through the IAEA’s technical co-operation programme. Developing Member States that are having difficulties in coping with such demands should request the necessary assistance when making technical co-operation project proposals to the IAEA.

K.L. SHRESTHA (Nepal): My country is not a Member State of the IAEA, although it is — I believe— preparing to apply for IAEA membership, and I should therefore like to know whether the IAEA can help non-Member States to strengthen their radiation safety infrastructures.

K. MRABIT (IAEA): The Statute of the IAEA says that the IAEA is authorized, inter alia, to provide for the application of (radiation protection) standards ‘at the request of a State’ in that State — it does not say that the requesting State must be an IAEA Member State.

However, the IAEA’s Board of Governors has decided that ‘non-urgent technical assistance’ may be provided by the IAEA to non-Member States only if all the costs (including administrative and other overhead costs) are met from non-IAEA financial resources, and the provision of the assistance will not interfere with the implementation of the IAEA's programme of technical co-operation with Member States.

Thus, the IAEA was unable to finance the participation of people from non-Member States in this conference. Their participation was financed from extrabudgetary resources provided by the United States of America.

In the long term, however, when it is a question of ensuring the safety and security of radioactive sources, one cannot leave some 50 countries without assistance. We are, therefore, seeking a solution to the problem through the establishment and implementation of an adequate extrabudgetary resources programme.

J.M. ROONEY (USA): The International Conference on Security of Radioactive Sources held in March 2003 in Vienna recognized the IAEA's Model Project on upgrading radiation safety infrastructure as "a powerful mechanism for assisting Member States in developing their infrastructures for the regulation and control of radioactive sources" and called upon the IAEA to explore how the Model Project approach might be applied to non-Member States.

I would welcome an opportunity to talk with the conference participants here from non-Member States in order to gain a better understanding of their countries' requirements as regards the safety and security of radioactive sources.

M.S. ABDULLAH (Yemen): In establishing a national infrastructure for radiation safety in my country, we had to start from scratch, and we encountered a problem that most countries in our part of the world have encountered when establishing such infrastructures: the need for long term training as opposed to short training courses. Only long term training that results in the trainees acquiring high level qualifications will contribute to the sustainability of national infrastructures for radiation safety. I should like to see the IAEA developing a strategy for the provision of long term training.

STAKEHOLDER INVOLVEMENT IN BUILDING AND MAINTAINING NATIONAL RADIATION SAFETY INFRASTRUCTURES

(Topical Session 1)

Chairperson

C.J. HUYSKENS
Netherlands

Keynote Address

STAKEHOLDER INVOLVEMENT IN BUILDING AND MAINTAINING NATIONAL AND INTERNATIONAL RADIATION SAFETY INFRASTRUCTURES

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1. INTRODUCTION

Contemporary society has become increasingly interested in participating in public decision making on health, safety and environmental protection issues. As governments have tried to better understand society's interests, and to better integrate societal needs in the decision making process, it has become possible to begin identifying common policy issues and lessons.

Trends in the nuclear industry mirror those observed for broader governance questions, and public interest in some issues can be extremely high. Within the radiological protection community, these stakeholder issues have moved steadily to the forefront of policy discussions, and clearly form key elements in decisions regarding the development and implementation of radiological protection policy.

For many years, the OECD Nuclear Energy Agency and its Committee on Radiation Protection and Public Health (CRPPH) has an active work programme on details and implications of stakeholder involvement in radiological protection decision making processes. The series of workshops in Villigen, Switzerland (in 1998 and 2002) and related follow-up work, offer assistance to the international radiological protection community on how to better integrate radiological protection into modern society. The lessons that have been learned in this area carry implications on national policy and on the governmental infrastructures necessary to carry it out.

2. EMERGING SOCIETAL EXPECTATIONS TOWARDS RISK POLICIES

Society's expectations with regard to policy towards risky technologies have changed significantly over the past 50 years, and perhaps most dramatically, over the past decade. Arrangements for the development and implementation of such policy may well fit with traditional theories from the disciplines of law, political science and engineering regarding democratic legitimacy, the delegation of power and the role of the expert. They may, however, no longer fit with a policy environment that is considerably more complex than those theories allow. The stakes are high for the radiation protection community as it seeks to recognize and accommodate these changed and changing expectations.

3. THE NEW CONTEXT OF RISK GOVERNANCE

The symptoms of changed societal expectations may, therefore, be quite clear in the form of the crises faced by public authorities and industry when tried and tested regulatory arrangements suddenly appear to lose public confidence. But if progress is to be made towards regaining that trust and confidence, and towards the avoidance of serious crises, then a better grasp of the new context of risk governance is required. The change can be characterized in terms of a definite *shift* from one state of affairs to another.

— *From the risk denial/catastrophe dichotomy to a more reasoned and realistic understanding of risk*. Thousands of deaths annually on the roads pass without general comment while a few deaths in a rail crash provoke a public outcry. In other words, with regard to rail travel, the public perception seems to be that there must be total safety and any failure in this regard is seen as a disaster. Generally speaking, however, there is evidence that the public is increasingly aware of the fact that zero risk is not possible and that every decision, whether at the policy or at the personal level, involves a balancing of possible risks and desired rewards. In this context, assurances from experts or regulators that something is safe is now less frequently regarded as an expression of total safety than as an assurance that something is *safe enough*. This, of course, begs the question of the methods and criteria used to reach that conclusion, and has implications for the policy process as a whole.

— *From an emphasis on risk perception to an emphasis on social trust.* While regulators and experts in the past had focused on how different *risks* were perceived, whatever the scientific picture, as a means of understanding adverse public reactions, there is now a greater need to focus on the public perception of the *process of making policy about risks.* In other words, it is not a question of factoring in 'irrational' fears but of considering how public trust in the policy process can be fostered.

— *From a top-down approach to risk governance to an approach based on mutual trust.* In practice, this means a shift away from an approach to risk governance that could be characterized as 'top-down', with regulators and experts 'announcing' solutions, to one where there is a more *dialogical* process involving much greater openness about assumptions, methods and value judgements.

— *From expert-led to pluralistic decision making.* It could be said that in this new model, experts and regulators no longer decide *for* the public but rather decide *with* them. This can be a difficult and controversial concept to grasp for all concerned, raising as it does issues such as the status of scientific knowledge, access to information, the appropriate role of the expert, and the precise location of responsibility for decision making.

— *From the concept of acceptable risk to that of accepted risk.* As difficult as this new approach seems to be as soon as one moves from the level of theory to the level of practice, the gain that may be realized is clear, in terms of a shift from *acceptable risk*, where that is ultimately the decision of experts, to a position of *accepted risk*, where there is broad understanding of the risks that must inevitably be run if desired societal rewards are to be achieved.

— *From a societal (utilitarian or teleological) ethical focus to an individual (deontological) ethical focus.* In other words, the shifts demanded in policy making on risk issues reflect the shift in political philosophy more generally in the past 50 years. A just society is now understood less in terms of a utilitarian calculation of the common good and more in terms of respect for individual rights. Similarly, risk policy must be less about the aggregation of populations and more about considering the position of individuals in specific risk contexts.

As risk is an important input into any stakeholder discussion involving radiological protection decision making, it is important to understand the different aspects of risk, and the different roles that it can play in the decision making process. First of all, there is the scientific aspect of risk assessment. Science can determine, as clearly as possible, the 'absolute' level of risk associated with a particular radiological hazard, including the assessment of uncertainties. In addition, science is self-assessing, and a transparent presentation of scientific judgements facilitates a critical review. Then there is the societal aspect of risk evaluation, management and acceptance. The evaluation, management and acceptance of risk will use scientific assessment as input for making judgements. However, social judgement may play a much more important role in decision making than the scientific assessment of the risk involved. Finally, there is the regulatory aspect of risk management. Competent national authorities establish policy and regulations for the protection of the public, the worker and the environment. In the absence of scientific certainty, authorities may apply the precautionary principle when establishing regulations. Stakeholder desire to participate in decisions involving public health or environmental protection has increased in many countries.

Science can assess the absolute value of a risk, but the acceptance of a risk is a social judgement. The use and importance of risk considerations can vary from case to case, region to region, and country to country.

4. CONCLUSIONS FROM THE VILLIGEN WORKSHOPS

There is widespread recognition within the radiation protection community in a range of countries of the need to change the way in which policy is developed and implemented. Whatever terminology may be chosen to describe the shift that has taken place in public expectations, and thus the context within which radiation policy must be elaborated, it is evident that this evolution has been discerned and is being acted upon. A striking feature of the innovative examples was, however, the extent to which they had been developed, by and large, in an ad hoc manner in response to the needs of a given situation whether at the highest level of priority setting, or at the most local level regarding a specific installation.

For all that, this has been largely successful as a result of the commitment of all the stakeholders to the various processes, there is clear merit in the widespread dissemination of best practice and of lessons learned from successes and failures. It is worthwhile to summarize some of the key lessons emerging from the Villigen Workshops as the radiation protection community continues to strive to meet societal expectations and remains sensitive to the dynamic context of risk governance.

— Perhaps the clearest lesson to emerge from the Villigen Workshops is the need to *foster mutual trust* between the radiation protection community and society as a whole. This can be done in a variety of ways, but in each case, the challenge for public authorities and experts is to identify the obstacles that stand in the way of mutual trust and to develop the means of overcoming them.

— There is no single blueprint for achieving this objective, and those involved must be sensitive to individual circumstances and *develop context-specific approaches*.
— Despite the need for context-specificity, certain principles must guide the development of innovative approaches including *openness*, *inclusiveness* and a *focus on developing procedures in common,* so that even if there is ultimately an agreement to disagree, all outcomes will merit respect.
— A significant challenge in developing such new approaches is the *clarification of roles*. There is frequently confusion about the respective roles of experts and political actors with regard to advice and decision making. Political actors can, for example, act as if scientific advice constitutes an instruction to decide in a particular way, while experts can sometimes encourage this perception. A strict separation is probably impossible and certainly undesirable given the range of decisions to be made at all levels on radiation protection issues. More open and inclusive procedures, however, will call for a greater awareness of roles and responsibilities.
— As significant as this last challenge is, some assistance can be derived from a proper *understanding of the nature of scientific rationality*. Provided it is kept in mind that science produces *knowledge* and not *certainty*, it is easier to see where advice ends and where a political decision begins. At the point of decision, there is an implicit acceptance to act as if knowledge were certain, with all that this implies for risk and responsibility. For example, where stakeholders are directly involved in decision making, this can help to focus attention on the responsibility that is the concomitant of participatory rights.
— The fact that the point of decision constitutes such a decisive step in 'converting' knowledge to certainty highlights the need for any innovative approach to radiation protection to adopt an explicitly *learning orientation*. Any engagement with stakeholders cannot be a once and for all exercise, but must envisage a future in which circumstances will change, whether in terms of the state of scientific knowledge or of societal attitudes and expectations.
— Nor is the need for a learning orientation confined to the possibility, indeed the probability, of change. It must be integral to any inclusive arrangement from the outset because it is fundamental to achieving the key objective with which this final summary began: *mutual trust*. In other words, if an approach to radiation protection which involves stakeholders is to fulfil its potential, it must be established in such a way as to encourage *mutual learning* where all concerned are able to learn from their interactions and factor that new information into their ongoing development of common solutions that enjoy general approval.

5. TOWARDS EFFECTIVE AND SUSTAINABLE INFRASTRUCTURES FOR RADIATION SAFETY

From these lessons, two key messages emerge. Firstly, stakeholder desire for involvement in policy and decision making involving radiological protection issues is increasing and will continue to do so. Broad groups of stakeholders will not necessarily be interested in most decisions. In fact, in most cases involving radiological protection, the national regulatory authority and the nuclear installation in question will be the only two stakeholders interested in holding discussions to reach an agreed upon solution. However, in some cases, the only way to reach a decision that will be accepted will be to enable broad groups of stakeholders to participate actively in discussions leading to a decision. Cases that involve public health and/or environmental health and safety are the types of situations that are most likely to require some sort of broad stakeholder involvement. As such, government policy and structure will need to be sufficiently flexible to enable such participation.

Secondly, governments must recognize that, in the situations mentioned where they have enabled broad stakeholder involvement, the outcome of discussions will not be predetermined, and is only loosely controllable through the establishment of an a priori decisional framework. While in most countries the regulatory officials are mandated by government to ‘make decisions’, in situations where stakeholder groups have contributed to the discussion process leading up to the decisional phase, stakeholders will expect that their views will be taken into account. As such, should the regulator, at the end of the process, choose a path other than that which was agreed upon by stakeholders, a significant loss of stakeholder trust and confidence will likely occur, making any other solution much less sustainable due to lack of support. Here again, policy and structural elements are necessary to allow governments to ‘release control’ over decisions in such cases.

Successful stakeholder involvement processes have shown that the processes and mechanisms for decision making and decision co-ordination are more important than the infrastructure itself.

Keynote Address

PUBLIC INVOLVEMENT IN REGULATORY DECISIONS
Some Australian experiences in accountability of the regulator

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1. SCOPE OF DISCUSSION

The term 'stakeholder' arose from thinking about companies — apart from the owners, the shareholders, who are the other people who have a stake in the work and the outputs of a corporation?

Stakeholders in a radiation safety regulatory organization include both management and workers in the regulatory organization itself. Outside the organization, they include the regulated operators and their workers. Then there are the users of the products and services of the operators, who have an interest in seeing that regulation of the operator does not drive up their costs unnecessarily. The stakeholders also include the government and legislature, which created the regulatory body and defined its scope. And, finally, the public is a stakeholder.

2. ROLE OF ARPANSA

Australia is made up of six states and two territories. This paper treats the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the national regulator and regulator of Australia's nuclear facilities, as if it is the sole regulator for Australia. Those who come from federations will know how to interpret the paper within different systems. Those who do not come from federations will not have to.

The CEO of ARPANSA is the regulatory decision maker and exercises those powers under an Act of Parliament. The Act has as its object "to protect the health and safety of people and to protect the environment, from the harmful effects of radiation". The Act also provides a framework for decision making. It says what is important to 'take into account' in deciding whether to issue a licence for using a radiation source or operating a facility. For licensing nuclear installations as defined in the Act, the CEO is required to take into account the matters raised in submissions from the public. For Australia, a nuclear installation includes a research reactor, major radioactive waste repositories and stores, and significant radiopharmaceutical production facilities.

ARPANSA is an official government entity under legislation. This means that the relationship of ARPANSA to the public is a part of the relationship between the Government and citizens, and is governed by law. This can be contrasted with a non-government commercial organization that can design its own relationship to the public in whatever way it chooses, albeit constrained by notions of corporate responsibility and legislative frameworks such as environmental legislation.

The role of the CEO is to make decisions on the basis of the best available evidence about safety. There is another level of decision making that is essentially political, and properly debated and determined within the framework of representative democracy, rather than as technical decisions.

3. DEFINING THE PUBLIC AND ITS ROLE IN REGULATORY DECISION MAKING

There are several different publics. The first is the 'local' public: the people who live near a radiation facility and who could potentially be exposed in the event of an accident. The second is the 'activist' public: those who belong to or are sympathetic to community and environmental groups that have a strong interest and a clear position on the use of radiation and nuclear facilities. Finally, there is everyone else in the society: the 'general' public.

What is the purpose of public consultation or involvement in regulatory decision making? That is, what is its role with regard to decisions to issue or not to issue a licence and impose certain licence conditions? In the decisions about whether a country will or will not have nuclear power, will or will not have a research reactor, will or will not undertake food irradiation and where any such facilities may be sited, the absolute necessity for public consultation and involvement can readily be seen. But what is the role in regulatory decision making?

No regulator should be so arrogant as to believe that there cannot be any insight into technical issues offered by members of the public. Some activist public representatives have long experience and have gained a great deal of knowledge during their careers. They may be able to point to flaws in a submission from an operator and to areas where there needs to be further argument made. Similarly, there can be well informed members of the general public who may offer particular insights.

A process of involvement also allows the public to make clear where its priorities lie in terms of safety. They may not be the same as regulatory priorities. Even if they are not consistent with the priorities determined by hazard and risk, they should, nonetheless, be taken into account. They inform the decision making process even if, ultimately, the conclusions of the regulator are different from those of the public.

The third and most vital role of effective public involvement in regulatory decision making is as an assurance of the integrity of the process. If the regulator engages and is seen to engage with the arguments and issues put forward by the public, including the activist public, then this is an assurance to the general public that the process is above board — ‘fair dinkum’ in Australian parlance.

4. AUSTRALIAN EXPERIENCES: CONSTRUCTION LICENCE FOR A RESEARCH REACTOR

The following is a description of the public process undertaken in connection with the decision as to whether to grant a construction licence for a replacement research reactor in Australia.

4.1. Public submissions

Two rounds of submission were invited from the public on the application. The application included a very detailed Preliminary Safety Analysis Report (PSAR) on the design of the reactor. Full copies were provided to local libraries, to each state and territory library, the local government body, national environmental groups and local activist groups. The application and a summary of the PSAR were placed on the ARPANSA web site.

As the technical assessment of the application progressed, the report of an international peer review of the PSAR, arranged through the IAEA, was made available as were some one thousand questions and answers arising during the initial review.

There were tens of thousands of submissions received — the great majority were form letters promoted by Greenpeace and others; but there were also a good number of substantive submissions.

Providing a second round of submissions also gave an opportunity for public reaction to the terrorist attacks in the United States of America to be expressed in relation to the project. Security and sabotage issues had not featured strongly in the first round of submissions.

All public submissions were analysed and the range of issues raised by them were logged and taken into account. A report was completed that described all the matters raised and how they were responded to in ARPANSA's assessment.

4.2. Public information sessions

ARPANSA had previously held two information sessions in the area surrounding the reactor site. For the information session on the construction licence application, an informal approach was arranged to try to maximize the interactions between the public and ARPANSA staff. The session was held 'in the round'. ARPANSA staff prepared poster presentations outlining the licence application, the ARPANSA regulatory criteria and the public consultation process. The public could wander around the room asking questions of the staff members.

The information session was successful in that about 40 people attended, mostly local residents, and the ARPANSA staff members were kept busy answering questions. The discussion to finish the session brought out the issues that were of main concern to the local people, being primarily arrangements for responding to accidents at the existing and proposed reactor.

A second information session on the application took place later in 2001. The success of the first session was not repeated. Reaction to the terrorist attacks on 11 September 2001 contributed to this, as did the fact that a national election campaign was in progress.

4.3. Public forum

Many people and groups pressed for a formal 'hearing' process such as takes place in the USA and Canada. Instead, a public forum was held that involved presentations by the applicant, other agencies, persons or groups that had made substantive submissions and public questioning by the CEO and a panel of independent experts.

A critical element for the forum was the agreement of all parties to follow the procedures in a spirit of co-operation and goodwill. One public interest group could not support the procedure and declined to attend, but all other invitees including the environmental groups agreed to take part, as did the applicant and other government agencies.

The independent individuals who assisted in questioning participants included an officer of the Canadian Nuclear Safety Commission, a nuclear consultant from the USA and a representative of the Australian Medical Association for the Prevention of War. All three provided reports after the forum, which were published on the ARPANSA web site, along with a transcript of the forum itself.

4.4. Council and committees

There was another channel for public involvement in this (and other) ARPANSA decisions. The law creating ARPANSA also creates a Radiation Health and Safety Advisory Council and two Committees — the Nuclear Safety Committee and Radiation Health Committee. The council and committees are made up of members with relevant expertise, but each has a member "to represent the interest of the general public". In addition, the Nuclear Safety Committee has a member from the staff of the local government area surrounding the reactor site. Three major issues pertaining to the construction licence were referred to the Nuclear Safety Committee for report to ARPANSA. Its reports were made public.

4.5. Decision and reasons

Finally, after all this public process and technical assessment, ARPANSA made its decision and published a detailed statement entitled Reasons for Decision on the web site. This statement included an analysis of public submissions, the reports from the Nuclear Safety Committee, the reports from the forum and a response to how ARPANSA dealt with them in making the decision to approve the construction and to impose various licence conditions.

Interestingly, the decision was contested legally by Greenpeace using general Australian administrative law. ARPANSA's decisions are, of course, subject to that law. The decision was upheld by the Court — and not appealed to a higher court.

5. LESSONS LEARNED

The process forced (and continues to force) ARPANSA to continually re-evaluate its position on contentious safety issues and to develop and document rigorous, principled arguments for the decisions it takes.

The process followed was extensive and thorough, consequently muting the standard criticism that people were being kept in the dark and that information was being withheld. The arguments advanced in public submissions were methodically dealt with and the process was seen to be open and responsive.

Public involvement in regulatory decisions is not able to achieve more than the three aims set out. If any regulator believes that by rational argument (as defined by ICRP Publication 60), activists can be convinced to drop their opposition to the siting of a research reactor or waste repository, then they are in for a surprise. But hopefully they will receive some insights, they will be challenged to think through their positions carefully, and they will understand the priorities of the public, and be able to respond to them and demonstrate integrity in their decision making.

Public involvement will be dominated by the activist public and mediated through the media. The media are more responsive to the approach of the activist public than to the approach of the regulator. These are facts of life. It is useless to rail against them and to assume that the activist public can be got around by appeal to a 'silent majority'. The activist public has to be engaged and their arguments considered in good faith by the regulator — not in an attempt to convince them, for they will not be convinced. Rather, the fact that their arguments are engaged by the regulator in an open fashion and that the arguments are taken proper account of — these are the means of giving some confidence in the process to the general public. The members of the general public may not have their own strong views but can be assured that the regulator is capable, professional and sensitive, because the regulator does engage and deal with the arguments that are put forward by the activists.

6. CONCLUSIONS

National radiation protection infrastructure benefits from a process of public involvement in regulatory decision making. It contributes to effective and sustainable regulatory decision making, the subject of this conference.

A commitment to a process for public involvement should be a part of international best practice in radiation protection and nuclear safety, reflected in the IAEA Safety Standards documents.

Each country has to devise the approach to public involvement that best suits its needs, its culture and its legal framework.

There is no right or wrong way to do it — and we can all learn from the experience of others.

Topical Session 1

STAKEHOLDER INVOLVEMENT IN BUILDING AND MAINTAINING NATIONAL RADIATION SAFETY INFRASTRUCTURES

DISCUSSION

C.J. HUYSKENS (Netherlands): I should like to open the discussion by asking a question and then answering it. The question is: "Is stakeholder involvement an objective in itself?" My answer is: "No, it is a means/process/technique/strategy for achieving an objective."

In connection with the building and maintenance of radiation safety infrastructures, policy makers and decision makers have objectives, the scientific and technical professionals have objectives, and various public parties have objectives. Some people might, therefore, regard stakeholder involvement as a kind of 'trick'. I do not think that it is; in my view, stakeholder involvement can make for better communication and greater transparency.

Stakeholder involvement in the area with which we are concerned here at this conference is rather like the 'informed consent' process that now exists in medicine. It ensures that all those who need to be properly informed are properly informed before the final decision is taken.

It is not the purpose of stakeholder involvement to persuade people to accept what has already been decided in some ivory tower. Stakeholder involvement should be a bottom-up, not a top-down, process.

J.M. ROONEY (USA): Has the European ALARA Network, described in a paper in Round Table 4, been extended to cover security in addition to radiation protection?

J.R. CROFT (United Kingdom): No, it has not.

C.J. HUYSKENS (Netherlands): In my view, one reason why it has not been extended to cover security is that there is not such a strong focus on security in Europe as in the USA— but that might well change.

J.R. CROFT (United Kingdom): I have, like C.J. Huyskens, had quite a lot to do with the European ALARA Network, and I would note that, in my view, there is a big difference in many people's minds between nuclear security (in other words, security within the nuclear fuel cycle) and the security of radioactive sources. The people in question feel that ensuring the security of radioactive sources is just part of the routine task of ensuring safety in radioactive source utilization. In their view, in order to ensure the safety of radioactive sources, it is obviously necessary to ensure that the sources are kept secure.

T. TANIGUCHI (IAEA): At the IAEA, we have brought our safety related and our security related activities together within a single department: the Department of Nuclear Safety and Security (formerly called the Department of Nuclear Safety), and are working to achieve the highest possible level of synergy between the two sets of activities.

One problem is that safety is enhanced by transparency, whereas security requires confidentiality. We shall have to solve this problem, particularly if the benefits of networking are to be enjoyed.

OVERVIEW OF IAEA MODEL PROJECTS

(Topical Session 2)

Chairperson

W. STERN
United States of America

Keynote Address

OVERVIEW OF THE IAEA'S MODEL PROJECTS FOR UPGRADING RADIATION PROTECTION INFRASTRUCTURE

Challenges, achievements and recommendations

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1. INTRODUCTION

The IAEA's radiation protection model projects now under implementation stem from a single, large, interregional technical co-operation project launched in 1994 [1]. In 1997, the activities of this interregional project were divided into five new regional projects: RAF/9/024 for Africa, RER/9/056 for Europe, RLA/9/030 for Latin America, RAS/9/021 for East Asia and the Pacific and RAW/9/006 for West Asia [2]. As implementation proceeded, each of these five regional projects were further subdivided in 2001 [3] into two projects, one on National Regulatory Control and Occupational Radiation Protection Programmes, and the other on Development of Technical Capabilities for Sustainable Radiation and Waste Safety. Hence, a total of ten projects are now being implemented. This division and subdivision was dictated not by technical but purely for administrative reasons. Technically, they all follow the same concept and implementation approach of the original interregional project. Hence, for this overview, the activities, experience and challenges of these 10 regional projects are treated as a single entity or project, as has been the case from the management point of view.

The Radiation Protection Model Project (INT/9/143) is the largest and the most complex technical co-operation project ever undertaken by the IAEA. At present, it is assisting 88 developing Member States of the IAEA and this number is increasing every year. It has been in operation for ten years, has trained over 4800 national staff, fielded over 1700 expert missions and provided a great deal of equipment and materials to the participating countries. The overall direct disbursement by the IAEA, as of July 2003, amounts to more than US $34 million. If training organized by the countries themselves is added, as their part of the project, the number of trained staff increases to about 23 000.

During the implementation, there were formidable challenges, including five radiological accidents (Bolivia, Costa Rica, Georgia, Ghana, Panama and Thailand), involving serious exposure or death.

On the other hand, considerable improvement was achieved in the status of radiation safety in the participating countries. In reality, there was more progress during these 10 years of implementation of the Model Project than in the previous 40 years of assistance in radiation protection provided by the IAEA. The achievements have been recognized internationally in many forums as well as its contribution to the enhancement and security of radioactive sources. For example, the President of the recent International Conference on Security of Radioactive Sources, held in Vienna, noted in the summary of his findings:

> "The Conference recognizes the Model Project on upgrading radiation safety infrastructure, now covering 88 Member States, as a powerful mechanism for assisting Member States in developing their infrastructure for the regulation and control of radioactive sources." [4]

Given the many lessons learned and the valuable experience gained, this overview is a timely beacon to guide future IAEA technical co-operation activities in radiation safety in general, and in radiation protection in particular.

2. THE SITUATION BEFORE THE MODEL PROJECT

The IAEA has assisted its Member States in radiation protection since the mid-1960s. However, early assistance was in response to requests received from Member States. The assistance was specific and punctual but did not consider the kind and adequacy of the existing national safety infrastructures or regulations.

Nuclear safety and radiation protection was not an area of interest to Member States and the demand for assistance through the IAEA's technical co-operation programme was small. However, after the accidents at Three Mile Island in 1979 and Chernobyl in 1986, demand increased considerably. Annex I shows the percentage for the different areas of assistance provided from 1979 to 2001. Noticeable is the dramatic decrease in the demand for projects in the area of nuclear power and the corresponding increase of projects in the area of safety that includes the projects in radiation protection.

In 1984, the IAEA introduced through its technical co-operation programme an interregional radiation protection project specifically aimed at assisting developing Member States in the promotion of a basic level of understanding of the IAEA's policy on radiation protection and in the practical aspects of the Basic Safety Standards for the use of radiation at that time [5]. The primary objective was to help the developing Member States to identify existing or potential radiation protection problems and to draw up national programmes to solve them. The group responsible was called the Radiation Protection Advisory Team (RAPAT).

Between 1984 and 1994, RAPAT missions were sent to 64 countries out of the 78 (82%) that were then receiving IAEA assistance [6]. These missions assessed their safety infrastructures and identified, together with the Member States, the immediate and future radiation protection needs and priorities. Similarly, a number of fact finding missions were also carried out in the early 1990s in countries of the former Soviet Union under joint initiative of the United Nations Development Programme and the IAEA, for strengthening radiation and nuclear safety infrastructures.

During these ten years of RAPAT, the IAEA trained hundreds of national staff, and provided large amounts of expert services in addition to equipment and materials. Annex II shows the RAPAT disbursements for training, expert services and equipment for the period of 1989 to 1993. During these five years, the disbursement amounted to US $23.5 million. RAPAT missions assessed the situation of radiation protection in the countries visited, briefed senior government authorities and sent recommendations to the competent authorities. Regretfully, the countries frequently did not follow up on the recommendations and in 1994, the project was discontinued without having achieved the envisaged goals.

3. WHY THE NEW PROJECT AND WHY 'MODEL'

The effectiveness of this early assistance was the object of an assessment in 1993. Surprisingly, it found that out of the countries receiving assistance, the vast majority still remained with poor or no infrastructure in radiation protection. This was a shocking discovery, considering the many years of assistance and the large volume of resources disbursed to correct the situation.

Clearly, the situation needed a fresh approach that would go beyond recommendations and isolated follow-ups by the IAEA, in order to find a satisfactory solution for the infrastructure problems. To achieve this, the IAEA contracted two consultants to develop a new approach for implementing the technical co-operation activities in this field that would overcome the difficulties encountered. After extensive review both of the past activities and the reasons for not achieving the expected objectives, the consultants proposed a new approach that consisted of the following elements:

— *Proactive role for the IAEA*: Instead of waiting for requests for assistance, the IAEA should be proactive and prepare, together with the Member State, a multi-year programme (not a project!) of radiation protection for the interested country.
— *National commitment*: Interested countries would be required to make a formal commitment to adhere to the agreed national activities (schedules and budget) and to appoint a national co-ordinator with commensurate authority.
— *Set of essential activities:* The country's specific needs would be identified from a set of essential activities to be carried out in the form of a work plan and used as reference for implementation. Additionally, milestones would be introduced to guide and measure achievements. This would ensure uniformity in the implementation.
— *Dedicated managers:* The IAEA would appoint managers dedicated exclusively to the project.
— *Condition for assistance:* No further technical co-operation projects involving ionizing radiation would be approved for those countries that, at the time of their request, had inadequate levels of safety for the kind of nuclear applications in use in their territory.

This set of characteristics identified this new approach as a 'model' for implementation.

The next step was then to prepare a proposal for a new interregional project with the above characteristics, named the Model Project for Upgrading Radiation Protection Infrastructure. Such a proposal was submitted in GOV/2696 to the Technical Assistance and Co-operation Committee (TACC) in October 1993 [1] and later approved by the Board of Governors of the IAEA and included in the technical co-operation programme (TCP) for implementation as of 1994. It received the code INT/9/143 and was considered as a 'model' for implementation. This was the first time the category of model appears in the IAEA's vocabulary to designate certain technical co-operation projects with special implementation characteristics.

4. IMPLEMENTATION

Implementation of INT/9/143 started in January 1994. To expedite the process, in 1995 the IAEA presented plans to accelerate implementation with detailed work plans for meeting the requirements of the BSS that were agreed upon with each of the participating Member States [7].

4.1. Participating countries and duration

The proposed duration was for five years. This long period of concentrated assistance was considered necessary to achieve the objectives of bringing most of the countries to an adequate level of radiation safety as well as building the necessary infrastructure to maintain safety. As it will be noted later, despite the presumed generous time allowed for implementation, it was still not enough.

A total of 52 countries participated in the activities carried out from 1994 to 2000 (Annex III). During this period, many countries experienced delays in implementing their part of the work plans. In particular, delays in enacting legislation or in the approval of regulations and in recruiting staff had a negative impact on the pace of implementation. The result was that at the end of 2000, when the project should have been completed, the participating countries requested an extension of two years. This was agreed by the IAEA.

At the same time, the technical co-operation programme received requests from an additional 29 countries to join the Model Project. This was also agreed to, although it resulted in having groups of countries at several stages of implementation. With these additional Member States, the number of countries participating in the project was 81 by 2001. Unfortunately, the two-year extension proved to be insufficient to complete the tasks and the project was, again, extended for four more years. The first period (1994–1999) is now called Phase I and the second (2000–2004), Phase II. The long duration of the project raises questions regarding commitments.

4.2. Milestones

To ensure uniformity in the implementation and to facilitate measuring the progress achieved by each country, the following five milestones were introduced covering all the topics of the work plans:

— *Milestone 1: The establishment of a regulatory framework* — the most time consuming activity — involves the drafting and promulgation of radiation protection laws and regulations; the designation and empowerment of a national regulatory authority; and the establishment of a system for the notification, authorization and control of radiation sources (including the preparation of an inventory of radiation sources and installations). Attainment of this milestone can be regarded as one of the main indicators of progress by a country in meeting its project obligations.

— *Milestone 2: The establishment of occupational exposure control* establishes individual and workplace monitoring programmes, including dose assessments, record keeping and quality assurance programmes. The effectiveness of the control system is strongly dependent on the soundness of the regulatory framework.
— *Milestone 3: The establishment of medical exposure control* relates to activities aimed at controlling the exposures of patients in diagnostic radiology, radiotherapy and nuclear medicine. It includes the establishment and implementation of appropriate quality assurance programmes. Priority was given to the control of patients in radiotherapy.
— *Milestone 4: The establishment of public exposure control* aims at radiation protection of the public and the environment. It involves programmes for the registration, control and safe disposal of radioactive sources and waste, for the control of foodstuffs and for environmental monitoring.
— *Milestone 5: The establishment of emergency preparedness and response capabilities* involves the development of plans and the allocation of resources to ensure the effectiveness of the national regulatory authority and other relevant organizations in dealing with different radiological emergency scenarios. Its implementation depends on the achievements of the previous milestones.

4.3. Training

While designing the project, it was realized that the availability of the qualified personnel was a prerequisite for an adequate, sustainable radiation protection infrastructure. To that end, recruitment of new staff and their training should receive high priority. Identified training needs were included in country-specific work plans to be implemented through national, regional and interregional courses and workshops, and through fellowships, scientific visits and on-the-job training.

The work plans assumed that national staff would be available to receive the training as scheduled. This was not always the case and without qualified personnel, the establishment of the infrastructure and services to be rendered suffered delays. The reasons for nonavailability of personnel were many:

restriction on recruitment, budget cuts, lack of replacements if a person leaves the country for an extended time, etc. These difficulties, however, do not overshadow the achievements of the training and the enhancement of the technical capabilities in the participating countries. The training modalities used and respective number of participants per region are given in Table I.

In addition to this practical training, during 1999–2000, long term educational courses leading to a diploma in radiation protection were established at the University of the Witwatersrand (South Africa), the National University of Malaysia and the High Institute for Applied Science and Technology (Syrian Arab Republic). This was in addition to the long-standing regional post-graduate course on radiation protection and nuclear safety offered by Argentina. These courses benefit from the IAEA's guidelines for establishing and improving national training programmes.

4.4. Expert services

This is the most effective means of technology transfer and the core of the IAEA's technical co-operation activities. The provision of this modality of assistance is shown in Table II.

Use of qualified experts from the regions was promoted and their number increased with time. This has many advantages, such as easier communication due to similarity of language, traditions and infrastructure. National consultants were also used, although on a smaller scale.

TABLE I. CAPACITY BUILDING THROUGH TRAINING (1994–2003)

Region	Scientific visits	Fellowships	Training course participants
Interregional	38	114	
Africa	40	134	506
East Asia and Pacific	70	208	932
Europe	72	52	815
Latin America	6	69	523
West Asia	65	258	940
Total	291	835	3716

TABLE II. EXPERT SERVICES PROVIDED (1994–2003)

Region	IAEA staff	International experts	National consultants	Participants in management meetings
Interregional	253	165	1	171
Africa	91	87	38	174
East Asia and Pacific	94	148	41	139
Europe	84	104	18	87
Latin America	70	231	35	86
West Asia	93	195	17	153
Total	685	930	150	810

4.5. Inventory of sources

Establishing a national inventory of radiation sources, including spent sources, was another high priority issue. Computer software (the Regulatory Authority Information System, known as RAIS) was delivered to all countries. Training was provided to expedite the registry and the regulatory control of radiation sources and practices.

The existence of 'orphan' sources and the resulting risk of accident were a major concern during implementation. Hence, efforts were made to search for and secure sources that had not been subject to regulatory control, sources that were in the inventory at one time but had since disappeared, and sources that were removed from their registered location without authorization, etc.

4.6. Evaluations

One of the reasons for having dedicated regional project managers for each technical co-operation geographical region was to have constant follow-up and timely correction of the problems. Therefore, the project enjoyed continuous assessment by the managers as well as by the National Co-ordinators.

In terms of location, the regional managers in Vienna were close to the technical officers. This helped in sharing experience and maintenance as well as providing uniformity in the implementation. In addition, the proximity to the technical officers greatly assisted in solving the problems in a timely manner. Regional meetings of decision makers, with the participation of high-level government officers, regulatory authorities and project personnel were another way to evaluate the implementation progress and needs, and to discuss strategic and technical issues.

Over and above these evaluations, the project also used independent peer reviews. Peer review teams consisting of international experts and IAEA officers provided an independent assessment of all project activities with an emphasis on the effectiveness of the regulatory infrastructure established in the countries visited. A total of 52 peer reviews were conducted as of August 2003, and an additional five are planned for implementation before the end of 2003.

An additional evaluation of the Model Project is scheduled to be done by the IAEA's Office of Internal Oversight Services (OIOS) in 2004.

5. CHALLENGES

The challenges during the implementation of the project have been many and of different magnitude and duration:

— *The sheer size of the project* and the volume of activities were a challenge for the IAEA and for the participating countries. The original idea of a single project manager had to be discarded soon after implementation started and replaced by four (and later by five) managers, fully dedicated to this project.

Similarly, it was also a challenge for the countries, because they had to cope with a project that required continuous attention and action by the officials in different ministries or government agencies at a much faster pace than their normal activities. Territorial disputes among government agencies were not uncommon.

— *Lack of human and financial resources.* In many countries, at the beginning of the project, there were nil or only a small number of personnel assigned to radiation safety activities. Even with the formal commitment of the countries, as required by the project, it was difficult to recruit new personnel for the tasks and for training. As such, progress towards the milestones took longer than expected.

— *Delays in the promulgation of legislation and regulations or other legal framework.* The designers of the project grossly underestimated the difficulties in the drafting, the parliamentary procedures and in the enacting of legislation or approval of regulations. This is currently still a challenge.

— *Institutional instability.* Changes in the administration, social unrest, change in priorities or changes in the personnel assigned to the project were challenges that were difficult to overcome and sometimes necessitated a reversion to the initial steps of implementation.

5.1. Countries' challenges for the future

Based on 10 years of implementation experience, some challenges that participating countries in the project may face in the future can be anticipated:

— Sustainability of the regulatory framework and the provision of radiation protection services;
— Further development of an effective national medical exposure control programme and its sustainability;
— Consolidation of a strategy on the prevention of radiological accidents. This will require not only the development of a national plan but also the establishment of an operational technical capability to respond to emergencies;
— Developing and implementing a policy and a programme for public exposure control with special attention to safety in the management of radioactive wastes. Here, another interregional technical co-operation project, Sustainable Technologies for Managing Radioactive Wastes (INT/4/131), may be of assistance;
— The continued development of qualified personnel in all areas of radiation safety. This will require maintenance of the national training programmes and keeping abreast of the international recommendations and standards. Such needs were already emphasized by the Buenos Aires conference in 2001 where States were urged to establish strategies for education and training of regulatory staff, including on-the-job training of inspectors.

6. ACHIEVEMENTS

Due to the high profile of the project, periodic reports on the progress in implementing the project and, in particular, in implementing the milestones were prepared for the Board of Governors of the IAEA [8, 9]. This is the only project in the entire technical co-operation programme to enjoy such status. The availability of these reports facilitates the step by step assessment of the achievements over time.

Annexes IV and V show the achievements per geographical region, as of July 2003, for the 52 countries participating in Phase I. The volume of information in these tables becomes apparent when the data for each of the elements of the milestones are examined in detail. Although a detailed assessment is beyond the scope of this overview, a simple examination will show that, out of the 52 countries considered:

— All countries either promulgated radiation protection laws (85%) or are in the final stages of promulgation (12%); three quarters of them have regulations (71%), regulatory authority (85%) and a system of notification, authorization and inspection (63%) in place (Milestone 1).
— As many as 85% achieved an adequate level of individual monitoring and control. Workplace monitoring, however, is lagging behind with only 58% (Milestone 2).
— Medical exposure control has been one of the most difficult milestones to achieve. Only one third of the countries have attained this milestone (Milestone 3).
— Similarly, public exposure control (Milestone 4) and emergency response plan (Milestone 5) were met only by a third of the countries. It should be noted, however, that activities for Milestones 3, 4 and 5 were intensified or, in some cases, initiated only in January 2000.

At first glance, this may look like a modest progress after 10 years' implementation. No, this is not the case. The figures show the dimension of the challenges that the developing countries faced in implementing the project and the complexity of the activities involved. Are the milestone goals set too high? Milestones 3 and 4, for example, may be too difficult for developing countries with large territories to achieve.

Another interesting aspect is the rate of achievements that can be derived from the data in Table III. It is clear that progress is not linear with the passage of time; it is slow in the initial period, then increases (due to the existence of countries with radiation safety levels closer to those described in the milestones), but then decreases with time. It seems that, after 10 years, the rate of implementation in the 52 countries reached a plateau and additional time will not significantly improve the picture. Countries that did not achieve Milestones 1 and 2 after so many years of work are unlikely to achieve them in another year or so.

TABLE III. HISTORICAL ACHIEVEMENT OF MILESTONES

Area	Achievement (in %)		
	1999	2001	2003
Law	67	77	88
Regulations	36	42	71
Regulatory authority	65	77	85
System of notification, authorization, inspection and enforcement	33	50	63
Occupational exposure control			
Individual	63	79	85
Workplace	50	56	58
Medical exposure control			
Diagnostic radiology	15	27	35
Radiotherapy	44	52	55
Nuclear medicine	9	19	29
Public exposure control			
Environmental monitoring	25	31	35
Waste management	13	19	30
Emergency response plan	13	19	30

Taking all these elements into consideration, the 89 countries currently participating shown in Annex VI can be classified into four categories:

(1) *Countries advanced in project implementation*: Countries that attained Milestones 1 and 2 and are advanced in the implementation of other milestones. These countries are the candidates for 'graduation' from the Model Project. They should now play the role of 'resource countries' for the region.
(2) *Countries where there have been implementation delays:* Countries that are revising existing legislation and national structure for radiation protection systems. These countries have all the technological information and all the elements to eliminate the delays.
(3) *Countries where there have been major implementation delays:* This includes countries that faced institutional instability, severe weaknesses in

their general infrastructure, inadequate support at the decision making level, changes in priorities or failure to mobilize the necessary resources. Under these conditions, the future directions and pace of implementation cannot be predicted.

(4) *Countries that joined the project in 2001 or later:* Countries that started participating during Phase II, hence not enough time has elapsed to be able to categorize them adequately.

Although the IAEA input into the project in terms of financial resources and technology has been substantive, the past experiences indicate that these inputs alone could not have achieved the progress observed in so many countries. Equally, such progress was not solely due to the dedication of the regional managers — who devoted all their time to the implementation of the project. Failures existed despite their efforts. The success must be attributed to a new factor or factors that did not exist in the past. One new factor is the change in attitude in the recipient country vis-à-vis this project, seen through the commitment of the national counterparts and support from senior government authorities. Excluding the countries that only recently joined the project, it is clear from the data presented in Annexes IV and V where such commitment existed and where it is lacking.

Such commitment is an important requisite in terms of technical co-operation and it should not be forgotten when designing regional or interregional projects.

7. CONCLUSIONS

Many practical and managerial lessons were learned during the 10 years of project implementation. Feedback about these lessons was given to the IAEA's planning and operations staff, to be used in the technical co-operation programme activities. For this conference, the following conclusions are relevant:

(1) The overall exercise is, by far, the largest and most complex technical co-operation project ever undertaken by the IAEA. The challenges were manifold, but it was successfully implemented simultaneously in five regions. The harmonized approach and the intensity of the activities resulted in considerable improvement in the level of compliance by participating Member States with the requirements of the BSS.

(2) The project promoted mutual understanding and sharing between the national regulatory authorities in the respective regions. The sharing of

information, utilization of laboratories for training, exchange of experts, etc., that took place was unknown before the Model Project became a reality.

(3) In most developing countries, there is only one regulatory authority responsible for radiation sources and other radioactive materials. These offices and personnel also often provide the technical support to customs officials and border police. Although the project was designed to increase the safety and security of radioactive sources, the infrastructure established and the training provided, it also addressed the root cause of illicit trafficking. Indeed, the establishment of a national system of registration, control and inspection of radioactive sources and materials is the basis for the prevention of their theft, sabotage, illicit trafficking or misuse. This additional benefit was not anticipated when the project was designed in 1993.

(4) With time, there has been a decrease in the enforcement of the concept of ‘government commitment’ which was one of the hallmarks of the original concept for the model projects. This concept must be preserved and reinforced in the countries that joined Phase II and with those that may join in the future. In addition, the management of the project should have remained unified within the IAEA, as was the case for the technical backstopping. These are important lessons for the implementation of comparable, large projects in the future.

(5) Finally, the rate in progress towards achieving the milestones decreased with time. It seems to have reached a plateau. Hence, it is unlikely that further project extensions will bring commensurable results. The project should be concluded at the end of 2004, after 11 years of implementation. The IAEA should continue to assist interested Member States through specific national, regional or subregional projects.

8. PROPOSAL

An international notification system should be created that encourages suppliers of radiation sources to inform the IAEA of the shipments to developing countries of certain categories of radiation sources. Reciprocally, countries importing such sources would notify the IAEA of their purchases. The IAEA could then advise the country on the best ways of managing the source or, if requested, provide the necessary technical assistance.

Annex I

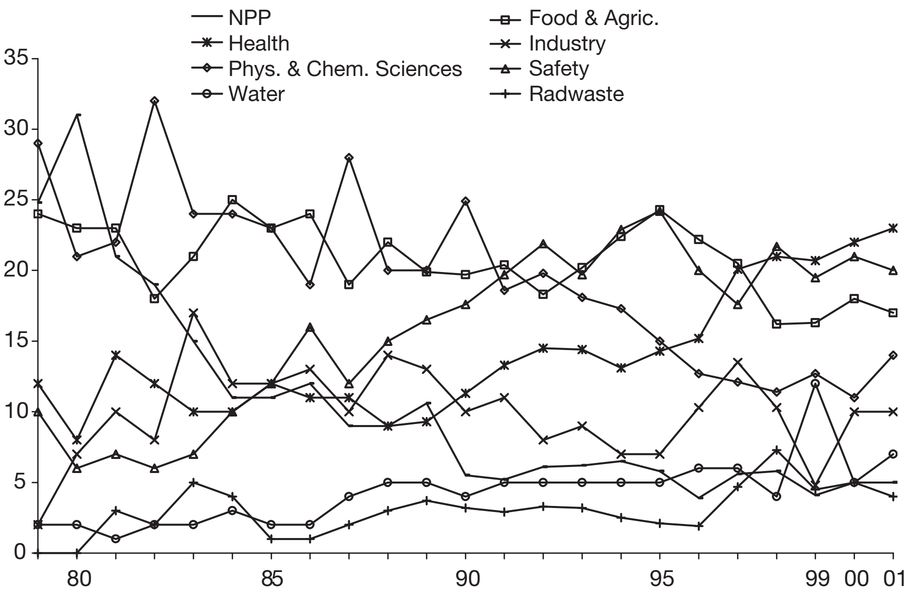

FIG. I-1. IAEA technical co-operation programme areas — disbursements 1979–2001.

Annex II

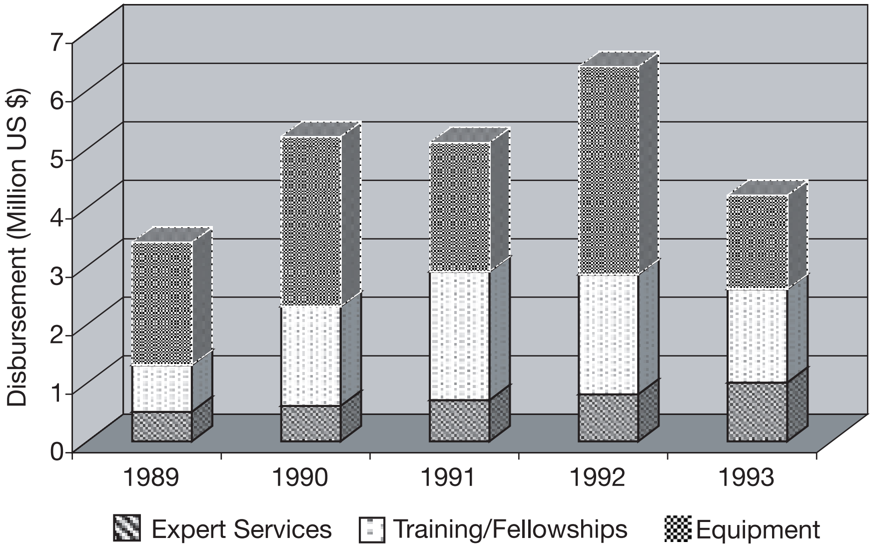

FIG. II-1. RAPAT disbursements by project component.

Annex III

TABLE III-1. COUNTRIES PARTICIPATING IN THE MODEL PROJECT INT/9/143 (DECEMBER 2000)

No.	Africa	Europe	Latin America	Asia & Pacific	West Asia
1	Cameroon	Albania	Bolivia	Bangladesh	Jordan
2	Côte d'Ivoire	Armenia	Colombia	Mongolia	Kazakhstan
3	Democratic Republic of the Congo	Belarus	Costa Rica	Myanmar	Lebanon
4	Ethiopia	Bosnia and Herzegovina	Dominican Republic	Sri Lanka	Qatar
5	Gabon	Cyprus	El Salvador	Viet Nam	Saudi Arabia
6	Ghana	Estonia	Guatemala		Syrian Arab Republic
7	Madagascar	Georgia	Jamaica		United Arab Emirates
8	Mali	Latvia	Nicaragua		Uzbekistan
9	Mauritius	Lithuania	Panama		Yemen
10	Namibia	Republic of Moldova	Paraguay		
11	Niger	The Former Yugoslav Republic of Macedonia			
12	Nigeria	Yugoslavia, Federal Republic of			
13	Senegal				
14	Sierra Leone				
15	Sudan				
16	Uganda				
17	Zimbabwe				

Annex IV

TABLE IV-1. PROGRESS IN ACHIEVING MILESTONE 1

Region*	Activity (in %)													
	1				2				3		4			
	Law				Regulation				Regulatory authority		System of notification, authorization, inspection and enforcement			
	1a	1b	1c	1d	2a	2b	2c	2d	3a	3b	4a	4b	4c	4d
Africa (17)	13	4	—	—	12	3	2	—	12	5	9	3	5	—
Europe (11)	11	—	—	—	6	2	3	—	10	1	7	1	1	2
Latin America (10)	9	1	—	—	9	1	—	—	9	1	8	1	—	1
East Asia (5)	5	—	—	—	4	1	—	—	5	—	4	—	1	—
West Asia (9)	8	1	—	—	6	1	2	—	8	1	5	3	—	1
Total	46	6	—	—	37	8	7	—	44	8	33	8	7	4
	88	12			71	15	14		85	15	63	15	14	8

* Number of countries in brackets.

1a Promulgated.
1b In final stage of development.
1c In draft stage of implementation.
1d No action taken.

2a Enacted.
2b In final stage of enactment.
2c In draft form.
2d No action taken.

3a Established.
3b Not established.

4a In place.
4b Being implemented.
4c At initial stage of implementation.
4d Not established.

Annex V

TABLE V-1. PROGRESS IN ACHIEVING MILESTONES 2 AND 3

	Milestone 2 (in %)						Milestone 3 (in %)								
	Occupational exposure control						Medical exposure control								
Region	Individual monitoring			Workplace monitoring			DR*			RT**			NM***		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
Africa (17)	13	4		6	10	1	5	8	4	4	1	12	1	3	13
Europe (11)	8	3		6	3	2	5	3	3	7	4		5	3	3
Latin America (10)	10	0		5	3	2	3	5	2	5	5		5	4	1
East Asia (5)	4	1		5			4	1		5			3	1	1
West Asia (9)	9	0		8	1		1	5	3	7	0	+	1	4	4
Total	44	8		30	17	5	18	22	12	28	10	12	15	15	22
	85	15		58	33	9	35	42	23	56	20	24	29	29	42

Note: Number of countries in brackets.

a National programme in place and operational.
b National programme being established.
c National programme not established.
* Diagnostic radiology.
** Radiotherapy.
*** Nuclear medicine.
+ Two countries do not have RT.

TABLE V-2. PROGRESS IN ACHIEVING MILESTONES 4 AND 5

Region	Milestone 4 (in %)						Milestone 5 (in %)		
	Public exposure control						Emergency response plan		
	Environmental monitoring			Waste management					
	a	b	c	a	b	c	a	b	c
Africa (17)	4	6	7	3	5	9	—	2	15
Europe (11)	6	3	2	7	2	2	7	2	2
Latin America (10)	5	5	—	3	4	3	5	3	2
East Asia (5)	2	2	1	—	1	4	2	2	1
West Asia (9)	1	6	2	2	4	3	1	6	2
Total	18	22	12	15	16	21	15	15	22
	35	42	23	29	31	40	29	29	42

Note: Number of countries in brackets.
a National programme in place and operational.
b National programme being established.
c National programme not established.

Annex VI

TABLE VI-1. COUNTRIES PARTICIPATING IN THE MODEL PROJECTS (AUGUST 2003) WITH YEAR OF ACCESSION

No.	Africa*	Europe	Latin America	West Asia	East Asia
1	Algeria (2002)	Albania (1996)	Bolivia (1996)	Islamic Republic of Iran (2001)	Bangladesh (1996)
2	Angola (2001)	Armenia (1996)	Columbia (1998)	Jordan (1997)	China (2001)
3	Benin (2003)	Azerbaijan (2003)	Costa Rica (1996)	Kazakhstan (1996)	Indonesia (2001)
4	Burkina Faso (2001)	Belarus** (1996)	Dominican Republic (1996)	Kuwait (2001)	Malaysia (2001)
5	Cameroon (1996)	Bosnia and Herzegovina (1996)	Ecuador (2000)	Lebanon (1996)	Mongolia (1996)
6	Central African Republic (2003)	Bulgaria (2001)	El Salvador (1996)	Qatar (1996)	Myanmar (1996)
7	Côte d'Ivoire (1996)	Croatia (2001)	Guatemala (1996)	Saudi Arabia (1996)	Pakistan (2001)
8	Democratic Rep. of the Congo (1996)	Cyprus (1996)	Haiti (1999)	Syrian Arab Republic (1997)	Philippines (2001)
9	Egypt (2001)	Estonia (1996)	Jamaica (1997)	Tajikistan (2002)	Singapore (2001)
10	Ethiopia (1996)	Georgia (1997)	Nicaragua (1996)	United Arab Emirates (1996)	Sri Lanka (1996)
11	Gabon (1996)	Hungary (2001)	Panama (1996)	Uzbekistan (1996)	Thailand (2001)
12	Ghana (1996)	Latvia (1996)	Paraguay (1996)	Yemen (1996)	Viet Nam (1996)

TABLE VI-1. COUNTRIES PARTICIPATING IN THE MODEL PROJECTS (AUGUST 2003) WITH YEAR OF ACCESSION (cont.)

No.	Africa*	Europe	Latin America	West Asia	East Asia
13	Kenya (2001)	Lithuania (1996)	Uruguay (2000)		
14	Libyan Arab Jamahiriya (2001)	Malta (2001)	Venezuela (2002)		
15	Madagascar (1996)	Portugal (2001)			
16	Mali (1996)	Republic of Moldova (1996)			
17	Mauritius (1996)	Romania (2001)			
18	Morocco (2001)	Serbia and Montenegro (2003)			
19	Namibia (1996)	Slovenia (2001)			
20	Niger (1996)	The Former Yugoslav Republic of Macedonia (1996)			
21	Nigeria (1996)	Turkey (2001)			
22	Senegal (1996)				
23	Sierra Leone (1996)				
24	South Africa (2002)				
25	Sudan (1996)				
26	Tunisia (2001)				
27	Uganda (1996)				

TABLE VI-1. COUNTRIES PARTICIPATING IN THE MODEL PROJECTS (AUGUST 2003) WITH YEAR OF ACCESSION (cont.)

No.	Africa*	Europe	Latin America	West Asia	East Asia
28	United Republic of Tanzania (2001)				
29	Zambia (2002)				
30	Zimbabwe (1996)				

*Botswana, Eritrea and the Seychelles are expected to join the Model Project RAF/9/027.
**Belarus concluded its participation in 2000.

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Keynote Address

THE IAEA MODEL PROJECTS
Achievements, challenges and recommendations — a Member State's perspective

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Abstract

The achievements and challenges of the IAEA technical co-operation Model Project for Upgrading Radiation Protection Infrastructure are essentially those of the various radiation protection programmes in IAEA Member States participating in the Model Projects. In the paper, some of the achievements are discussed with an emphasis on the challenges ahead as they were encountered during the implementation. The discussion is followed by recommendations for the future from the point of view of a Member State.

1. ACHIEVEMENTS

Any discussion about the IAEA technical co-operation Model Project for Upgrading Radiation Protection Infrastructure is a discussion about the radiation protection programmes in Member States themselves. Prior to the introduction of the Model Projects in 1994, the picture worldwide was rather bleak. Both the IAEA and Member States receiving its assistance had a rather passive approach in establishing and maintaining adequate safety and security infrastructures. A case example is Yemen. Prior to 1996, when Yemen joined the Model Project, there was no radiation protection infrastructure whatsoever — zero, nothing. With the introduction of the Model Projects in 1994, an unprecedented and unique proactive approach was initiated within the framework of the radiation protection infrastructure. Because of the proactive and integrated model project approach consisting of, inter alia, a strong national and IAEA commitment and the excellent assistance received within this framework, today, Yemen is one of the best performing countries in the region. Indeed, in terms of authorization licensing, inspection and enforcement, Yemen is one of the countries that has an adequate safety infrastructure.

The achievements of the Model Projects are now being assessed using performance indicators. This assessment methodology will be described in detail by W.-D. Kraus in his keynote address in Topical Session 8. For present purposes, only a brief example is discussed in order to illustrate the progress that has been made by the Model Projects.

The five milestones of the technical co-operation Model Project for Upgrading Radiation Protection Infrastructure are:

— *Milestone 1*: Establishment of legislative and regulatory infrastructure.
— *Milestone 2*: Establishment of occupational exposure control.
— *Milestone 3*: Establishment of medical exposure control.
— *Milestone 4*: Establishment of public exposure control.
— *Milestone 5*: Establishment of emergency preparedness and response capabilities.

Preliminary assessments have been done for Milestones 1 and 2. For example, Table I shows the percentage of countries participating in the Model Project in West Asia and in the world that have good achievements for Milestone 1.

TABLE I. PRELIMINARY DATA: PERCENTAGE OF MODEL PROJECT COUNTRIES IN WEST ASIA AND IN THE WORLD THAT HAVE GOOD ACHIEVEMENTS FOR MILESTONE 1 (IN ROUNDED FIGURES)

Parameter	West Asia (in %)	Rest of world (in %)
Legislation	90	80
Regulations	60	70
Regulatory IAEA independence	85	65
Regulatory IAEA staffing	75	60
Regulatory IAEA funding	70	50
Co-ordination and co-operation	75	60
Notification and authorization	50	50
Inventory of sources	60	65
Inspection and review	60	45
Enforcement	30	30

This means that the picture worldwide has improved. It also means that the region of West Asia is in a good position in the world. Similar preliminary assessments of performance indicators have been made in all regions for Milestones 1 and 2. These data will be reported to the Board of Governors of the IAEA in November 2003. It is hoped that in the future, these performance indicators will be periodically re-evaluated, and performance indicators for Milestones 3, 4 and 5 will also be assessed. Thus, the IAEA will have a quantitative and harmonized measure of Model Project achievements.

A comment about West Asia is in order at this point (i.e. the region in which Yemen is found). As shown in Table I, West Asia is in good standing in the world. Looking back less than 10 years, however, only a couple of countries (20%) in the region had legislation or regulations, compared with 90% today. Clearly, much has been achieved, thanks to the countires of West Asia and thanks to the IAEA Model Projects. One of the most important reasons why good progress has been made in West Asia is the coherence within this region's Member States, in addition to the excellent assistance of the IAEA.

2. CHALLENGES

Challenges of the Model Project are the challenges that are facing the radiation safety programmes worldwide. The main challenges are (in no particular order):

- High international holdings of radioactivity (mostly for no necessary reason) in China, the Russian Federation, the United States of America and the European Union, among others. This fact makes radiation protection programmes costly in these countries. Imagine that security officers are needed in every hospital or clinic in the USA;
- Sustainability of successful programmes (discussed later and in the recommendations);
- Poor infrastructure, in particular, tends to be apparent in countries in Africa, Asia and Latin America where the shortcomings include:
  - Lack of legal framework;
  - Lack of regulating authority;
  - Lack of human resources and/or funds;
- Flawed infrastructure, found in many different countries and regions, where:
  - The regulating authority is not independent;
  - The regulating authority is very weak (a small office in a ministry);

  - The regulating authority responsibilities are scattered among many institutions;
  - There are no enforcement capabilities;
- Absence of infrastructure: there are a number of countries, especially those which are not IAEA Member States, that do not have a radiation protection infrastructure (Yemen was one of these prior to 1996);
- Integrating security with safety within the framework of radiation protection. This is a new challenge and an important one (a detailed discussion of this issue is provided in conference paper CN-107/132 — in the CD-ROM).

3. THE SOLUTION

In principle, the solution is, firstly, to create, correct or update the radiation protection infrastructure in every country in the world. Secondly, it is to minimize the international holdings of radioactivity through recycling and bilateral, multilateral and regional co-operation (e.g. if a country has a source that is not needed and can be used by another, why not borrow it instead of buying a new one?).

Clearly, this is an idealistic vision. Realistically, however, the best solution available to many countries is the Model Project, as it has been so beautifully structured through its five milestones, listed previously, to do just what is needed.

The cornerstone of the Model Project and hence of any given country's radiation protection programme is Milestone 1: establishing the legislative and regulatory infrastructure. Therefore, it seems rational to suggest that all Member States should join the Model Project (even non-Member States).

From the Yemeni experience, it would take both the assistance of the IAEA and a strong national will to be able to build a successful radiation protection programme (see Fig. 1).

In this regard, the following list highlights the advantages of the Model Project:

- Proactive approach: problems are identified and resolved—no delay;
- Commitments of both the IAEA and Member States;
- The integrity of the structure (the five Milestones and an action plan associated with them);
- Coherence with ICRP recommendations and IAEA International Safety Standards;
- Excellent, practical and successful approach and methodology;

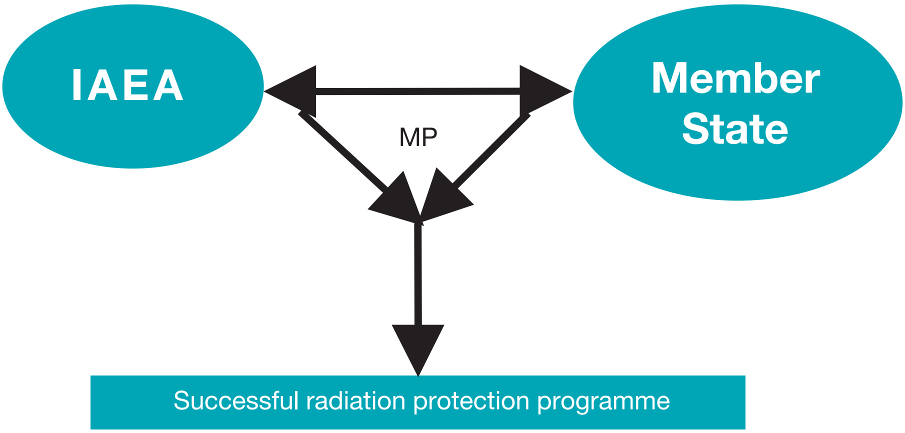

FIG. 1. Requirements for a successful radiation protection programme.

— No two-year cycle requirement (available resources and no delay);
— The regional dimension that allows for co-operation and sharing of experience, know-how and resources, and effective networking.

4. RECOMMENDATIONS

(1) All Member States should implement the International Basic Safety Standards and the Code of Conduct. An important first step is to implement Milestones 1 and 2 of the Model Project, and many countries have already taken this step.

(2) The Model Project should be continued for at least another four years and its approach should be adopted in any future work by the IAEA in this regard.

(3) Provisions for the integration of radioactive sources security within the Model Project structure should take place, particularly as the Model Project is renewed for at least four more years. A simple, cost effective and powerful approach to reconcile security with safety within the framework of radiation protection as described in conference paper CN-107/132 — in the CD-ROM.

(4) States must have the political will that can lead to a strong national commitment for a radiation safety and security programme in coherence with the international standards and other supporting documents.

(5) The IAEA and Member States should look for additional resources to strengthen the funding of the Model Project and its activities, in order to meet all the objectives of radiation safety and security.
(6) The Model Project approach should be followed to help countries that are not IAEA Member States, to develop an appropriate infrastructure for radiation safety and security. In fact, while non-Member States are encouraged to join the IAEA, they should be allowed to join the Model Project in the meantime, using extrabudgetary resources.
(7) The IAEA should encourage regional co-operation in radiation safety and security. It is the recommendation of this paper that in most cases, safety and security go hand in hand.
(8) As one of the most important tasks of the radiation protection programme, each Member State should establish a national registry of radioactive sources. It is edifying to learn that through extrabudgetary resources of the USA, the RAIS system is being upgraded, taking into account the Code of Conduct and Categorization of Sources.
(9) Member States should assess their infrastructures for radiation safety and security, with assistance from the IAEA, using the newly introduced performance indicators.
(10) Member States need to provide information to the Radiation Events Database (RADEV).
(11) To ensure continued sustainability of a strong radiation safety and security programme in a given Member State, the Member States must have a vested interest in the sustainability of any success in this area. In addition, the IAEA and Member States should work together to foster regional co-operation for the safety and security of radiation sources. Examples include:

— Establishing and operating a regional network;
— The regional harmonization of laws and regulations;
— The exchanges of information and expertise;
— Custom and border controls co-operation;
— Training in a specific language;
— Common culture approach to dealing with the public.

Member States should develop *strategies* for education and training, in order to sustain:

— A safety and security infrastructure;
— The required human resources;

— Appropriate controls of occupational, medical and public exposures;
— The ability to respond well to emergencies.

Member States should educate occupationally exposed workers (such as medical and irradiator facility staff and regulators), potentially exposed workers (such as source distributors, police, firefighters, scrap dealers, customs officers, border guards and news media staff) and the general public about radiological hazards, radiation protection, waste safety and emergency response.

(12) The IAEA should continue to organize future conferences dealing with radiation safety and security.

Topical Session 2

OVERVIEW OF IAEA MODEL PROJECTS

DISCUSSION

W. STERN (USA): At the end of Topical Session 1, T. Taniguchi spoke about the efforts of the IAEA to achieve the highest possible level of synergy between its safety related activities and its security related activities. In that connection, and pursuant to the presentation just made by P.M.C. Barretto, I would say that, if you are successfully implementing a sound regulatory infrastructure established for ensuring the safety of radioactive sources, you are already doing a great deal to ensure their security as well. Perhaps the question which needs to be answered is whether security should be addressed explicitly in the IAEA Model Projects.

S.B. ELEGBA (Nigeria): In my view, the Model Projects have proved to be very effective, and I would not like to see them terminated at the end of 2004. I would like to see the Model Project concept examined and then adjusted in such a way that the Model Projects can continue beyond 2004.

W. STERN (USA): I think that we need to find a way of ensuring that the Model Projects, with the necessary improvements made, continue beyond 2004 and that this conference could point the right way forward.

J.B. NYOBE (Cameroon): A problem which radiation protection specialists in very poor countries like Cameroon are facing is that radiation protection is not considered by our policy makers to be a high-priority issue, so that little or nothing is allocated to radiation protection in our national budgets.

In the allocation of budgetary resources, our countries tend to follow policies laid down by United Nations agencies, and I would therefore welcome it if those agencies were to recognize that radiation protection is important and reflect its importance in the policies which they lay down.

P.M.C. BARRETTO (IAEA): Further to what S.B. Elegba and W. Stern just said about the Model Projects, I would recall that a meeting is due to take place here later this week between, on one hand, the representatives of IAEA Member States which are participating in the Model Projects and, on the other, IAEA representatives.

In that connection, I think it would be useful to hear the views not only of Model Project participants but also those who are not participating in the Model Projects, and about what needs to be done in order to deal with the realities which may be expected in 2005, when the next IAEA technical co-operation cycle starts.

I take this opportunity to emphasize that there will be no break after December 2004; new projects may start in January 2005. During 2004, the IAEA will assess the project requests being received in order to obtain guidance on how the new projects should be designed. This conference and the meeting which I just mentioned could be very useful in that connection.

One of the things which will have to be borne in mind in the assessment of the project requests is that the IAEA now has a programme of security related activities with which its safety related activities should be combined as far as possible.

M. BAHRAN (Yemen): I believe that the revised Code of Conduct on the Safety and Security of Radioactive Sources will, if approved by the IAEA's Board of Governors next week, prove to be helpful in combining safety related activities with security related ones.

W. STERN (USA): In my view, it is important that both the safety and the security of radioactive sources be covered in the Model Projects.

The Code of Conduct relates to the entire life-cycle of radioactive sources, up to and including disposal, and I would be interested in hearing views about whether the Model Projects should also cover life-cycle management.

G.A.M. WEBB (IRPA): It should be borne in mind that the description of Model Project Milestone 4 (the establishment of public exposure control) refers to 'programmes for the registration, control and safe disposal of radioactive waste' and that most disused radioactive sources are one form of radioactive waste.

Given the emphasis now being placed on linking safety and security, perhaps thought should be given to focusing more on the waste management aspects of Milestone 4 as a means of promoting life-cycle management.

Every State represented here has or will ultimately have responsibility for managing radioactive waste properly. I should therefore welcome it if all of them — plus many more States — were parties to the Joint Convention, which provides a strong political motivation for the proper management of radioactive waste.

W. STERN (USA): I should like to see many countries entering into a political commitment to abide by the revised Code of Conduct and to ratify the Joint Convention.

With regard to the life-cycle management of radioactive sources, A. Hasan, who is currently working at the Sandia National Laboratories on the establishment of a life-cycle management programme for his home country, Egypt, might like to say a few words about that programme.

A. HASAN (USA): The programme is for the 'cradle to grave' management of sealed radioactive sources. Work on establishing the programme started in 2000, after an incident involving an iridium source claimed the lives of two people in Egypt. This programme is being funded by the United States Agency for International Development (USAID).

The programme will have two focuses: one on sources still in use, which are the responsibility of the Egyptian Ministry of Health, and one on sources no longer in use, which are the responsibility of the Egyptian Atomic Energy Authority.

We are developing a system for keeping track of all the radioactive sources in use in Egypt. The system will draw on experience gained with the IAEA's Regulatory Authority Information System (RAIS), which we may modify through, for example, the addition of a bar code capability. Raising the awareness of the users of radioactive sources and also of decision makers will also be important, as a means of reducing the number of incidents involving such sources; if the technician who had used the iridium source involved in the incident which I just referred to had been aware of the hazards associated with it, he would have reported its loss to his superiors immediately.

Another aspect of the programme will be the security of sources, since a large number of sources in one place — for example, a hospital — may tempt terrorists or others to steal them for malevolent purposes.

In addition, we are working with the Egyptian Atomic Energy Authority on issues such as the enforcement of regulations, the recovery of lost sources, the packaging and transport of sources, and the conditioning of sources for long term storage.

In due course, we shall work with them on the issue of disposal and emergency response.

P.M.C. BARRETTO (IAEA): Regarding G.A.M. Webb's comment about the waste management aspects of Model Project Milestone 4, I would mention that in 1994 the IAEA also launched a Model Project for strengthening radioactive waste management infrastructures, which is still running. Use has been made of the Model Project on many occasions, for example, in assisting Latin American countries with the conditioning of radioactive sources. However, the Model Project has not been as successful as the Model Projects which are the subject of this topical session.

K. MRABIT (IAEA): I should like to say a few words, not as the Scientific Secretary of this conference, but as the Technical Officer of the Model Projects since their inception in 1994.

First, I would emphasize that the Model Project concept is designed to enable the participating countries to meet the requirements of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the BSS) by attaining the objectives of the five milestones. All participating countries wish to meet those requirements because, in accordance with the Statute of the IAEA, the IAEA's Board of Governors approves technical co-operation projects involving the supply of radioactive materials only if the envisaged recipient countries have the radiation protection infrastructures necessary for handling the radioactive materials safely.

Second, I would also emphasize that the Model Project approach is a proactive one, with the IAEA — through its regional managers — working together with the participating Member States on the preparation and implementation of national action plans.

The commitment to the Model Projects on the part of some participating countries has declined somewhat, and we need to learn from events like this conference what should be done in order to restore the commitment of those countries to its original level. However, I believe that the Model Project concept and the Model Project approach are correct. At the same time, I also believe that the Model Projects can be adjusted, for example, along the lines which G.A.M. Webb seems to envisage with regard to the waste management aspects of Milestone 4.

Perhaps we should see whether we all agree that the Model Project concept and the Model Project approach are correct and, if we do agree, then consider how the Model Projects can be improved.

W. STERN (USA): From what I have heard, read and seen, I have the impression that there is extremely widespread agreement that the concept and the approach are correct.

K. SKORNIK (IAEA): As the IAEA's regional manager for the Model Project under way in Africa, I would say that the Model Projects paved the way for the initiation of security related IAEA activities in many participating Member States following the events of 11 September 2001. The attainment of Milestone 1 (the establishment of a regulatory framework) by those Member States was very important in that connection.

I should like to draw attention also to Milestone 5 (the establishment of emergency preparedness and response capabilities), and point out that the IAEA is involving national agencies responsible for law enforcement and security in the preparation of national action plans together with regulators. This is an area where much remains to be done.

IMPLEMENTATION EXPERIENCE WITH MODEL PROJECTS

(Topical Session 3)

Chairperson

M. MARKKANEN
Finland

Keynote Address

IMPLEMENTATION OF THE MODEL PROJECT
Experience of peer review assessment missions

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Abstract

The Model Project approach introduced in 1994 was based upon five objectives called milestones, developed to facilitate compliance with the requirements of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS). The primary objective of the project, the technical co-operation Model Project for Upgrading Radiation Protection Infrastructures is to assist Member States of the IAEA to address protection, safety issues and shortcomings in safety infrastructure for the control of radiation sources. Fifty-two Member States of the IAEA were assisted from 1995 to 2000. Currently, about 80 countries are benefiting from IAEA assistance under the framework of the Model Project. Participating countries in the different regions have been divided into two groups: those focusing on national regulatory control and occupational radiation protection programmes (Milestones 1 and 2); and those focusing on the development of technical capability for sustainable radiation and waste safety infrastructure (Milestones 3, 4 and 5). Peer review assessment missions were instituted in 1999 by the IAEA to assess the effectiveness of regulatory programmes for radiation safety, and thereby enable appropriate recommendations to be made which are meant to strengthen or upgrade the programme commensurate with the extent of application of ionizing radiation and radiation sources in the assessed Member States. The IAEA, noting that many of the peer review assessment missions are of a qualitative nature, is developing, in collaboration with consultants, a quantitative assessment scheme for evaluating national infrastructures for radiation safety. This scheme makes use of infrastructure parameters, assessment criteria and a performance indicator grading scheme to quantify and assess the progress in achieving compliance with the performance criterion for each of the infrastructure parameters of the milestones. The paper focuses on findings and recommendations of peer review assessment missions regarding the status of implementation of Milestones 1 and 2 and key issues for discussion.

1. BACKGROUND TO THE MODEL PROJECT

Even though the IAEA has assisted Member States through regional and many technical co-operation projects in radiation safety, in 1994, the IAEA launched an interregional technical co-operation Model Project for Upgrading Radiation Protection Infrastructure. The Model Project approach was based upon five objectives called milestones developed to facilitate compliance with the requirements of the BSS [1]. The primary objective of this project is to assist Member States to address protection and safety issues and shortcomings in safety infrastructure for the control of radiation sources. Fifty-two Member States of the IAEA were assisted from 1995 to 2000. Currently, about 80 countries are benefiting from IAEA assistance under the framework of the Model Project. Participating countries in the different regions have been divided into two groups: those focusing on national regulatory control and occupational radiation protection programmes (Milestones 1 and 2); and those focusing on the development of technical capability for a sustainable radiation and waste safety infrastructure (Milestones 3, 4 and 5).

This paper focuses on Milestones 1 and 2.

Milestone 1: covers the establishment of a national regulatory framework with the following infrastructure elements:

— Legislation;
— Radiation safety regulations;
— Regulatory authority established and effectively independent;
— Regulatory authority staffing;
— Co-ordination and co-operation at the national level;
— International co-operation;
— Notification and authorization;
— Inventory of sources;
— Inspection and review;
— Enforcement;
— Quality management system.

This milestone is considered to be achieved when:

— Legislation and regulations exist in a Member State based upon and/or compatible with the BSS and other IAEA safety related documents [1, 2];
— The organizational structure of the regulatory authority has been established with effective independence and sufficient resources to carry out inspection and enforcement actions [3];

— The regulatory authority has a sufficient number of qualified staff and appropriate training programmes;
— The regulatory authority has established procedures, including procedures for quality management and analysis of programme data, to ensure that it maintains an effective and efficient regulatory programme for radiation protection and safety of radiation sources.

Milestone 2: covers the establishment of occupational exposure control with the following infrastructure elements:

— Individual monitoring for external radiation;
— Calibration of monitoring equipment for external radiation;
— Workplace monitoring including dose assessment;
— Assessment of exposure due to natural radiation;
— Central dose record keeping for external and internal exposure.

This milestone is considered to be achieved when:

— External individual monitoring services relevant to the type of application is in place using thermoluminescent dectectors (TLDs), film dosimetry or other approved dosimetry techniques provided routinely to all relevant workers [4];
— Internal individual monitoring services relevant to the type of application by measuring radionuclides in the whole body or specific organs, in biological samples such as excreta or breath, in physical samples such as filters from personal or fixed air samples, or surface samples [5];
— There is a quality assurance programme available;
— The national services are in compliance with IAEA Safety Standards and guides, and accredited by the regulatory authority:

- Making use of qualified and appropriately trained staff;
- With available calibration services or, at least, free access to such services;
- Covering all workers or at least those having potential for exposure above the relevant dose limit;
- Having a centralized record of exposures of radiation workers;
- With the calibration service approved in an accredited comparative exercise.

2. CONDUCT OF PEER REVIEW MISSIONS

Peer review assessment missions were instituted in 1999 by the IAEA to assess the effectiveness of regulatory programmes for radiation safety and, thereby, to enable appropriate recommendations to be made that are meant to strengthen and upgrade the programme, commensurate with the extent of application of ionizing radiation and radiation sources in the assessed Member States. The assessment involves an examination of all the infrastructure elements of the five milestones of the programme for radiation safety as they are established, organized and implemented by the regulatory authority, in order to determine whether they are achieving their intended purposes, and to identify areas needing remedial actions and make recommendations where adjustments or changes might be made to optimize effectiveness.

The IAEA selects peer review teams from a group of experts — usually two or three individuals who, collectively, have a good understanding and extensive practical experience with the organization, as well as with operational and technical aspects of a regulatory control programme.

The assessment of effectiveness of a regulatory control programme covers the following infrastructure elements:

— The legal framework comprising legislation, regulations and guidance documents;
— Regulatory authority empowerment to exercise its regulatory functions;
— Notification;
— Authorization by registration and/or licensing;
— Inspection;
— Enforcement;
— Investigation and follow-up;
— Technical services;
— Co-ordination and co-operation;
— Staffing and training;
— Funding;
— Information dissemination.

The assessment begins with an entry briefing with the counterpart, the head of the regulatory authority and all key stakeholders. This meeting provides the opportunity for discussion on the objective and scope of the assessment, how it will be conducted and how the findings will be reported.

The assessment includes analysis of data, examining documents, visiting appropriate facilities and offices, and interviewing regulatory authority managers and other staff.

The peer review team members keep an accurate record of files and data examined, interviews conducted and visits of facilities and offices of relevant radiation users and technical support services carried out, and other relevant activities so that the basis of findings, conclusions and recommendations can be adequately documented in their report. The peer review team leader directs the frequency of meetings (usually daily) with the counterpart to discuss progress, findings and direction of the assessment. Towards the end of the assessment, the peer review team develops recommendations and assigns priorities to them.

Upon completion of its work on-site, the peer review team holds an exit meeting with the regulatory authority management and principal staff members involved to discuss the findings, conclusions and recommendations likely to be included in its report, and to agree on any outstanding discrepancies, determine missing information and in order to take into account any comments regarding the conduct of the assessment.

IAEA-TECDOC-1217 [6] provides the methods for conducting peer review assessment to obtain qualitative and quantitative information and questions leading to performance indicators. This document also provides guidance on how to use checklists in the assessment of regulatory staff performance.

3. FINDINGS AND LESSONS LEARNED FROM PEER REVIEW MISSIONS

The IAEA must be commended for the leading role it plays in the selection of experts, co-ordination of contacts between experts and project counterparts, and regulatory authorities in the Member States being assessed, in particular, in developing a consensus methodology for a graded approach to the assessment of the effectiveness of a regulatory programme by external qualified experts through the issue of IAEA-TECDOC-1217 [6]. The findings of peer review missions assist the Members States to readjust or update programme implementation direction (action plans). They also assist the IAEA to cost effectively provide focused assistance to Member States in order to speed up the implementation of the requirements of the BSS.

An inadequate infrastructure for radiation and waste safety, in particular, the regulatory infrastructure was identified in a number of Member States as the main reason for not meeting the requirements of the BSS. The root causes and contributory factors identified are:

— Political and institutional instability;
— Inadequate commitment at the decision making and management level;
— Unfocused regulatory structures;
— Long delays in the legislative and regulations enactment processes;
— Budgetary constraints.

These factors make the achievement of Milestone 1 the most time consuming activity. The attainment of Milestone 1 is considered as the primary indicator of progress in meeting the Model Project objectives. In fact, attainment of this milestone has a direct bearing on the effective attainment of other milestones.

The attainment of Milestone 2 is constrained in many countries by budgetary constraints resulting in insufficient resources, both human and in terms of facilities and buildings to house equipment supplied by the IAEA. Poor conditions of service mitigate against the retention of qualified staff.

Lack of succession plans for an effective replacement of qualified and experienced staff who retire from active service is a contributing factor to the inability of some Member States to sustain the achievement of the milestones.

The use of performance indicators has been found to be a useful tool for gauging the progress of implementation and identification of problem areas needing particular attention.

Tables I and II provide an overview of the performance indicators for the elements of infrastructure for Milestones 1 and 2, and key problem areas that limit or have the potential to limit effectiveness.

4. KEY ISSUES FOR DISCUSSION

4.1. Management and leadership

The objectives of the Model Project in a Member State are achieved more efficiently if activities and resources are managed as a process. A systematic approach to management ensures that there is identification, understanding and management of the interrelationships of the various elements of radiation safety infrastructure elements which contribute to organizational effectiveness and efficiency. Applying the principles of a systematic approach to managing the Model Project ensures the involvement of staff who are actively seeking opportunities to enhance their knowledge, skills and experience. In addition, it ensures that the system is continually improving through monitoring and evaluation.

TABLE I. PERFORMANCE INDICATORS TO ASSESS THE EFFECTIVENESS OF THE REGULATORY PROGRAMME FOR MILESTONE 1

MILESTONE 1: REGULATORY FRAMEWORK		
Element of infrastructure	Performance indicators	Problems areas
1.1. Legislation	Legislation provides effective empowerment of the regulatory authority (RA)	Updating legislation existing before the issue of the BSS and supporting documents
1.2. Radiation safety regulations	Regulations compatible with the BSS	Developing a prioritized set of regulations and regulatory guides in keeping with IAEA guidance documents. It is noted that IAEA documents started being available three years after the BSS. Practice-specific regulations versus practice guidance documents, which way?
1.3. Regulatory authority establishment and independence	The RA established and effectively applies a systematic approach to the fulfilment of its responsibilities	Delays in establishing the regulatory authority and empowering it with adequate resources to fulfil its functions. Full independence is a graded process which depends on the system of governance and rule of law in the country
1.4. Regulatory authority staffing	The RA has an adequate number of staff with the necessary qualifications, experience and expertise to undertake its functions and responsibilities, making use of consultants and advisory bodies where necessary	Adequacy of the number of competent staff members depends on the scope of the regulatory programmes. Due to budgetary constraints and the time frame required to develop appropriate competencies, the full complement of competent staff is lacking in a number of Member States

TABLE I. PERFORMANCE INDICATORS TO ASSESS THE EFFECTIVENESS OF THE REGULATORY PROGRAMME FOR MILESTONE 1 (cont.)

MILESTONE 1: REGULATORY FRAMEWORK		
Element of infrastructure	Performance indicators	Problems areas
1.5. Regulatory authority funding	The RA to be provided with adequate financial and other resources for staffing, staff training, buildings, facilities, equipment, use of consultants, etc. in order to operate effectively and perform all of its functions	Inadequate funding for the RA is the most challenging aspect of managing a regulatory programme in most Member States. This condition makes RA resources and facilities inadequate for fulfilling its tasks
1.6. Co-ordination and co-operation at the national level	Co-ordination and co-operation between the RA and other organizations is effective on the assumption that no single organization can handle all matters associated with radiation protection and safety of radiation sources	The RAs have identified the co-ordination and co-operation needed to fulfil their mandate, but a formal legal binding memorandum of understanding has not been established in a number of Member States
1.7. International co-operation	Necessary co-operation is formally established and maintained with other RAs in the region and with other relevant international organizations (e.g. ILO, WHO)	The establishment of formal co-operation with other RAs and with other relevant organization depends on the region and the stage of a Member State's programme
1.8. Notification and authorization	Notification and authorization system of the RA functions fully and covers all practices and radiation sources	Most Member States are using the Risk Assessment Information System (RAIS) as a management tool for their system of notification and authorization. Upgrading of RAIS to make it more effective and efficient is long overdue

TABLE I. PERFORMANCE INDICATORS TO ASSESS THE EFFECTIVENESS OF THE REGULATORY PROGRAMME FOR MILESTONE 1 (cont.)

MILESTONE 1: REGULATORY FRAMEWORK		
Element of infrastructure	Performance indicators	Problems areas
1.9. Inventory of radiation sources	National level inventory established through the notification system that can be used to effectively identify radiation sources under control and their location	The facility provided by RAIS is being used to have an effective inventory system to effectively identify their location and their status from possessions, use, transfer, storage and disposal
1.10. Inspection and review (compliance)	The RA has established an effective functioning inspection regime	Many Member States need to bring their inspection programme in line with IAEA-TECDOC-1113 [7], at least for the most common practices
1.11. Enforcement	The RA makes use of its enforcement powers and the enforcement procedures fully developed and is effective in enforcing compliance with regulations	Most regulations do not cover details about enforcement actions. Development of supporting enforcement procedures and enforcement notices to facilitate effective enforcement of compliance with administrative, protection, safety and security requirements are not in place in some Member States
1.12. Quality management systems	The RA has established procedures, including procedures for quality management and analysis of programme data to ensure that it maintains an effective and efficient regulatory programme for radiation protection and safety of radiation sources	Developing a quality management system compatible with the relevant ISO 9000 series to cover all the regulatory activity is a major undertaking for proper registration/certification by the appropriate national body or the ISO (this is non-existent in most Member States)

TABLE II. PERFORMANCE INDICATORS TO ASSESS THE EFFECTIVENESS OF THE REGULATORY PROGRAMME FOR MILESTONE 2

MILESTONE 2: CONTROL OF OCCUPATIONAL EXPOSURE		
Element of infrastructure	Performance indicators	Problems areas
2.1. Individual monitoring for external radiation	One or more dosimetry services are available and are operating to satisfactory standards, including the use of type-tested dosimeters, adequate quality management systems, and assessment testing and approved by the RA. Required dosimetry is provided to all relevant workers	Many countries had individual monitoring for external exposure existing before the issue of IAEA Safety Guide No. RS-G-1.3 [4]. Making operations in this area compatible with this guide is a challenge that needs to be managed
2.2. Calibration of monitoring equipment for external radiation	A national or regional calibration system is available; such as SSDL which is available to all potential users. The system is traceable to a primary standard, has good quality management systems and covers all required radiation types and qualities. Its use is prescribed by the regulations for individual and workplace monitoring and verified by the RA	Apart from the SSDLs established under the auspices of the IAEA/WHO network establishing a national level calibration laboratory is major capital investment for many Member States. There is the need for the IAEA to assist existing SSDLs to provide well co-ordinated regional and sub-regional calibration services to needy States. Availability of good management is a general weakness
2.3. Individual monitoring for and assessment of intakes of radionuclides	One or more dosimetry services are available for both direct and indirect methods and measurements, and for dose assessment as needed. These operate to satisfactory standards and are approved by the RA. They provide the needed dosimetry to all relevant workers	A few Member States have advanced to the level required by IAEA Safety Guide No. RS-G-1.2 [5]. A number of Member States would need internal dosimetry services if proper initial assessment for potential intake of radionuclides is done, particularly in the mining sector

TABLE II. PERFORMANCE INDICATORS TO ASSESS THE EFFECTIVENESS OF THE REGULATORY PROGRAMME FOR MILESTONE 2 (cont.)

2.4. Workplace monitoring	Programmes for workplace monitoring and exposure assessment, including quality management systems and services for calibration and maintenance of instruments, as prescribed in the regulations and approved by the RA for all types of facilities. Implementation verified by the RA	Maintaining and keeping to the frequency of calibration and maintaining a reliable and sustained record of the workplace, developing a maintenance capability and establishing a QA system are problem areas
2.5. Central dose record keeping for external and internal exposure	There is a centralized record keeping system for external and internal occupational exposures, operated and approved by the RA. Periodic assessment re: national occupational exposure data.	For countries with multiple dosimetry services, establishing a central dose recording system is a challenging undertaking due to reliability, credibility of record keeping, and retrieval and harmonizing of record keeping matrices

Effective leadership establishes unity of purpose and direction of the regulatory authority, and creates and maintains the internal environment in which all staff members become fully involved in achieving the organizational objectives. Applying the principles of leadership ensures that the establishment of a clear vision of the regulatory authority's future; setting challenging goals and targets; providing staff with the required resources and training; nurturing responsibility and accountability; as well as inspiring, encouraging and recognizing the human contribution.

It has been observed by many peer review teams that Member States where good management and leadership principles are in place make considerable progress in a timely and cost effective manner despite challenging budgetary constraints.

4.2. Independence of the regulatory authority

An effectively independent regulatory authority is one that is adequately empowered by legislation, with the right to communicate directly with high-level governmental authorities. Effective independence means organizational and financial independence from:

- Governmental organizations that are responsible for promotion and development of the practices being regulated;
- Registrant, licensees, designers and constructors of the radiation sources and facilities used in practices.

For some regulatory authorities, there is a conflict of interest since they are charged with the responsibility of providing technical support services, including individual monitoring for external and internal radiation exposures, calibration and consultancy services, since there are no competent institutions to carry out these responsibilities.

4.3. Sustainability of the regulatory programme

Sustainable development means meeting the needs of the present without compromising the needs of future generations. For an adequate national radiation safety infrastructure, the four essential elements of sustainability are:

- *Sustainable legal framework*: ensured by a transparent system of governance and rule of law that supports a coherent system of radiation and nuclear legislation and regulations, code of practice or practice specific regulatory guidance documents which are amenable to updating in order to respond to current trends in radiation and nuclear applications and emerging technologies. The availability of core personnel trained in nuclear and radiation legislation who can be used as and when needed will facilitate sustainability in this area.

— *Sustainable physical facilities*: ensured through a culture of preventative maintenance and repair capability for all equipment, instruments and facilities available, including users' and maintenance manuals, repair kits and vital spare parts; as well as quality assurance and quality control systems.
— *Sustainable human resources*: ensured by the availability of an adequate number of qualified and experienced staff for all activities working under a very competitive condition of service, with an effective mechanism for replacement of lost staff members within the shortest possible lead time and retention of staff.

  Additionally, the availability of a national level competence building programme for regulatory staff, users of radiation sources, qualified experts and health professionals will go a long way to sustain the human resources required in radiation safety [8, 9].
— *Sustainable financial resources:* ensured by timely and adequate government budget allocation, independent of fees from the regulatory authorization or fines, as well as a transparent and accountable management of funds.

5. QUANTITATIVE ASSESSMENT OF THE EFFECTIVENESS OF A REGULATORY PROGRAMME

The IAEA, noting that many of the peer review assessment missions are of a qualitative nature, is developing, in collaboration with consultants, a quantitative assessment scheme for evaluating national infrastructures for radiation safety. This scheme makes use of infrastructure parameters, assessment criteria and a performance indicator grading scheme to quantify and assess progress in achieving compliance with the performance criterion for each of the infrastructure parameters of the milestones [10].

6. CONCLUSIONS

Findings of peer review missions have proved very useful in providing the motivation and the challenge for Member States to work towards achieving the requirements of the BSS. The recommendations from these missions form the basis for upgrading and/or making adjustments to the regulatory programme implementation plans, in order to ensure speedy implementations of the Model Project. The mission's findings provide inputs for updating Member States Country Radiation and Waste Safety Profiles (CRWSPs).

The development and issue of IAEA-TECDOC-1217 [6] has created the enabling environment for peer review teams to use the same methodology for assessing the effectiveness of Member States' regulatory control programmes. This framework does not preclude the need for the careful selection of a team of experts with requisite knowledge and experience appropriate for the country to be assessed. The success of any mission depends very much on the synergy between team leader and team members, and the way that the assignment is organized and implemented. Adequate pre-mission access to information about the regulatory programme of the country to be assessed is a very important prerequisite for a fruitful mission.

The time allotted to the review team to perform their assignment is also another important factor. This depends on the nature of the assignment and extends to the regulatory control programme being examined. The usual three working days in a week allotted in many cases is not adequate to verify the information provided by national project counterparts and to observe on-site inspections of relevant facilities, as specified in IAEA-TECDOC-1217.

The IAEA is developing a quantitative assessment scheme, known as the National Infrastructure for Radiation Safety. This scheme makes use of infrastructure parameters, assessment criteria and a performance indicator grading scheme to quantify the progress in achieving compliance with the performance criterion for each of the infrastructure parameters of the milestones.

The sustainable issues highlighted should be given the attention they deserve so that, in the final analysis, the huge investments made over the years to establish national infrastructure for radiation safety will not compromise the protection and safety needs of future generations.

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Keynote Address

IMPLEMENTATION EXPERIENCE OF THE RADIATION PROTECTION INFRASTRUCTURE IN LITHUANIA

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Abstract

A national radiation protection infrastructure has been created in Lithuania in order to ensure radiation protection in the country and to comply with the IAEA and European Union requirements and recommendations regarding radiation protection. The new laws, namely, the Law on Radiation Protection, the Law on Nuclear Energy, the Law on Radioactive Waste Management, and different regulations were approved. The Radiation Protection Centre of the Ministry of Health is the regulatory authority responsible for radiation protection both of members of the public and employees associated with the nuclear industry in Lithuania. According to the Law on Radiation Protection, the Radiation Protection Centre is a body co-ordinating the activities of executive and other bodies of public administration and local government in the field of radiation protection, exercising State supervision and control of radiation protection, monitoring and expert examination of public exposure. Problems connected with establishing the national radiation infrastructure in Lithuania are presented and their solution is discussed.

1. INTRODUCTION

Lithuania has few nuclear facilities. There are two nuclear reactors of RBMK-1500 series with liquid and solid radioactive waste treatment and temporary storage facilities, an on-site dry spent nuclear fuel interim storage facility at the Ignalina nuclear power plant. However, when considering problems of radiation protection and safety of sources, it should be emphasized that there are more than 890 users for more than 40 000 radioactive sources with higher or lower activity

The State infrastructure of radiation protection is still being created after Lithuania regained its independence and in connection with recommendations laid out in ICRP Publication No. 60 and IAEA recommendations [2–13], as well as requirements of legislation of the European Community. That includes adequate laws and regulations, an efficient regulatory system, and supporting services.

Lithuania joined the IAEA in 1993 and it was already in 1994 that the Radiation Protection and Waste Management Services Upgrading Programme commenced. The Radiation Protection Centre is grateful to the IAEA for its inclusion in 1996, together with other countries, into the new Upgrading Radiation and Waste Safety Infrastructure Programme and, later, to the Europe Regional Project known as the Model Project for Upgrading Radiation Protection and Waste Safety Infrastructure and the technical co-operation Model Project for Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure. Since 1998, the Radiation Protection Centre has been participating in the IAEA technical collaboration project, Improvement of Radiation Protection in Nuclear Power Plants, that has grown into the technical co-operation project known as Enhancing Occupational Radiation Protection in Nuclear Power Plants. The Radiation Protection Centre expresses its sincere appreciation to the IAEA for its positive attitude to the new national project with respect to the strengthening of regulatory capabilities of the State nuclear power safety inspectorate and upgrading training in nuclear and radiation safety, which will provide Lithuania with much needed assistance in establishing a national radiation protection training centre.

The projects and implementing national plans have had a great impact on establishing and developing an effective and sustainable national radiation protection infrastructure based on international requirements. For implementation of the projects mentioned and performing duties, the Radiation Protection Centre received necessary help and expertise from the IAEA, as well as from other international organizations and countries in the framework of co-operation. Experts have been providing their expertise in Lithuania, and the Radiation Protection Centre took part in workshops, seminars, training courses and fellowships.

Together with the help received from the IAEA, the Radiation Protection Centre has received support from the Government of Sweden and from the Swedish Radiation Protection Regulatory Authority. Over the last two years, the Radiation Protection Centre has been implementing a project known as Improvement of Capacity of Services essential for Radiation Protection in Medicine (MAYRA), with support from the Government of the Netherlands. The European Commission in 2001 approved the Twinning and PHARE programmes. The objective of those programmes is to strengthen the Radiation Protection Centre. The co-ordination of all of the activities implementing international, regional, bilaterial and other technical support projects and programmes is suggested.

In order to achieve the objective of the Europe Regional Project National Regulatory Control and Occupational Radiation Protection Programmes (RER/9/062) and the Model Project for Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure (RER/9/065), five milestones were identified. The establishment of a regulatory framework, from the point of view of the Radiation Protection Centre, is the main milestone in the process of upgrading radiation protection infrastructure in the country.

Since the re-establishment of the independence of the Republic of Lithuania, the Lithuanian authorities have invested a lot of work in setting up national legislation. The new laws, namely, the Law on Radiation Protection (1999), the Law on Nuclear Energy (1996), the Law on Radioactive Waste Management (1999), and different regulations were approved.

The basic requirements on radiation protection including dose limits are described in the Hygiene Regulation entitled Basic Standards of Radiation Protection which was prepared by the Radiation Protection Centre for the implementation of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS) and European Council Directive 96/29/Euratom and the Council Directive 97/43 [6]. On the basis of the requirements of those Hygiene Regulations and [1–3], more than 15 other hygiene regulations were prepared and adopted.

The Law on Radiation Protection stipulates the competencies and the duties in the field of radiation protection of the Government, the Ministries and the Radiation Protection Centre. According to that Law, the Radiation Protection Centre is a body co-ordinating the activities of executive and other bodies of public administration and local government in the sphere of radioactive protection, exercising State supervision and control of radiation protection, monitoring and expert examination of public exposure. In addition, the Radiation Protection Centre is responsible for the control of medical exposure, monitoring radioactive contamination of foodstuffs, its raw materials, drinking water and building materials, control of indoor radon concentrations, personal dosimetry control and emergency preparedness.

The establishment of a regulatory framework requires effort and financial support from the Seimas (Parliament) and the Government. Personnel development has received high priority in the implementation of each activity. Personnel education and training needs were strongly identified.

According to the Report of the IAEA Peer Review Mission to Lithuania (October 2000), which reflects the assessment of the implementation of the Model Project for Upgrading Radiation Protection Infrastructure and Waste Safety Infrastructure, Lithuania has effectively implemented Milestones 1 and 2 of the Model Project.

Other milestones, such as control of medical exposure, control of public exposure, and establishment of a system of emergency preparedness and response, have been established.

2. MILESTONE 3: ESTABLISHMENT OF MEDICAL EXPOSURE CONTROL

Milestone 3 relates to activities aimed at controlling the exposures of patients in diagnostic radiology, radiotherapy and nuclear medicine. It includes the establishment of the control and implementation of an appropriate quality assurance programme. It is important because it covers about 30% of all exposures to the public.

Lithuania, with a population of only 3.5 million, has more than 1400 X ray machines, eight cobalt 60 tele-therapy units, two accelerators and eight departments of nuclear medicine. According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) classification, Lithuania is in the group of States at health care level I. For this reason, medical exposure is an important source of doses. Due care shall be paid when regulating radiation protection in medicine.

A legal basis for medical radiation protection in Lithuania has already been prepared and adopted. The main documents are the Radiation Protection Law adopted by the Parliament in 1999, and Hygienic Norm HN 73: 2001 [14]. They cover all the main parts of radiation protection, including medical exposure. There are also dedicated and detailed documents that give requirements for different fields:

- Radiation protection requirements in medical X ray diagnostic (HN 31: 2002);
- Radiation protection and quality assurance in nuclear medicine (HN 77: 2002);
- Radiation protection and quality assurance in radiotherapy (HN 95: 1999).

Quality control of X ray equipment is regulated by HN 78: 1998, ‘Quality control in medical X-ray diagnostics. General requirements and evaluation criteria’; and HN 94: 1999, ‘Quality control in conventional and computed tomography and mammography screening’. All these and other documents were prepared on the basis of the BSS, other IAEA technical documents and EC directives.

Apart from technical documents that are highly useful in the construction of a radiation protection infrastructure in medicine, the employees of the Radiation Protection Centre attended different training courses organized in the framework of the Model Project and obtained on-the-job training in the Czech Republic, Poland, Denmark and Ireland. Relevant expert visits from the IAEA were held in the fields of diagnostic radiology, nuclear medicine and radiation therapy; seminars and workshops (focusing on the application of the new dosimetry protocol for radiation therapy, quality control in nuclear medicine, radiation protection of patients and staff in nuclear medicine) were held under the auspices of the IAEA. The appropriate equipment (REX phantoms, multimeters 'Victoreen', dose rate meters) was received from the IAEA.

All the practices, including those using ionizing radiation for medicine, are to be licensed. Conditions for the licensing are the following: justification of practices, quality assurance programmes, suitable qualification of staff members, emergency preparedness plans, approved design of facilities, radiation protection programmes. The information, collected during licensing, is used for inspections. An approved schedule of inspections takes place. Frequency of inspections depends on potential risk caused by sources used by the licensee.

The important part in the radiation protection of patients is quality assurance and control of patients' doses in diagnostics. Quality control of X ray machines and measurements of doses received by patients in diagnostic radiology is one of the most powerful tools in the optimization of radiation protection in medicine.

Since 1997, the Radiation Protection Centre has carried out the measurements of quality control of the X ray units. PMX-III and Victoreen systems, TOR and REX phantoms provided by the Swedish Government and the IAEA are used for measurements. Some other institutions also have started such measurements.

In 2002, the Radiation Protection Centre conducted 179 quality tests of X ray units. Out of this number, 26 units (14.5%) failed to meet requirements, 18 of which were successfully repaired provided they are adequately maintained. Figure 1 shows the tendency of units found to be below standard. The number of unsuitable X ray machines is decreasing.

The important task is implementation of operative quality systems in hospitals. In this field, the help provided by the IAEA is effectively combined with the support given by Sweden and the Netherlands. The task of the Dutch MATRA Project is to implement quality systems in the X ray departments of four Lithuanian hospitals by the end of 2003. Later, these hospitals will become centres of dissemination of information and experience.

The Radiation Protection Centre also makes measurements of patients' doses during conventional X ray diagnostics and photofluorographic examinations. The patients' doses have been measured for chest AP/PA, chest LAT, skull AP/PA, skull LAT, thorax spine AP and LAT, lumbar spine AP and LAT, abdomen AP radiographic and chest PA photofluorographic examinations. Patients are selected randomly. The entrance surface doses were measured with thermoluminescent detectors (TLDs).

The measurements show that individual values of patients' entrance surface dose examinations are:

— Chest AP/PA: 0.01 to 3.49 mGy;
— Skull AP/PA: 0.04 to 9 mGy;
— Skull LAT: 0.14 to 39 mGy;
— Abdomen AP: 2 to 24 mGy;
— Lumbar spine AP: 2.9 to 26 mGy;
— Lumbar spine LAT: 3 to 26 mGy.

Figure 2 shows the distribution of mean values of entrance surface doses in different health care institutions where the study was conducted. (See Fig. 3 for the relevant average entrance surface doses.)

Measurements show that individual values of patients' entrance surface dose in photofluorographic chest PA examinations are 0.34 to 38 mGy. The average dose is 3.8±0.38 mGy (95% confidence).

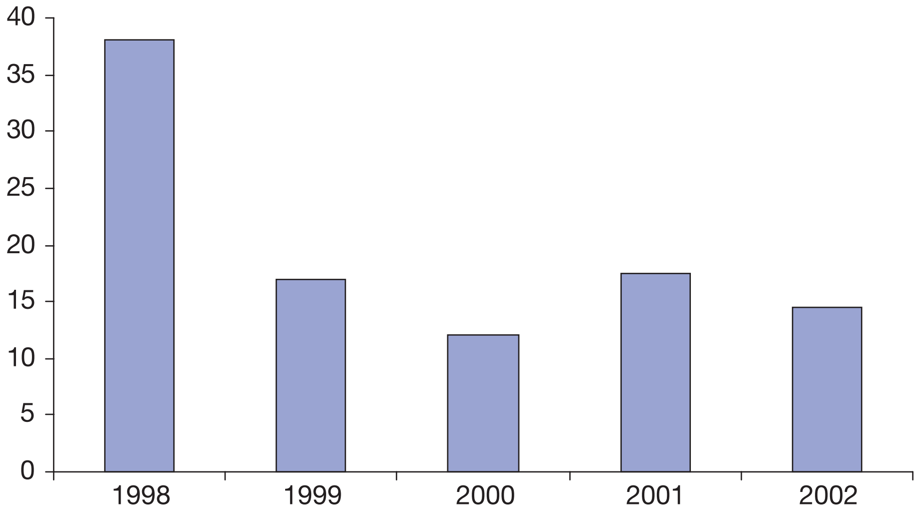

FIG. 1. Numbers of X ray units found to be below standard (in %).

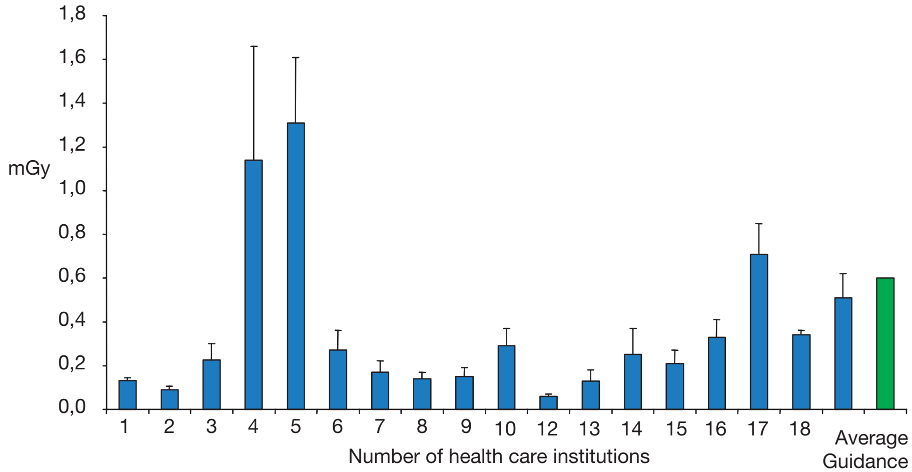

FIG. 2. Entrance surface doses in different health care institutions during chest PA examinations.

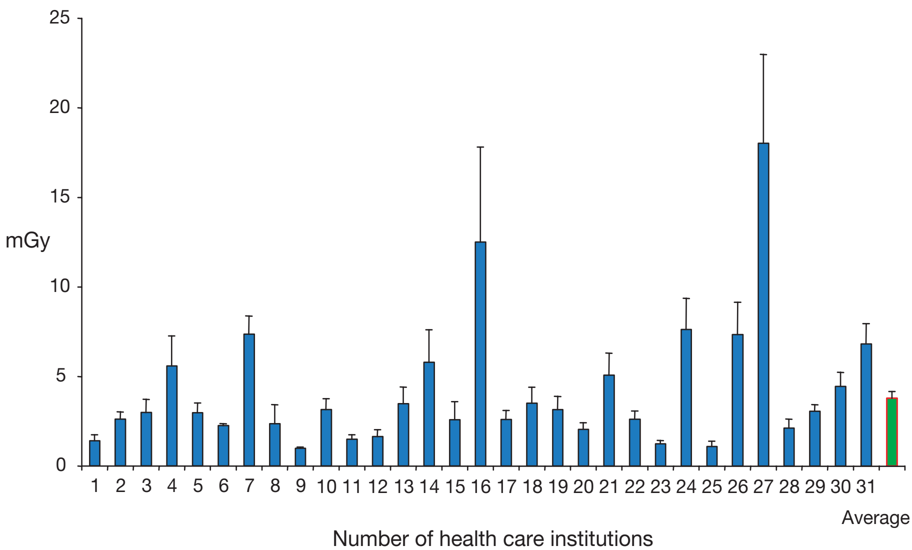

FIG. 3. Average entrance surface doses in different health care institutions during photofluorographic chest PA examinations.

It was found that during such examinations, patients receive an average effective dose of 0.44±0.05 mSv (95% confidence). During the same radiographic examinations, patients receive an average effective dose of 0.05±0.01 mSv. It shows that effective doses in photofluorographic examinations are about 10 times higher compared with the same radiographic examinations.

Results of the survey indicated that national guidance levels should be about 20% higher than the ones recommended by international organizations. The important detail is the fact that average doses in radiological examinations are decreasing. In future, national guidance levels will be established to start dose area product measurements in fluoroscopy and dose measurements in computed tomography (CT).

In nuclear medicine, basic recommendations given by the IAEA are put into legislation and the first steps in the creation of quality systems are also made. A dose calibrator provided as a technical help by the IAEA is the basis for the evaluation of performance of available dose calibrators.

Some problems are encountered in radiation therapy, including a lack of equipment for quality control, particularly in X ray therapy, an effective system of reporting about accidents and the availability of systems of recording doses to critical organs. On the other hand, all the basic requirements of the IAEA and the EC are transposed into Lithuanian radiation protection legislation and followed by health care institutions.

The most important problem in all the fields of medical exposure is a lack of medical knowledge. The first steps have been made to improve the situation: the education syllabus is prepared, and the appropriate agreement has been made between educational and health care institutions.

3. MILESTONE 4: ESTABLISHMENT OF PUBLIC EXPOSURE CONTROL

Milestone 4 aims at radiation protection of the public and the environment. It involves programmes for the registration, control and safe disposal of radioactive waste, for control of consumer products containing radioactive substances and for environmental monitoring.

Control of public exposure is rather complicated for various reasons: personal dosimetry cannot be performed, different groups of the population might be exposed to different sources of different strengths, and sources of public exposure are rather difficult to control.

In this field, the following measures were and are still undertaken:

— Creation of a legal basis for the control of public exposure and radiation protection of members of the public;
— Establishment of procedures for the practical implementation of the appropriate tasks;
— Monitoring of radioactivity in different bodies;
— Assessment of doses;
— Identification of the most important sources and the most exposed members of the public;
— Informing the public about its exposure and radiation protection.

The legal basis is the Law on Radiation Protection. The main radiation protection principles are given in the hygienic norm HN 73: 2001 [10]. These and other appropriate standards, such as Maximum Permitted Levels of Radioactive Contamination of Foodstuffs and Feedingstuffs Following a Nuclear of Radiological Emergency (HN 84: 1998), Sampling Methods of Foodstuffs, Feedingstuffs, Soil and Water for Determination of Specific and Volumetric Activity of Radionuclides (HN 72: 1997), Drinking Water: Quality Requirements and Monitoring (HN 24: 1998), Mineral Waters for Drinking: Quality Requirements and Monitoring (HN 28: 1998), Raw Materials and Foodstuffs. Maximum Permitted Levels of Chemical Contaminants and Radionuclides (HN 54: 1998), Natural Exposure: Standards of Radiation Protection (HN 85: 1998) have been drafted on the basis of IAEA Safety Series No. 120 and No. 115 [2, 3], as well as the IAEA technical documents, and legislation of the European Union.

Prerequisites for the control of public exposure under normal and accidental conditions are also given in other documents, such as laws on protection of the environment, on environmental monitoring, on civil protection, on nuclear energy and on veterinary issues.

The Decision of the Minister of Environment and the Minister of Health Care was adopted in 2002, which includes practical procedures of environmental monitoring and the transmission of data to national institutions and the EC. The new programme started on 1 January 2003. It employs two networks for monitoring: the dense and sparse. Samples of air particles and surface water are sampled and analysed at the Joint Research Centre of the Ministry of Environment. The Radiation Protection Centre is analysing samples of drinking water, milk and mixed diet.

The legal documents in Lithuania regulating discharges from nuclear facilities are also in force, one of which is Limitation of Radioactive Discharges from Nuclear Facilities, on the Permitting of Discharges and on the Radiological

Monitoring (Order No. 60, LAND 42-2001). This document provides principles of limitation of radioactive releases to the environment from nuclear facilities via air and water, and establishes procedures for issuing permissions for radioactive discharges and requirements for radiological monitoring at nuclear facilities. This document is applied to nuclear facilities operating under normal conditions, including 'short time anticipated operational transient', and is not applicable for accidents.

The normative document, Limitation of Radioactive Discharges from Medical, Industrial, Research and Agriculture Facilities and Order of Issuance of Permits for Discharges (LAND 41-2001), limits discharges of radionuclides into the environment. This document was prepared in order to protect humans and the natural resources of a country from the harmful influence of ionizing radiation and contamination by radionuclides during the use of radioactive materials in different fields.

The normative document, Clearance Levels of Radionuclides, Conditions of Reuse of Materials and Disposal of Waste (LAND 34-2000), establishes criteria when materials, equipment, installations, buildings and waste contaminated with radionuclides may be used or disposed of without any application of requirements of radiation protection.

The limitation of discharges is based on the results of dose assessment for members of critical groups. Public exposure from all controlled practices (excluding natural background radioactivity and doses of exposure from medical treatment and diagnostics) shall not exceed 1 mSv/a. Dose constraints from a single source for the public are 0.2–0.3 mSv/a depending on the practice.

The Radiation Protection Centre monitors levels of radioactivity in foodstuffs and drinking water. Concentrations of caesium-137 and strontium-90 and natural radionuclides (potassium-40) are monitored (see Figs 4 and 5). Sampling is performed periodically in eight sampling places including the one in the Ignalina nuclear power plant region. The main fresh foods are analysed: milk, meat, fish, vegetables, grain and drinking water. Drinking water (from private wells and from community supply systems) and milk are sampled four times per year; other types of samples, once per year.

The dose due to the monitored radionuclides is 0.186 mSv; potassium-40 is responsible for almost of 99% of this dose. The dose due to human-made radionuclides caesium-137 and strontium-90 in food is only about 0.4% of this dose.

Wild products are popular in Lithuania, so the mushrooms and wild berries are analysed. Soil and forest floor (moss) samples from the locations where the mushrooms samples are taken are analysed also. About 400 samples of mushrooms are analysed every year.

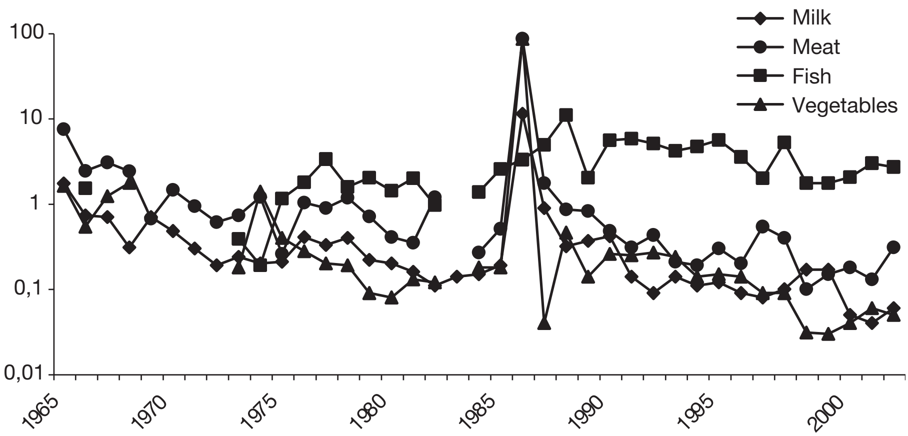

FIG. 4. Dynamics of caesium-137 concentrations in food in Lithuania, Bq/kg, L of fresh weight, 1965–2002.

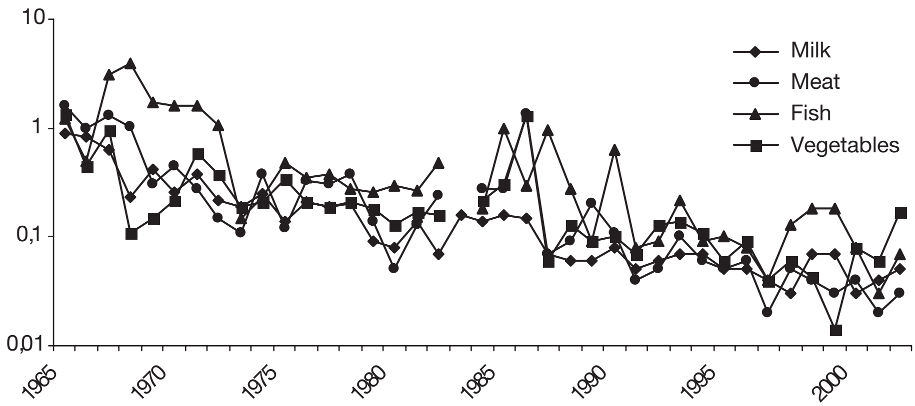

FIG. 5. Dynamics of strontium-90 concentrations in food in Lithuania, Bq/kg, L of fresh weight, 1965–2002.

In 2001, a new programme began, known as Radioactive Contamination Studies of a Typical Diet of Lithuanian Residents and Assessment of Doses Resulting from the Diet. Amounts of radionuclides in the typical diet of hospital patients are being analysed. The assessment of doses due to radionuclides in the diet was done on the basis of measurement results of radionuclide concentrations in samples from two hospitals in Vilnius. The average intake of strontium-90 was 0.09±0.01 Bq/d, and caesium-137 was 0.12±0.01 Bq/d; the gross beta intake except for drinks was 46±4 Bq/d; in drinks, 5±1 Bq/d (see Figs 6 and 7). The average gross beta concentration in the whole sample was 51±7 Bq/d. These results were used for dose calculations. The annual effective dose due to radionuclides in the diet is 0.115 mSv; potassium-40 is responsible for almost all of the entire dose. The dose due to the radionuclides in prepared food is about 0.6 of the dose 0.186 mSv, calculated on the measurement results of radionuclide concentrations in separate fresh food products and is equal to about 1/20 of all doses to adults from all other sources available in Lithuania.

The impact of the Ignalina nuclear power plant on doses to the population is also evaluated by means of environmental dosimetry. It is performed in the vicinity of the Ignalina district and in the control region without large industrial enterprises. TLD dosimeters are used for it. Results of environmental dosimetry measurements indicate that no statistically significant differences exist between exposures of the inhabitants of the areas, which are in the vicinity of the Ignalina nuclear power plant, and the ones in the control region. The most significant source of exposure is natural radiation.

Indoor radon measurements started in 1995, and performed in 400 randomly selected detached houses in heating periods from 1995 to 1998. It helped not only to evaluate the national average of indoor radon concentration and identify the regions with higher indoor radon concentrations, but also to disclose the main relationships between indoor radon concentrations and house construction related parameters. The results of the study helped to identify the future directions of research — the radon prone regions and the most vulnerable types of houses. Measurements of indoor radon concentrations in regions with higher radon risk began in 2001. The aim of those measurements is not only collecting data on actual indoor radon concentrations

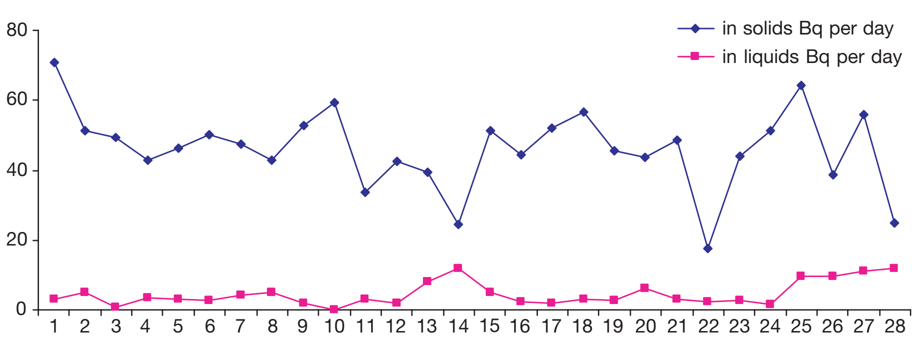

FIG. 6. Intake caused by gross beta concentrations in the diet, Bq/d, October 2001–September 2002.

and their distributions, but also giving the advice to owners of houses on possible measures of mitigation.

Radon risk studies began in 2002. The first measurements of radon and radium concentrations in soil coupled with soil permeability studies show that some places in Lithuania might be classified as increased or even high indoor radon risk areas.

From the measurements of radon concentrations in drinking water, the possible impact of radon exposure in drinking water was evaluated.

The radioactivity of construction materials is under constant surveillance. It is connected with the fact that new technologies and raw materials are used for the manufacturing of construction materials. A databank on concentrations of gamma radionuclides (mainly natural) in these materials is available and permanently updated.

As a result of those studies, the collected data have been used in drafting the new radiation protection regulations, Natural Exposure and Standards of Radiation Protection. These regulations have come into force recently and cover such items as action levels of indoor radon concentrations, maximum permitted concentrations of radon in drinking water, natural radionuclides in construction materials, and maximum permitted levels of dose rate indoors. Measures which shall be taken if indoor radon concentrations exceed the action levels are described in the regulations.

Assessments are also undertaken in particular cases when the decision about optimized radiation protection measures is to be taken. An example of such a study might be an assessment of the possible radiological impact of sludge concentrated in a waste treatment plant and slightly contaminated with cobalt-60. Measurements have been performed, possible doses to members of critical groups have been assessed using different scenarios, and recommendations have been given on optimized radiation protection measures.

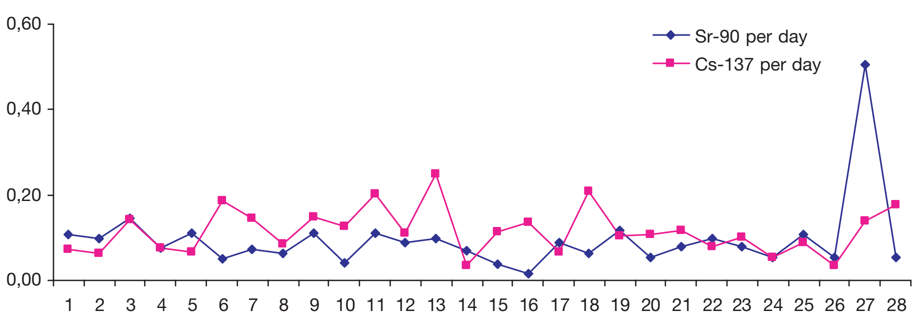

FIG. 7. Intake caused by strontium-90 and caesium-137 concentrations in the diet, Bq/d, October 2001–September 2002.

Doses to the public are also assessed using data collected by permanently operating gamma stations. Prognostic evaluation of doses to members of critical groups is also performed if necessary. Both general and site-specific parameters, as well as different exposure pathways are taken into account.

These results are achieved by a combination of the help given by the IAEA with the support of the Swedish Government, which is particularly significant in the field of indoor radon. Recently, attention has been given to the problem of naturally occurring radiation material (NORM) — possible problematic areas are to be defined and the appropriate measurements undertaken.

It is also important that training is received, which includes training courses organized by the IAEA and the Swedish Radiation Protection Authority.

Public exposure is a complicated area that requires effort and expertise. The system created in the framework of the Model Project is a good start in solving this problem.

4. MILESTONE 5: ESTABLISHMENT OF EMERGENCY PREPAREDNESS AND RESPONSE CAPABILITIES

Milestone 5 involves the development of plans and the allocation of resources to ensure the effectiveness of the national regulatory authority and other relevant organizations in dealing with different radiological emergency scenarios.

According to the Law on Civil Protection, the emergency management system in Lithuania has three levels: national, county and district. All the bodies mentioned have to perform concrete functions in case of an accident.

The main document, which co-ordinates the activities of all the institutions involved, is the National Emergency Response Plan, put into action in the event of a radiological accident at the Ignalina nuclear power plant, approved by the Minister of Defence (in 2000). The Plan outlines the main objectives, reasons and purposes of the planning, the concept of controlled zones, classification system of radiological accidents, distribution of functions of civil protection and the management of radiological accidents as well as the activities of the Civil Protection Service, i.e., covering two important aspects: warning the population and organizing the system of communication. The Plan includes all the necessary engineering and technical means, monitoring of radiation, radiological reconnaissance, sanitary clean-up of polluted areas, etc.

The main functions of the Radiation Protection Centre are to:

— Organize radiation exposure control of the forces, liquidating consequences of the accident and the population;
— Submit proposals for the reduction of exposure of people to the Emergency Commission;
— Organize, co-ordinate and fulfil dosimetric control of the population;
— Control sanitary cleaning of the population and decontamination of the environment;
— Organize and carry out the detection of the radionuclides in the environment and provide expertise on the impact on human health;
— Carry out an analysis of foodstuffs and drinking water for radionuclides and provide conclusions on their suitability for consumption.

In the case of nuclear or radiological emergency, the Radiation Protection Centre shall work according to the Radiation Protection Centre Emergency Preparedness Plan. The present version of the Plan was approved in 2001.

Within the framework of technical co-operation projects with the IAEA, the Radiation Protection Centre has developed a legal basis for emergency preparedness and response:

— The generic optimized intervention levels for urgent protective actions (sheltering, evacuation, iodine prophylaxis), generic optimized intervention levels for initiating and terminating temporary relocation and permanent resettlement, are determined by Basic Standards of Radiation Protection, Hygiene Standard HN 73: 2001 [10].
— Operational intervention levels, administration of stabile iodine, clean-up procedures, foodstuffs and drinking water control, dosimetric control of contaminated general public are approved by Protective Actions of Public in Case of Radiological or Nuclear Accident, Hygiene Standard HN 99: 2000.
— Maximum permitted levels of radioactive contamination of foodstuffs and feedingstuffs following a nuclear or radiological emergency, Hygiene Standard HN 84: 1998.
— Regulations of Dosimetric Control in Case of a Nuclear or Radiological Emergency, No. 57, prepared and approved by decree of the Director of the Radiation Protection Centre on 13 December 2002. These regulations have set the order of dosimetric control of emergency workers, vehicles, equipment, etc. and decontamination procedures.

All the Hygiene Standards and regulations mentioned meet the requirements of the International Basic Safety Standards, EC Council and European Commission regulations, directives and decisions and IAEA documents including, among others:

— Generic Assessment Procedures for Determining Protective Actions during a Reactor Accident [8];
— Method for the Development of Emergency Response Preparedness for Nuclear or Radiological Accidents [9];
— Generic Procedures for Monitoring in a Nuclear or Radiological Emergency [10];
— Preparedness and Response for a Nuclear or Radiological Emergency — Requirements [11];
— Intervention Criteria in a Nuclear or Radiation Emergency [12].

The draft of the regulation, Generic procedures for assessment and response during a radiological emergency, will be approved in 2003 taking into account recommendations of IAEA-TECDOC-1162, Generic Procedures for Assessment and Response during a Radiological Emergency [13].

The draft regulations of sampling of environment samples after nuclear or radiological emergency, is prepared for approval using recommendations from IAEA-TECDOC-1092 [10].

4.1. Training and exercises

The Radiation Protection Centre organized training courses and exercises for its staff, for Public Health and other Emergency Response Institutions, and participated in the following exercises at national and international level:

— The actions of public health care institutions in the case of a nuclear accident;
— The actions of public health care institutions, civil protection and fire-prevention and rescue services in the case of nuclear or radiological accident;
— Radiological measurements in the case of nuclear or radiological emergency;
— Training on off-site emergency management in central eastern Europe;
— Training course for Instructors;
— Training course: ‘Response to Radiological Emergencies’;
— Workshop on an analysis of responsibilities and actions of Lithuanian approved institutions in nuclear emergency warning and response.

The Radiation Protection Centre participated in the organization of the exercises, and took part in a roundtable exercise on 14 February 2002, Planning of Work of National Level Institutions and the Order of Decision Making in Case of Emergency in Ignalina NPP. As the continuation of this work, a meeting on Cooperation and Information Exchange of State Level Institutions in Case of Nuclear Emergency was organized on 18–19 June 2002. Some actions have been organized based on the Swedish-Baltic States Project Emergency Preparedness in Baltic States.

The Radiation Protection Centre participated in the following international exercises:

— INEX-2-HUN, 1998-11-03;
— INEX-2-FIN, 1997;
— Nuclear Simulation Exercise JINEX/INEX 2000, 22–23 May 2001;
— “Baltic nuclear” workshop, Stockholm, Sweden 19–20 March 2001;
— Barents Rescue ALEX (alarm Exercise), 2001.

4.2. Public information

The Radiation Protection Centre has produced the following brochures:

— How to recognize health injuries caused by radiological emergencies, 2002, for medical staff;
— Ionizing radiation, 2001;
— What one has to know about the preparedness for a nuclear accident, 2002.

In 2002, the Radiation Protection Centre together with the Swedish Radiation Protection Authority finished the project of providing iodine tablets to the inhabitants of Visaginas City and nearby villages. The Swedish Government financed this project.

5. CONCLUSIONS

The most valuable results are that the radiation protection infrastructure according to the IAEA recommendations has been created, appropriate technical help and training received, many useful contacts established, co-operation between countries which take part in the Model Project started, and experience exchanged. It allows the expectation that the necessary level of radiation protection will be achieved in Lithuania as in other European countries.

Using the framework of the IAEA technical co-operation Model Project, and on the basis of the assessment of the current status in Lithuania, it would be expedient to continue with the programme, including the following objectives:

— Training radiation protection professionals, radiation protection officers, radiation workers and all the other individuals directly or indirectly connected with ionizing radiation or improving a system for the occupational exposure control, particularly during the decommissioning of the nuclear power plant, as well as improving the level of preparedness and response to a radiological emergency, and creating the system of public information and education;
— Further assistance from the IAEA would be necessary in establishing or substantially improving a system for the exposure control of patients in diagnostic radiology, radiotherapy and nuclear medicine through the development of appropriate QA/QC programmes;
— It would be highly desirable for the IAEA to support the creation of the Central and Eastern European ALARA Network. This network, keeping in mind the common problems and similar situations in the Model Project States, would be very helpful in solving many problems of operational radiation protection.

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Topical Session 3

IMPLEMENTATION EXPERIENCE WITH MODEL PROJECTS

DISCUSSION

J. VAN DER STEEN (Netherlands): The occupational exposures in NORM industries are generally higher than those in the nuclear industry, and they are almost always higher when the NORM industry workplaces are dusty and poorly controlled. However, not much attention is paid in the Model Projects to the infrastructural aspects of reducing the occupational exposures in NORM industries. In my view, more attention should be paid to those aspects.

C. HONE (Ireland): As a former regional manager for the Model Project under way in Africa, I endorse what J. Van der Steen just said. For example, there are people in many countries, including Ireland, who are receiving doses from radon that are much higher than the doses considered acceptable in the nuclear industry. Another issue which we need to consider more closely is that of local rules. For example, should diagnostic radiographers be classified as radiation workers and thus be subjected to individual dose monitoring?

A.M. NYANDA (United Republic of Tanzania): There have been references to the life-cycle management of radioactive sources — an issue which, in my view, could very well be handled within the framework of the Model Projects. In most developing countries, we end up with disused sources in protracted interim storage at the users' premises. I would welcome the establishment of arrangements whereby disused sources — especially the more powerful ones — are brought to central storage facilities, and in my view it should be possible to establish such arrangements through the Model Projects.

A. HASAN (USA): Things which contribute to the sustainability of national infrastructures for radiation safety but which tend not to receive much attention are, for example, good records management, communication skills, quality assurance and quality control. They should receive sufficient attention in the Model Projects.

M.S. ABDULLAH (Yemen): The countries participating in the Model Projects have generally done well as regards attaining Milestone 1 and quite well as regards attaining Milestone 2. However, a lot needs to be done if Milestones 3–5 are to be attained, and there is also the question of integrating security into safety. Consequently, I believe that the Model Projects should continue beyond 2004 and that a recommendation in favour of their continuation should be included in the findings of this conference.

M. NOVAKOVIC (Croatia): Very little has been said so far at this conference about emergency preparedness and response, although "the establishment of emergency preparedness and response capabilities" is the purpose of Milestone 5. That being so, I was wondering why Milestone 5 was included in the Model Projects.

K. MRABIT (IAEA): Milestone 5 was included in the Model Projects in order to cover all BSS requirements and related safety documents. I would point out in this connection that not all IAEA Member States are parties to the Convention on Early Notification of a Nuclear Accident (the Early Notification Convention) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (the Assistance Convention). Therefore, all participants whose countries have not yet ratified such conventions are encouraged to make every effort to speed up their process of ratification.

C. SCHANDORF (Ghana): With regard to Milestone 5, in my view, a distinction should be made between, on one hand, emergency preparedness and response at the national level and, on the other, emergency preparedness and response at the facility level. I believe that the first step should be to enable facility operators to establish their own emergency preparedness and response capabilities, with the authorization procedure taking account of facility level emergency preparedness and response requirements. One could then go on to establish an emergency preparedness and response system at the national level, operated by a dedicated core group of well qualified people.

I would note in this connection that establishing such a system at the national level involves educating many governmental agencies and persuading them to enter into the necessary commitments.

A.J. Al-KHATIBEH (Qatar): Clearly, a great deal of progress has been made with regard to the attainment of Model Project Milestones 1 and 2, and not much progress with regard to the attainment of Milestones 3–5. In my view, there are two reasons for that. Firstly, the regional managers have urged the countries participating in the Model Projects to focus on attaining Milestones 1 and 2, and the provision of assistance requested in support of efforts to attain Milestones 3–5 has been postponed. Secondly, the role of the IAEA in connection with Milestones 1 and 2 is clear: the IAEA is able to provide very useful model laws and regulations. However, it is not able to provide, say, model local rules or model emergency response plans. That having been said, there are ways in which the IAEA could support the attainment of Milestones 3–5. For example, the IAEA could provide information on how to go about quality assurance in the area of medical exposure control.

W. KRAUS (Germany): With regard to what J. Van der Steen and C. Hone just said about NORM industries and radon, one problem is that clear policies regarding them have not yet been formulated. However, I think the situation will change during the next two years or so. There is clearly some dissatisfaction about what is being done within the framework of the Model Projects as regards workplace monitoring. In my view, the difficulty here is due to the fact that workplace monitoring is mainly the responsibility of licensees and registrants, and an international organization like the IAEA cannot gain an accurate overall picture of what is being done as regards workplace monitoring in a given country — it can only make spot checks.

P.M.C. BARRETTO (IAEA): In response to what M.S. Abdullah just said, and to similar comments made in earlier sessions, I would urge the representatives of countries participating in the Model Projects not to worry about whether the Model Projects will continue beyond the end of 2004. Support by the IAEA for the establishment of effective and sustainable national infrastructures for radiation safety will continue. It was planned from the outset that the Model Projects would not continue beyond the end of 2004 and that new mechanisms for the provision of IAEA assistance would take over. It is now up to the IAEA to decide what those mechanisms should be. The Model Project concept is a good one, but it was formulated in the early 1990s, since when many things have changed in the world. There is now a need for modernization and greater dynamism. What the participating countries should do now is make their needs clearly known to the IAEA.

I. USLU (Turkey): Uncertainty about the time following 2004 is creating a problem for my country, which has to decide soon what technical co-operation projects it should propose to the IAEA for 2005–2006. It will be difficult to reach a decision on radiation protection related project proposals without knowing what is going to happen regarding the Model Projects after the end of 2004.

S. JOVANOVIC (Serbia and Montenegro): Despite P.M.C. Barretto's reassurances, we are worried about the possible termination of the Model Projects. My country has not yet even attained Milestone 1, and there are other participating countries in that position. There has been talk of replacing the Model Projects with a large number of national projects. In my view, that would unnecessarily complicate the ongoing co-operation between the IAEA and countries participating in the Model Projects.

Rapporteur's Summary

IMPLEMENTATION EXPERIENCE WITH THE MODEL PROJECT

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Abstract

Thirty-five participant countries in the technical co-operation Model Project for Upgrading Radiation Protection Infrastructures have reported on their experience. It is clear that there has been significant progress in the adoption of legislation and regulations for radiation safety in most countries over the life of the project, including the development of authorization and inspection procedures by regulatory authorities. In addition, measures for control of occupational exposure are well advanced in most countries. It is also evident that there is an ongoing need for the assistance provided by the Model Project as the Member States involved continue to implement regulatory processes for controlling medical and public exposure and for emergency preparedness. The participant reports, together with experience gained from peer review missions, draw attention to a number of other matters meriting discussion and consideration in the future.

1. INTRODUCTION

The IAEA's technical co-operation Model Project for Upgrading Radiation Protection Infrastructures was initiated in 1994 as a strategically targeted programme to assist a number of Member States having similar needs. It had become evident that, in some countries, national systems for regulation of radiation safety fell short of international norms, especially following adoption of the International Basic Safety Standards (BSS) [1] by the Board of Governors of the IAEA in the same year. In part, the idea was to replace several individually requested and separately managed assistance programmes with a single, coherently organized project. In addition, the Model Project allowed many other countries to request inclusion when they recognized their need. Furthermore, the IAEA recognized a responsibility, when supplying radiation sources under its technical co-operation programme, to assure itself of a country's ability to manage the sources safely through a national regulatory infrastructure.

After almost nine years of the Model Project, and a growth in participation to over 80 countries, this conference provides an opportunity to assess progress, reflecting on both positive and negative experiences. Thirty-five papers submitted to the conference have been allocated to Topical Session 3 (see Table I). The first part of this summary follows the style of presentation of the contributed papers, reviewing each Model Project milestone in turn.[1] The latter part is an assessment of progress and discusses some of the issues raised and problems yet to be solved.

TABLE I. CONTRIBUTED PAPERS BY REGION AND COUNTRY (35 PAPERS IN TOTAL)

Africa	East Asia/Pacific	Europe	Latin America	West Asia
Ethiopia	Bangladesh	Albania	Bolivia	Jordan
Ghana	China	Armenia	Dominican Republic	Kazakhstan
Kenya	Indonesia	Bosnia and Herzegovina	Paraguay	Kuwait
Libyan Arab Jamahiriya	Myanmar	Cyprus		Qatar
Madagascar	Philippines	Hungary		United Arab Emirates
Niger	Thailand	Lithuania		Yemen
Uganda		Malta		
Zambia		Republic of Moldova		
		Slovenia		
		The Former Yugoslav Republic of Macedonia		
		Turkey		

[1] It is not appropriate for a conference rapporteur to make judgements about whether a Member State has or has not reached a given milestone: that is a matter between the Member State and the IAEA. Consequently, this commentary is qualitative in nature. Delegates are encouraged to read the submitted papers for further detail.

2. BASIC REGULATORY INFRASTRUCTURE (MILESTONE 1)

Almost all countries reporting at this conference have now established a legal basis for regulating radiation protection. However, there are several where the existing law requires updating. There are three main drivers for new laws: first, in some countries that used to be effectively included in the regulatory framework of the former Soviet Union, there has been a need to develop new national legislation; second, in a few countries with limited resources, regulation of radiation safety has been a low priority for governments and no legislation previously existed; and third, some countries have recognized a need to update existing legislation to take account of the requirements of the BSS and of the desire to keep the regulation of radiation safety functionally separated from organizations engaged in radiation related activities. The principal purpose of the legislation is to establish a regulatory authority with the necessary powers to control activities involving radiation. This includes the power to develop and implement regulations for specific control measures. The drafting, development and implementation of up to date regulatory legislation in so many countries is a direct result of the efforts of those involved in the Model Project and a major achievement by the IAEA and by those Member States.

Most countries now have a regulatory authority with the requisite legal powers. However, there are a few where pre-existing regulatory arrangements could be improved, for example, when they are divided among government agencies or too closely connected with agencies engaged in radiation related activities. These deficiencies have been recognized, but a small number of countries report difficulties in making progress in removing them. Typically, this is due to a shortage of resources allocated to the task and the low priority afforded to it by governments. Furthermore, some countries indicate that while the regulatory authority formally exists, there are difficulties in making it fully operational, usually due to resourcing problems.

One of the first tasks of a regulatory authority is to establish a system of notification, authorization, inspection and enforcement for the control of radiation related activities. On the basis of the papers contributed to this conference, most countries have put such a system in place. Once again, several countries report resourcing problems in implementing the authorization and inspection regime to the level thought to be necessary. Sometimes it seems to be chiefly a funding difficulty, but shortage of skilled and experienced staff is also mentioned. Training and education issues are discussed below.

A particular requirement under Milestone 1 of the Model Project is the need for all Member States to establish an inventory of radiation sources held in the country. It is essential that the ownership of sources is known to the authorities, so that their whereabouts are known or can be made known, especially for the more active radioactive sources that are capable of serious injury if mishandled. Implementation of source inventories appears to track closely with implementation of regulatory systems, although in some cases the inventory was tackled first as a priority. Few countries have not yet completed this task, although it is possible that some sources presently unknown to the authorities will be added to their inventories over time.

Several authors express their appreciation of the assistance provided by the IAEA. Persuading governments to enact legislation and to provide funding for regulatory bodies can be difficult, and even where there is a will, legal drafting and formal governmental processes can take a long time to complete. It seems that, in a number of cases, involvement of an international agency has stimulated governments to provide resources and support for the tasks required to complete Milestone 1, when this might otherwise have been viewed as of low priority.

3. OCCUPATIONAL EXPOSURE CONTROL (MILESTONE 2)

Monitoring of external exposure of workers using film or thermoluminescent detector (TLD) badges is undertaken in most countries. In many cases, monitoring services preceded more recent steps to establish or update regulatory systems. In the past, organizations such as hospitals, universities and industries using radiation sources have been aware of the need to monitor their workforce and have done so whether regulated or not. In smaller countries, it has often been a hospital or a university that has provided the monitoring service because that has been where the skills and equipment were available. Some countries report a need to extend the coverage of their monitoring programmes and some have yet to fully implement national regulatory requirements for dose monitoring. However, this aspect of occupational exposure control is well advanced.

Less clear is the extent of workplace controls, such as the use of controlled and supervised areas, of local working rules, or of dose constraints and optimization of protection in the design of working environments. Many countries have implemented regulations for workplace controls, but in reporting on progress there appears to have been a greater focus on monitoring services and dose statistics. This may be an artefact of reporting style or expectation, but suggests that safety practices in the workplace may need greater attention by regulators, including increased emphasis on inspection programmes. The IAEA has published several accident reports showing that failure to maintain or to follow workplace safety rules have led to serious health consequences.

Few countries report on internal dosimetry capabilities, although several have laboratory facilities for radionuclide analysis. This is understandable in view of the cost of resources required to provide bioassay or whole-body monitoring services. Internal dosimetry appears to be available when most needed, in countries with nuclear power plants or uranium mines. There is little information available on mining more generally, although it is known that radon can sometimes be a problem in underground environments. The issue of exposure from naturally occurring radioactive material (NORM) and the extent to which it requires regulatory control is being debated among all countries, not just those involved in the Model Project.

4. MEDICAL EXPOSURE CONTROL (MILESTONE 3)

Regulatory controls for medical exposure are, in many cases, still being implemented. That is not to say that hospitals may not have quality control programmes in their radiology or nuclear medicine departments, but that these may often have been locally developed through the knowledge and training of the professionals involved. Few countries mention the use of guidance levels in diagnostic radiology or nuclear medicine. A common complaint is a shortage of trained personnel, such as medical physicists, and the need for further training opportunities in this area. Some countries report having to make use of very old X ray equipment. Medical exposure control is perhaps the next big challenge for those countries that have passed or are close to passing Milestones 1 and 2. One of the challenges will be to develop practical and effective regulatory processes: this is an instance where stakeholder participation — the involvement of the medical profession — is essential.

5. PUBLIC EXPOSURE CONTROL (MILESTONE 4)

Reporting on public exposure control is mixed. There are some reports of environmental monitoring programmes for testing air, water, soil and foodstuffs, but other countries note their inability to carry out such testing due to a shortage of equipment and skilled personnel. Several countries have addressed the issue of radioactive waste management under this heading. It is clearly a problem for some, especially in the case of used radioactive sources obtained for medical, industrial or research purposes that cannot be returned to the manufacturer or supplier. A number of countries comment on the steps they have taken to create temporary storage facilities; in some cases this has been done with technical assistance from the IAEA. It is probably fair to say that the task of dealing with spent sources is receiving attention, but that in many cases further work will need to be done to establish long term solutions within a fully regulated national infrastructure.

6. EMERGENCY PREPAREDNESS (MILESTONE 5)

With a few exceptions, mainly larger countries with some nuclear power experience, preparations for radiation emergencies are still under development. Often the power to establish emergency management systems is contained in the regulations, but the planning, resourcing and testing of emergency preparedness remains a challenge. Among the planning tasks required is the need to co-ordinate the responsibilities of multiple emergency response organizations.

7. SECURITY MATTERS

Several countries comment on the increased attention now paid to the security of radiation sources in an anti-terrorism context. Some observe that import controls and adoption of the international transport regulations [2] establish reasonably secure barriers to the intrusion of unwanted sources. There is clearly a need to integrate import, transportation, authorization, inventory, user practice and emergency preparedness measures with security issues, and for co-ordination at the national level. At the time of submitting their reports, authors may not have been aware of recent IAEA activities in this area (discussed later).

8. OTHER ISSUES RAISED

Among additional matters raised by contributors are the following:

— There is a common theme concerning shortage of funding and resources. While this is to be expected, the stature of the Model Project and communications between the IAEA and its Member States appear to have assisted a number of countries in securing government funding. Nonetheless, it is clear that regulatory authorities in a number of countries are struggling to meet their desired objectives within the budgets available to them. This seems to be a significant problem in some African countries; less so for some European countries.

— Similarly, several countries mention difficulties in recruiting staff with the necessary level of training and skills. This is perhaps most evident in medical applications, with medical physicists in short supply, but it also occurs across the spectrum of skills required to maintain an effective regulatory infrastructure for radiation safety.
— Several countries comment on the value of the IAEA training that has been provided and the need for more of it. This is an area where the IAEA has a history of assistance to Member States and clearly there is a continuing need. The IAEA's encouragement and support in establishing regional training centres should greatly assist with this demand. Training is also a key element in the sustainability of regulatory infrastructures. At least one country noted the potential for on-line learning approaches to training.
— A number of countries comment favourably on their experience with IAEA peer review missions. There seems little doubt that regulators engaged in implementing and upgrading regulatory systems find great value in meeting and discussing with peers the issues facing them. An occasional remark concerns the uniformity of advice provided by consultants employed by the IAEA. While it is sometimes difficult to find the right combination of skills, experience and availability of a consultant, the IAEA should ensure that all those assisting with the Model Project are fully informed about the standards framework within which it operates, so that there is a consistent and uniform approach.

One noticeable shortage of comment is reference to the IAEA's Safety Standards Series, apart from the BSS itself and the transport regulations. In particular, Safety Standards Series No. GS-R-1 [3] is not mentioned: this may be in part due to its relatively recent publication (in 2000). Perhaps this indicates a need for the IAEA to assess the utility of Safety Standards Series publications among Member States engaged in the Model Project. Much use, however, has been made of a number of TECDOCs, including numbers 1067, 1113 and 1217 [4, 5, 6].

One negative comment suggested that Model Project action plans may set too ambitious a timetable for implementation of the various milestones. This will clearly be of more concern in countries where resources and skilled personnel are scarce.

9. OBSERVATIONS AND ISSUES FOR THE FUTURE

There is a clear need for the Model Project to continue, including the associated peer review missions. While most countries have reached the key Milestones 1 and 2, some have not and these need further assistance. Many countries are still implementing Milestones 3 and 4, dealing with radiation safety for medical and public exposure, and few have well developed emergency preparedness arrangements in place (Milestone 5).

The IAEA is also aware that many countries that are not Member States, similar in number to those involved with the Model Project, are likely to require the same kind of assistance in order to upgrade their regulatory infrastructures. To promote safe practices in all countries, the IAEA, perhaps in concert with other United Nations organizations having broader membership such as the World Health Organization, might explore ways in which IAEA non-Member States could become involved in an extension of the Model Project.

While the IAEA has other programmes under way to deal with security issues, some adjustment to Model Project action plans may be needed to accommodate an increased emphasis on the security of radioactive sources. The recent guidance developed by the IAEA on categorization [7] and security [8] of sources should be incorporated into the project planning.

With most countries having now established a regulatory framework for occupational exposure control, including requirements for personal monitoring of external exposure, particular emphasis may now need to be given to developing, implementing, inspecting and auditing workplace safety practices. This could include evaluating the circumstances of exposure and considering measures to change work practices where practicable to optimize protection. It should also extend to promoting the development of a safety culture in the workplace, particularly where hazardous sources are involved, and promoting quality management systems that ensure continuing attention to matters of safety.

One area where the broader international safety community has a common interest with Model Project countries is in developing sensible solutions for the regulation, where needed, of activities involving NORM. This is also an example of a regulatory discussion that could benefit from stakeholder involvement. A number of extractive and mineral processing industries, some making a significant contribution to national wealth, including the oil industry, deal with natural materials containing small amounts of uranium and thorium. It would be sensible to include their experience and input in reaching practical solutions to regulation.

Another area that ultimately depends on stakeholder involvement for maximum success is the regulation of radiation exposure in medicine. This is difficult territory for the regulator, recognizing on the one hand the responsibilities and experience of the medical profession and, on the other, the need to ensure safe practices involving patient exposure. It is essential that the medical professions are included in developing the solution.

The development of regional networks among regulators and radiation safety professionals may assist in some areas. At the least, exchanges of information and experience could broaden and enrich the professional knowledge and expertise of those involved who, in many countries, are very few in number. There may be a role for other organizations, such as the International Radiation Protection Association, in this regard. There may even be some scope for developing specialist services on a regional basis, where it would not be feasible for every individual country to provide them, possibly in conjunction with activities already underway to establish regional training centres. Examples where a need has been noted include internal dosimetry, radionuclide analysis, medical physics advice and assistance in decommissioning nuclear reactors.

10. FINAL REMARKS

Acknowledging that there is still some way to go in reaching the desired level of effective and sustainable regulatory control of radiation safety in all countries, the Model Project has made significant progress. Developing legislation and regulations, and nurturing them through the necessary governmental processes of adoption is never easy, especially in circumstances where there are limited budgetary resources available for the task. So the establishment of a regulatory foundation for radiation safety in almost all of the Model Project countries is undoubtedly a success. It is to be hoped that the energy and enthusiasm among Model Project participants can be maintained in achieving their remaining milestones. The ultimate objective is the assurance that radiation sources are being managed safely and securely in every corner of the globe, and in conformity with up to date international standards. Those involved in the Model Project deserve credit for making substantial progress in that direction.

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Round Table 1

IMPLEMENTATION OF THE MODEL PROJECT FOR UPGRADING RADIATION SAFETY INFRASTRUCTURES

DISCUSSION

Chairperson

G.A.M. WEBB
International Radiation Protection Association

ROUND TABLE 1

I. OTHMAN (Syrian Arab Republic): Two things which, in my view, have proved to be very useful in the implementation of the Model Projects are international peer review missions and co-ordination seminars.

Peer review missions help the regulatory authorities in participating countries to, inter alia, assess what has been accomplished, determine why certain objectives have not been achieved and identify areas where adjustments are necessary. Co-ordination seminars enable representatives of participating countries to, inter alia, exchange experience and thereby identify gaps in their radiation safety infrastructures. I have participated in and benefited from both types of activity.

It is generally accepted that the establishment of a regulatory framework (Milestone 1) is the most time consuming Model Project activity. The establishment of emergency preparedness response capabilities (Milestone 5) is also very time consuming, however, as it involves not only the regulatory authority but also numerous other national bodies, who must be convinced that they have a role to play in emergency planning. It took us at the Atomic Energy Commission of Syria (AECS) over three years to bring together representatives of the Ministries of the Interior, Defence, Justice, Health and Labour and the representatives of other departments for the purpose of drawing up an emergency plan — and, of course, every emergency plan needs to be tested, which also calls for a major collaborative effort.

M. BAHRAN (Yemen): The management of the Model Projects by the IAEA has been excellent, but in 2001, when the five Model Projects launched in 1997 (one per region) were succeeded by ten Model Projects (two per region), we in Yemen experienced an approximately eight-month-long hiatus in IAEA assistance. I would urge the IAEA to ensure that such hiccups do not occur in future transition phases.

The regional managers have to do a great deal of travelling, so that they are away from the IAEA's Headquarters — in Vienna — for long periods of time, during which counterparts in participating countries are unable to contact them. I would greatly welcome it, therefore, if each regional manager had an assistant capable of dealing effectively with problems reported to the IAEA's Headquarters by counterparts.

A. SALMINS (Latvia): In several of the European participating countries, the substantial progress made in Model Project implementation — in areas such as workplace monitoring and medical exposure control — has been due in large measure to the fact that those countries are looking forward to membership in the European Union, where a high level of commitment to radiation safety is expected of the Member States.

Regarding M. Bahran’s point about the long absences of regional managers from the IAEA’s Headquarters in Vienna, in each region there are participating countries at very different levels of advancement in the establishment of radiation safety infrastructures and, if a more advanced participating country encounters a problem just when the regional manager is absent from Vienna, it should perhaps try to ‘go it alone’. The regional manager may well be in one of the less advanced participating countries, helping it to resolve its problems.

O.I. Al-AMIN (Sudan): The regional Model Projects have undoubtedly been an improvement over the national projects that preceded them. The long absences of regional managers from Vienna do constitute an issue, but I think it could be resolved through institutional arrangements whereby alternate managers are available to deal with the problems of participating countries.

I have been asked whether, in my view, the order of the five Model Project Milestones is the natural order. I believe that it is.

In my experience, the greatest difficulties arise when one has to deal with the medical community, which is well entrenched and considers itself to be very knowledgeable about the effects of ionizing radiation. At the end of the day, we succeed in convincing medical practitioners that we do not wish to police them, but it takes a long time and a lot of personal contact.

G.A.M. WEBB (IRPA): Some years ago in the United Kingdom, when we were trying to implement radiation protection standards in the medical area, we did it largely through professional bodies like the Royal College of Radiologists, convincing their members that we did not wish to take over their jobs but to work with them in making improvements. Even so, the exercise took over a decade.

F.J. MORALES (Nicaragua): Our experience with the Model Projects has been very good, and I believe that progress is faster with such Model Projects than with national projects. The IAEA assigns technical officers both to regional Model Projects and to national projects, but to the Model Projects we are talking about here it has also assigned regional managers, who do much to expedite matters.

The regional Model Project concept is particularly helpful for small participating countries like Nicaragua. We have passed the necessary legislation and established a regulatory authority, but we need a lot of scientific and technical information — and we find that we can obtain it best through the Model Project mechanism.

I think we need to remain for two years or so more within the Model Project framework; then we can continue with a national project. We will have ‘graduated’, but there will be a lot of ‘post-graduate’ work to do.

A. HASAN (USA): For the Model Project approach to succeed in a participating country, it must be supported by high level decision makers, especially where co-ordination among several governmental agencies is necessary, for example, in the area of emergency preparedness and response.

Also, the country should make a careful assessment of its training, equipment and other needs. Things move faster once such an assessment has been made.

A.J. Al-KHATIBEH (Qatar): We have found it difficult to assess our training needs because we do not have sufficient information about the qualifications which radiation workers of different kinds ought to possess. It would be helpful if there were model local rules which we could apply.

One grey area, as far as we are concerned, is whether a firm which imports radioactive sources for use by others and handles the export of the sources when they are no longer wanted in Qatar needs a radiation protection officer and special storage and transport facilities, or can it simply rely on the users. The Model Project approach does not address that problem.

Also, I do not think that emergency preparedness and response should be covered by the last of the five milestones — Milestone 5. My country is in a part of the world where several wars have taken place in recent years, radioactive materials have been looted and lost, and nuclear powered vessels ply, and I therefore believe that the priorities should be adjusted.

In conclusion, I associate myself with what M. Bahran and O.I. Al-Amin said about the long absences of regional managers from Vienna.

G.A.M. WEBB (IRPA): Perhaps this regional manager issue is about whether the IAEA should provide practical assistance in support of the day to day running of regulatory bodies — and, if so, how.

J.R. CROFT (United Kingdom): In the United Kingdom, 'qualified experts' often provide such assistance. Perhaps the IAEA should look into how the qualified expert concept in the BSS might be developed for this purpose.

K. MRABIT (IAEA): I should like to pick up from what I. Othman said about the international peer review missions organized within the Model Project framework. In my view, whatever is going to happen with the Model Projects, it is essential that the international dimension exemplified by activities like those missions not be lost.

An important aspect of international peer review missions is their potential for enabling regulatory bodies to carry out self-assessments in due course, the ability to carry out self-assessments being a major contributor to continuous improvement and sustainability.

I. Othman also mentioned co-ordination seminars, which may be regarded as a form of networking — the future importance of which

T. Taniguchi emphasized in the Background Session. This is another example of the international dimension that, in my view, should not be lost.

In this connection, I would recall that the IAEA has made the Regulatory Authority Information System (RAIS) source inventory available to regulatory authorities in many countries. Now, with the revised Code of Conduct on the Safety and Security of Radioactive Sources and the recently issued Categorization of Radioactive Sources (IAEA-TECDOC-1344), we are upgrading RAIS — with extrabudgetary support from the United States of America. This can only be done with an international, or at least a regional, approach; it cannot be done just at the national level. This new version of RAIS will be made available during 2004 to countries through specific regional workshops.

K. SKORNIK (IAEA): Just before I left Vienna to attend this conference, we had a regional managers' meeting at the IAEA's Headquarters at which I was authorized by my fellow regional managers to make a number of comments regarding the Model Projects.

An important aspect of the Model Projects is that, from the very outset, they required an intense interaction between the IAEA and the participating countries at the decision making level. The interaction did not always go smoothly; in order to create a sufficient awareness of radiation safety issues, we had to gain the ear of high level officials, parliamentarians and even cabinet members. That delayed practical implementation in some participating countries, but we believe that creating that awareness has been one of the major accomplishments of the Model Projects.

We were overoptimistic in our assumption about the duration of the Model Projects, because we did not realize how difficult it is to get laws enacted and regulations approved. We know better now.

Another important aspect of the Model Projects is that they are geared to the BSS requirements and to policies of the IAEA set by its Board of Governors. This has proved to be a strong incentive for participating countries to attain Milestones 1 and 2, and then embark on the attainment of the other three milestones.

Still another important aspect is that the needs of the different participating countries can be met through country specific action plans, which can be adjusted almost immediately in the light of the findings of monitoring missions, peer review missions and co-ordination seminars.

The Model Projects are flexible also in the sense that, when a participating country makes major progress, we can respond by providing additional assistance — and if implementation problems arise, we have high level contacts through whom we can persuade the decision makers to take the necessary corrective action.

A further aspect of the Model Projects which, I think, deserves mention is capacity building through training programmes.

We regional managers brought the problem of our long absences from Vienna to the attention of senior decision makers in the IAEA, and the associated needs have been addressed on several occasions for limited periods, but one must bear in mind the financial constraints on the IAEA. I would note in this connection that the number of participating countries varies, from region to region, between 30 and 12. However, all the regional managers have an immense workload — but the feeling of achievement when good progress is being made is also immense.

That having been said, we are very aware that we could do our job better.

G.A.M. WEBB (IRPA): It is the nature of management that the job can always be done better, but the IAEA will not simply have to 'do better' if the needs of countries which are not IAEA Member States are to be met through the Model Project approach. It is not clear how such countries could be integrated into the present organizational arrangements.

M. BAHRAN (Yemen): With the increase in the number of participating countries from just over 50 to well over 80, it is only natural that the workload of the regional managers is immense. Some form of assistance should be provided to them.

In that connection, I would say that, as a participating country advances in the implementation of its action plan, it needs more attention from the regional manager — not less. What K. Skornik called 'an intense interaction' has to become more intense.

K. SKORNIK (IAEA): Further to what M. Bahran just said, I would point out that several of the countries which started participating only recently have not been IAEA Member States for long. That has not made matters any easier.

M. ARAMRATTANA (Thailand): I sympathize with the regional managers, but about 15 years ago, I was the regional manager of an IAEA project in Asia which was considered to be very successful, and I think that one reason for its success was the fact that I was based in the region — not in Vienna.

F.J. Morales spoke of 'graduating'. In that connection, I would note that different countries will spend different lengths of time participating in the Model Projects before 'graduating', so perhaps 'graduation' is a relative concept. At all events, I think it would be useful to have some kind of 'infrastructure development indicators' by means of which we could judge which participating countries should 'graduate'.

Further to what was said by G.A.M. Webb and J.R. Croft about the day to day running of regulatory bodies and 'qualified experts', I should like to see the establishment of a network of specialists who could provide administrative and technical support to national managements through national projects.

Accordingly, I think we need both regional Model Projects and national projects.

SEONG HO NA (Republic of Korea): If one talks about 'graduation', one must also talk about failure, and there must be a process for assessing the willingness of the participating countries — whether their attitude is positive or negative.

A. Hasan spoke about the participating country making a careful assessment of its training, equipment and other needs. In my view, a participating country able to make such an assessment is significantly more advanced than participating countries not able to do so, and the IAEA should take that into account by being flexible and adjusting the milestones that lead to 'graduation'.

Perhaps one could introduce the concepts of 'minimum level', 'acceptable level', 'harmonized level' and 'enhanced level' as performance indicators.

N.A. DROUGHI (Libyan Arab Jamahiriya): In this discussion, nothing has been said about the distinction between safety and security. I should like that distinction to be made very clear, because I am afraid that the IAEA, with its severe budgetary constraints, is going to focus in the future on security at the expense of safety.

S.B. ELEGBA (Nigeria): If there is a switch from the regional Model Project approach back to national projects, will the IAEA provide technical assistance through a national project to each of the countries now participating in the Model Projects? In my view, the answer to that question is almost certainly "No". Even if it were "Yes", we must bear in mind that networking would not be easy with such a large number of national projects.

That having been said, I would say that future IAEA assistance is not the issue; pursuant to its Statute, the IAEA has to provide assistance to Member States. The issue is how the assistance will be provided. National projects worked to some extent, but they were not nearly as effective as the Model Projects.

These have created a kind of platform for safety related activities and, in my view, the best thing now would be to strengthen it so that it can support security related activities, rather than creating a new platform.

M. BAHRAN (Yemen): In response to N.A. Droughi's comment, I would say that a secure radioactive source is not necessarily safe and a safe radioactive source is not necessarily secure, but safety and security are to a great extent mutually supportive. It should, therefore, be fairly easy to handle safety together with security within the framework of radiation protection.

A. SALMINS (Latvia): When considering security, one must assess the potential impact of the malevolent use of a radioactive source. The approach is similar to that followed when one is considering safety, and much of the terminology is the same. Ultimately, one has to decide whether the practice involving that radioactive source is justified in the light of the security risks — the ICRP justification criterion has to be applied in the security area as well.

A.O. KOTENG (Kenya): Two terrorist bomb attacks have taken place in my country in recent years, and I shudder to think how much worse things would have been if radioactive materials had also been involved in them. How would our regulatory body — which is concerned with the safety of radioactive sources being used in medicine, industry, research, teaching and so on — have coped?

The issue of radioactive source security — which embraces issues such as illegal trafficking in radioactive materials — is too broad for a national regulatory body to handle on its own. It is an international issue in which police officers and customs officials must become involved, and I believe that an international — or at least a regional — approach to it would be best.

I. OTHMAN (Syrian Arab Republic): Regarding 'graduation', I would note that a benefit for the IAEA is that a participating country which 'graduates' can take over some of the task of helping other participating countries in that part of the world.

When talking about what will happen after the end of 2004, we should bear in mind that the original interregional Model Project, launched in 1994, was succeeded — in 1997 — by five regional Model Projects, which were succeeded — in 2001 — by ten regional Model Projects. There have been big changes, but no break in continuity, and I do not think that there will be a break in continuity after the end of 2004.

K. MRABIT (IAEA): In response to the comments just made about security, I would note that security is not a new issue for the IAEA. The BSS contain requirements relating to the security of radioactive sources. However, what is relatively new is the prevention and detection of, and response to, malicious acts involving radioactive materials.

During this discussion, there have been references to 'graduation' and calls for flexibility on the part of the IAEA. In this connection, I would suggest that we await the keynote address which W. Kraus of Germany is going to make in Topical Session 8 on 'Performance evaluation'.

M. DAUD (Malaysia): I share N.A. Droughi's concern about the possibility of the IAEA focusing on security at the expense of safety, and I hope that separate budgetary arrangements will be made for the IAEA's security related activities.

P.M.C. BARRETTO (IAEA): IAEA Member States which are very concerned about the safety of the radioactive sources within their territories, and want IAEA assistance in ensuring the safety of those sources, should reflect their concern in the technical co-operation project proposals which they submit to the IAEA. They should indicate that they assign high priority to the proposals for projects designed to increase radioactive source safety. The IAEA wants to see how strong the commitment of Member States to radiation safety is compared with their commitment to water resources management, plant breeding, insect pest eradication, environmental protection and so on.

M. Aramrattana said that 'graduation' is perhaps a relative concept. Of course it is a relative concept. At all events, countries participating in the Model Projects should not be afraid of 'graduating'. The IAEA will not stop providing the 'graduate' countries with assistance in the field of radiation protection.

As regards the question of providing the regional managers with assistance/assistants, when I was Director of the IAEA's Division for Europe, Latin America and West Asia, I tried to do that. However, it meant the creation of additional posts within the IAEA Secretariat, which is always very difficult. In fact, the IAEA's Department of Technical Co-operation has [in the past] been under pressure to relinquish posts for use elsewhere in the Secretariat.

The regional managers were originally posted in the regions for which they were responsible, but then they were brought back to Vienna and posted there — for two main reasons: greater ease of communication with different participating countries; and proximity to technical officers within the IAEA Secretariat.

Thought will be given by the IAEA to ideas such as arranging for its technical Divisions to assist the regional managers [more], but the process of planning for the future is an internal one which I believe the IAEA should be left to conduct on its own.

RESOURCES AND SERVICES, QUALITY ASSURANCE, INTERNATIONAL SUPPORT OF SERVICES

(Topical Session 4)

Chairperson

L. KOBLINGER
Hungary

Keynote Address

HOW TO ESTABLISH, OPERATE AND MAINTAIN A NATIONAL RADIATION PROTECTION SYSTEM

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Abstract

In the paper, the conditions required for establishing and operating an appropriate national radiation system are discussed. Requirements of the legal and institutional frameworks, as well as the fields to be covered are also described. In addition, the role and importance of international co-operation are emphasized, with examples taken from the existing radiation protection system of Hungary.

1. BASIC REQUIREMENTS

There are four major components of a good radiation protection system:

— legal framework
— institutional framework
— technical conditions
— availability of personnel

1.1. Legal framework

The legal framework is based in most countries on the Basic Safety Standards (BSS) [1] of the IAEA. Acts and decrees state the basic principles of radiation protection (e.g. the concepts of justification, optimization and dose limitation) and specify the tasks and responsibilities of the authority or authorities and the licensees. Various level decrees explain details such as practical requirements and derived emission limits. The legal instruments should not be static, they should be revised from time to time, reflecting the new certified scientific and technical achievements.

1.2. Institutional framework

The legal instruments should specify the national authority or authorities which are responsible for the licensing of workplaces, activities and/or sources, for advising and supervising the licensees, accounting for radioactive sources and nuclear material, as well as registering the doses received by the occupationally exposed workers.

Besides the central authority or authorities, other institutions such as regional centres, university laboratories, research institutes or private companies can have partial roles in a complete national system of radiation protection.

1.3. Technical conditions

An appropriate radiation protection system cannot be operated without accurate and reliable instrumentation. The measuring devices as well as the software tools used for the evaluation and interpretation of results should be up to date. The accreditation of participating laboratories and the continuous calibration of the measuring devices are required. Quality management plays a crucial role in medical applications in the reduction of patients' doses. The demand for quality management of the authority (or authorities) is increasing. Technical support organizations may help the work of the authorities.

1.4. Personnel

Only well educated and trained personnel can successfully operate an intelligent system. Education and regular training of personnel is a crucial point of the system. Appropriate education of all people working with ionizing radiation is an essential part of a safety culture.

2. FIELDS TO BE COVERED

The basic criteria should be clearly specified in the legal instruments. These criteria should direct all further steps, such as:

— Licensing workplaces and/or sources;
— Derivation of discharge limits;
— Methods of authority that are supervising emissions/discharges, workplaces and practices;
— Enforcing the regulatory requirements;

- Monitoring the workers possibly irradiated (establishment of methods of external and internal dosimetry, determination of the frequency of measurements, establishment and maintenance of a registry of dose data);
- Monitoring the environment (country-wide and local on-line dose rate measurements, determination of the types of environmental samples to be taken and of the frequency of sampling, classification of sample analysing techniques, methods to be used in dose assessments);
- Requirements in calibration of radiation monitoring instruments;
- Developing a system of periodic and occasion-based (in cases of events) reporting to the authority or authorities;
- Waste management;
- Emergency preparedness.

3. INTERNATIONAL CO-OPERATION

International co-operation is very important in many aspects of radiation protection. In most countries, the basic concepts laid down in national regulation follow the recommendations of the IAEA. The Model Projects organized and operated by the IAEA further help the development of common understanding [2].

On a European level, the European Radiation Dosimetry Group (EURADOS) project carries out activities to advance the scientific understanding of the dosimetry of ionizing radiation, to promote the technical development of dosimetric methods and instruments and their implementation in routine dosimetry, and to ensure consistency of dosimetric procedures used within the European Union.

International comparison exercises of measuring tools (e.g. dose rate and dose meters, environmental sample analysing techniques), as well as of mathematical models (e.g. used for dose assessment or dispersion calculations) help the participating countries to control and update their tools (see Ref. [3]).

4. AN EXAMPLE: HUNGARY

Hungary may be considered a medium size country from the viewpoint of radiation protection, where the wide scale application of radioactive materials started in the early 1960s.

4.1. Legal background

The Act on Atomic Energy [4] allocates regulatory tasks to several ministries. The regulation of radiation protection belongs to the Ministry of Health, the technical side of radiation protection in nuclear facilities is under the Hungarian Atomic Energy Authority. The limitation of releases and the protection of the environment belongs to the Ministry of Environmental Protection, while tasks related to the radioactivity of the soil and flora belong to the scope of the Ministry of Agriculture.

A decree issued by the Minister of Health [5] lays down the basis of radiation protection (in accordance with ICRP Publication No. 60 [6] and the BSS [1]). This decree specifies the tasks and responsibilities of the licensees and the authorities, as well as the accreditation requirements of laboratories and the education and periodic training of personnel.

A national body, the Office of the National Chief Medical Officer, is the licensing authority for radiation protection regulation and the health physics service section of the facilities. The bodies of the State Public Health and Medical Officer's Service, at the county level, are empowered to supervise the adherence to radiation protection rules in all civilian uses of atomic energy. There are about 70 people in these bodies dealing with inspections at workplaces.

4.2. Registries of radioactive materials

A decree issued by the Minister of Industry and Trade and Tourism [7] regulates the system of local and central registries of radioactive material. There are approximately 1000 workplaces where radioactive materials are used. Most of them are industrial facilities and hospitals. The number of *significant* radiation sources (with an activity exceeding 10^{10} Bq) is about 3000. Under the system, all licensees should have a local registry of all radioactive sources in their possession. In parallel, the central registry should be maintained in such a way that the quality, quantity and location of all radioactive material in Hungary could be established in any given time.

4.3. Personnel dosimetry

People working with radiation have been regularly tested in Hungary since 1965. External gamma doses are evaluated by the national personal dosimetry service. Dosimeters are distributed to about 15 000 people working in about 1300 institutions. In addition, thermoluminescence dosimeters (TLDs) are used at the Paks nuclear power plant and at the Atomic Energy Research

Institute by about 1300 workers altogether. At the power plant, the research reactor and the training reactor, personnel and workplace neutron detectors are distributed.

According to a decree issued by the Minister of Health, the licensee should specify those workers who are possibly exposed to internal contamination and who, therefore, should be monitored regularly by whole body counting or by an analysis of excreta. Moreover, special measurements are carried out in cases when an individual is suspected of having inhaled or ingested significant amounts of radioactive material. There are between 2000 and 3000 measurements for internal contamination per year.

In the period 1991–1995, no person's exposure exceeded the dose limits; from 1996 to 1999, there were two cases when the dose absorbed was higher than the limit (50 mSv/a, 100 mSv in five consecutive years). Since the year 2000, no doses above the limit have been found.

4.4. Radiological monitoring of the environment

Limits of discharges to the environment are specified in a decree issued by the Minister of Environmental Protection. Environmental samples are collected and measured in laboratories of the Ministry of Health, the Ministry of Environmental Protection and the Ministry of Agriculture. All environmental radiological data are collected in the National Environmental Radiological Monitoring System [8].

4.5. Nuclear emergency preparedness

The National System for Nuclear Emergency Preparedness was created at the end of 1989. Nuclear emergency is a part of the integrated system for protection against all kinds of catastrophes. The system is managed by the Governmental Co-ordination Committee. In the case of a nuclear accident, it is the task of the specific National Defence Committee to provide advice to the decision makers. The Hungarian Atomic Energy Authority operates an expert section, evaluates the nuclear and radiological situation, and forecasts its propagation. The current National Emergency Response Plan entered into force in 1994 and was prepared in line with the structure and responsibilities valid at that time.

4.6. International co-operation

Though Hungary has long traditions in radiation protection, and both the registry of the radiation sources and the national personal dosimetry service are well developed, the operation and continuous development of the systems cannot be imagined without international co-operation. One of the most valuable contributions regarding both knowledge transfer and technical aids is Model Technical Co-operation Project RER/9/062, National Regulatory Control and Occupational Radiation Protection Programmes, led by the IAEA.

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Topical Session 4

RESOURCES AND SERVICES, QUALITY ASSURANCE, INTERNATIONAL SUPPORT OF SERVICES

DISCUSSION

M. NOVAKOVIC (Croatia): Further to R. Czarwinski's comments on my contributed paper, I do not think that you can create reliable and sustainable radiation infrastructures on the basis of decrees which assign the predominant role to inspectors. In my view, the role of the inspector should simply be to help ensure that the infrastructure is functioning properly — by identifying gaps, correcting mistakes and generally ironing out difficulties. I do not believe that you can build competence from the top down — only from the bottom up.

J.M. ROONEY (USA): In his keynote presentation, L. Koblinger described Hungary's arrangements for responding to radiation accidents. Does Hungary have similar arrangements for responding to cases of sabotage at nuclear facilities and of theft of radioactive materials?

L. KOBLINGER (Hungary): Yes, it does.

SEONG HO NA (Republic of Korea): From R. Czarwinski's presentation, it was not clear to me whether she was advocating the centralized or the decentralized provision of individual monitoring services for occupationally exposed persons (radiation workers). R. Czarwinski used both expressions.

R. CZARWINSKI (Germany): It depends on the number of occupationally exposed persons (radiation workers) in the country. If there are not many, it may be more advantageous to provide the services at one central location, bringing together all the qualified radiation monitoring personnel there rather than having them dispersed around the country.

A. HASAN (USA): Should the regulations governing national radiation safety infrastructures cover quality assurance in connection with the provision of services?

K. COY (Germany): I think they should. For example, when services are provided through outsourcing, the provider must be accredited, and that must be covered by the regulations.

K. MRABIT (IAEA): I agree with K. Coy. That is in line with the BSS requirements.

In that connection, I would note that, although the provision of services — for example, food monitoring — should be one feature of national radiation safety infrastructures, the regulatory body should normally not function as a service provider. The main function of a regulatory authority is to authorize and inspect regulated activities and to enforce the national legislation and regulations.

A.M. NYANDA (United Republic of Tanzania): In poor developing countries, it is difficult for the regulatory bodies to enjoy financial independence without earning income through the provision of personnel monitoring, radioactive waste management or other services.

K. COY (Germany): Perhaps the important thing is the independence of regulatory inspectors. At all events, I think that the independence of the regulatory bodies in Model Project participating countries is an issue for the IAEA.

SEONG HO NA (Republic of Korea): In my country, we have found that the quality of personnel dosimetry deteriorates if there is no quality assurance programme. Accordingly, we now attach great importance to quality assurance, which we think should be based on ISO requirements.

W. KRAUS (Germany): Ideally, quality assurance should be based on ISO requirements, but in many countries, including Germany, the quality assurance of individual monitoring services is conducted in a manner not completely in line with ISO requirements. In the case of countries just embarking on the development of such services, it may be necessary to require even less, in order that the services can get under way. Then a stepwise approach may be adopted in further developing the services.

M. DAUD (Malaysia): Quality assurance is very important for testing and calibration, because of the legal implications, and in my country we have placed great emphasis on quality assurance on the basis of ISO 17025 ('General requirements for the competence of testing and calibration laboratories').

E.C.S. AMARAL (Brazil): The basis for radiation safety is the dose measurement, so I do not agree that regulatory bodies do not need to have a dosimetry capacity. At the very least, they must understand enough about dosimetry to interpret regulatory inspection results and to evaluate service providers.

However, I do not think that a capacity for every kind of dosimetry must exist in every country. In Brazil, for example, we do not carry out neutron dosimetry; we rely on outsourcing.

K. COY (Germany): In my view, the most important thing is to have comparable, accurate and precise dose measurements and good record keeping for lifetime doses.

M.Y. OSMAN (Sudan): K. Mrabit said that the regulatory body should normally not function as a service provider. In my view, the regulatory body should never function as a service provider. If it needs to generate income, it can do so by, for example, charging for the licences which it issues and fining users who fail to comply with the regulations. It should not try to be a referee and a player at the same time.

K. MRABIT (IAEA): In IAEA Safety Standards Series No. GS-R-1, ‘Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety’, the main responsibilities or functions of the regulatory body are clearly stated and, therefore, no other responsibility or function shall be assigned to the regulatory body which may jeopardize or conflict with the main ones. It is also stated that additional functions of the regulatory body may, inter alia, include “providing personnel monitoring services and conducting medical examinations”. When such functions are undertaken, care shall be taken by the regulatory body to ensure that any conflicts with its main regulatory functions is avoided and that the prime responsibility of the operation for safety is not diminished.

Thus, the regulatory body should clearly not, for example, provide consultancy services to registrants and licensees but, if the country has no other provider of personnel monitoring services, I think the regulatory body should be allowed to provide such services as long as that does not hinder it in the execution of its main tasks.

M. ARAMRATTANA (Thailand): In my country, we have found it impossible to initiate a quality assurance programme. I would therefore welcome it if the IAEA introduced — in addition to peer reviews of entire radiation safety infrastructures — peer reviews of individual infrastructure elements such as the quality assurance systems.

K. MRABIT (IAEA): The IAEA is already moving in that direction. For example, it has recently created an Occupational Radiation Protection Appraisal System (ORPAS) — and its aim is ultimately to have separate modular appraisal systems for various infrastructure elements, in addition to a system for the appraisal of entire infrastructures.

Regarding the independence of regulatory bodies, it is stated in IAEA Safety Standards Series No. GS-R-1: “A regulatory body ... shall be effectively independent of organizations or bodies charged with the promotion of nuclear technologies or responsible for facilities or activities. This is so that regulatory judgements can be made, and enforcement actions taken, without pressure from interests that may conflict with safety.” How the effective independence of the regulatory body is achieved will vary from country to country. One way of achieving it, in some countries, is to make the regulatory body answerable only to the office of the country’s president or prime minister.

If the regulatory body is separated administratively from all “organizations or bodies charged with the promotion of nuclear technologies or responsible for facilities or activities”, there is a lower probability that it will be influenced by them.

A. ALONSO (Spain): Some time ago, the IAEA's International Nuclear Safety Advisory Group (INSAG), of which I am a member, came to the conclusion that no regulatory body is completely independent in practice. It has produced a report entitled 'Independence in regulatory decision-making' which the IAEA will — I hope — publish soon, and I think that many participants in this conference would find that report helpful.

G. GEBEYEHU WOLDE (Ethiopia): In my view, providing services in areas such as individual monitoring will not compromise the independence of regulatory bodies. In some countries, individual monitoring services and the like simply have to be provided by the regulatory bodies.

K. MRABIT (IAEA): One of the topics to be covered in Topical Session 7 is independence of regulatory authorities. That session will provide an opportunity for a fuller discussion.

Rapporteur's Summary

RESOURCES AND SERVICES, QUALITY ASSURANCE, INTERNATIONAL SUPPORT OF SERVICES

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1. INTRODUCTION

Beside laws and regulations, as well as a regulatory system, services and resources are elements of the national infrastructure in radiation protection. In addition, the safety culture practised by all those with responsibilities for protection (also in the conventional work activities) is the basis for an effective radiation safety infrastructure. It is important to have clear lines in authority and responsibility, and sufficient and adequate resources — appropriate to national requirements.

In an effective national infrastructure, social concerns also have to be addressed, such as appropriate arrangements have to be made for disposing of radioactive wastes, for preparing responses in emergency cases where public exposure has to be expected or for the exchange of information [1].

It should be mentioned that broad variations in the level of the radiation safety infrastructure exist between the Member States of the IAEA. On one side, some Member States have no infrastructure in radiation protection or their infrastructure is inappropriate for the types of practices which are applied. On the other, there are countries with a highly developed and adapted radiation safety infrastructure.

In all cases, the question of an optimal adequacy of resources is an open one and has to be fitted to the actual situation.

To summarize the Basic Safety Standards of the IAEA (the BSS), a national infrastructure must provide facilities and services which are essential for radiation safety, for example, those needed for:

— personal dosimetry
— intervention
— environmental monitoring

— calibration and intercomparison of radiation measuring equipment [1]

In addition, workplace monitoring has become increasingly important in recent times. In Topical Session 4 Resources and Services, 14 papers were presented, from Bulgaria, Croatia (and other European States) the Democratic Republic of the Congo, Ecuador, Egypt, El Salvador, Iran, Malaysia, Tunisia, Ukraine, United Arab Emirates and Zambia.[1] Mostly these presentations dealt with general aspects and overviews on national administrative structures. Only in some papers were selected services discussed, whereas the main emphasis was given to the personal dosimetry which is the most important task in radiation protection in these countries.

2. SERVICES

The term 'services' refers to experts, groups of experts or institutions which offer specialized activities (i.e. services). They are acting by order of the regulatory body or of the user of ionizing radiation. Services can be conducted centrally, for example, by administrative bodies or they can be decentralized. For obligatory services, such as dosimetry services, an approval by the regulatory body should be an established part of the process.

Selected examples of services are:

— Dosimetry services (external and internal monitoring);
— Central dose record keeping;
— Quality assurance;
— Quality management of medical equipment;
— Calibration services;
— Radioanalytical laboratories;
— Technical advisory services;
— Maintenance services;
— Provider of emergency equipment.

In general, there are three targets for protection where services are needed: occupational, exposed persons, public exposure and exposure in medicine.

Monitoring of occupational exposure is an obligation that goes with the authorization of ionizing radiation. Part of the authorization process for a

[1] Contributed papers mentioned in this summary can be found in the CD-ROM.

radiation source should be emergency preparedness. Suited to the use and types of sources, emergency measures and equipment have to be planned for and put in place in order to ensure that any consequences of an incident or accident can be dealt with successfully.

The monitoring of environmental radioactivity is a widespread field with many tasks. In developed countries, very often all the following environmental compartments — which need well equipped radioanalytical laboratories — are monitored:

- atmosphere
- precipitation
- plants and foods (and carbon-14 in plants)
- soil
- aquatic systems (including sediments)

Furthermore, the external radiation doses of members of the public (mainly caused by terrestrial and cosmic radiation) are measured and observed. The necessity to monitor all these compartments is not given in every case. Therefore, significant resources should not be given to the detailed monitoring of the environment or food unless it is justified by an accident, the safety evidence has to be guaranteed or public confidence in the special application of ionizing radiation have to be kept.

From my point of view, a prioritization of the provision of services is strongly recommended, particularly for developing countries with limited resources.

3. RESOURCES

In general, resources comprise the financial, technical and staff power to solve a specific task.

The fundamental precondition for a cost effective planning and optimal use/investment of resources is an analysis of the national situation (necessities and availabilities) at the application of ionizing radiation. Beyond the existing and intended applications of radiation sources, the priorities for the establishment and scope of nationally planned services have to be defined. Limited resources have to be focused on the main applications of radiation sources in the country.

For instance, with each authorized use of radioactive sources, individual monitoring of the involved radiation workers has to be done. Over and above that, it has to be checked whether the use of the radioactive source could cause public exposure and their safety and security after the end of application. It means the waste management/disposal has to be clarified before the use will be authorized. This gives rise again to the issue of orphan sources.

In many countries, the monitoring of occupational radiation exposure, especially external exposure, is a well functioning routine business. However, optimization is possible and often necessary, particularly if the implementation of an effective national infrastructure is starting.

4. INTERNATIONAL CO-OPERATION

In many of the countries that were the subject of presentations in this session, the use of nuclear energy already has a long tradition. In addition, the application of radioactive sources in industry and especially in medicine is increasing. But it happened without any *detailed* programme for radiation protection and safety. In the presentations, it is evident that the IAEA Model Project for Upgrading Radiation Protection Infrastructure provides very important assistance to increasing radiation safety in those countries.

A typical situation for a developing country is described in the presentation of L.F. Badimbayi-Matu from the Democratic Republic of the Congo. The peaceful use of nuclear energy began there in 1959. This country has had occupational monitoring and good practices in reactor management. Since 1978, the application of radioactive sources in medicine and industry exists all over the country. But all of these activities have been carried out without any act or legal regulations. With the support of an IAEA Regional Model Project in 2002, a law was promulgated and a competent authority, Comité National de Protection contre les Rayonnements Ionisants (CNPRI) was established — one of the main preconditions for a national infrastructure. Against this background, guidelines based on the IAEA Safety Standards were soon developed for monitoring, inspection and quality assurance, as well as for qualification and certification of radiation workers. In the Democratic Republic of the Congo, 300 radiological facilities in hospitals and industries with around 1000 radiation workers are controlled. Now they have four main scientific laboratories: environmental monitoring laboratory, radiation protection laboratory (including workplace monitoring and intervention), personal dosimetry laboratory (including whole body counter) and radiation metrology laboratory.

The great importance of participation in an IAEA Model Project for the establishment of a radiation protection infrastructure is shown by R.E. Torres Gomez from El Salvador. Under this umbrella, this country started to work out its legal framework on international recommendations with clear strategies.

The issue of substituting radon-226 needles was mentioned but waste management remains an open question. The safe and secure management of radon-226 sources, mostly coming from former medical uses, is a worldwide issue and should be discussed. Waste management, particularly the management of spent sources, was also raised in the presentation of N.E. Mantilla from Ecuador. With the support of the IAEA Model Project, Ecuador is now establishing a national emergency plan.

5. ASSESSMENT OF A NATIONAL SITUATION

A good assessment of the national situation in personal dosimetry was demonstrated in the presentation focusing on the Ukraine. V. Chumak and others showed a review of the current status of dosimetric monitoring begun in 2002, and discussed approaches to the development of a united system. Whereas the situation with dosimetric monitoring in nuclear power plants is not bad (taking into account its long history and the outstanding international support after Chernobyl), the dosimetric service at the use of radioactive sources in medicine, industry and research is at a low level. Old and partly not functioning technical devices, as well as a lack of information exchange (no Internet, only partial access to e-mail) in and between the individual dosimetry services has to be stated. This situation leads to an urgent modernization and elaboration of a unified national system for monitoring and recording of individual doses in the Ukraine. On three levels, they define the different goals and responsibilities. The first and primary step will perform a high quality dosimetric service to all users in the Ukraine — that means the implementation of a unified technical policy, including the development of guidelines, information exchange, training and quality assurance. The second level is the management of regional (local) dosimetric services; and the third level will comprise well equipped laboratories for different tasks in nuclear facilities, territorial dosimetric stations (e.g. also epidemiology) and independent dosimetric services.

In large countries where you can find a widespread distribution of users of radioactive sources with a high number of occupationally exposed persons, it will be advantageous to have approved local services within a well functioning national system. In such local services, specific knowledge of additional relevant parameters for protection exists, inspectors have a short way to the user, and they are familiar with details of the licence and equipment.

The paper on the Ukraine highlighted the unitary structure of that State, its strong administrative command and the good communications between regions of the country. They are positive factors for an effective implementation of the national project in improving the radiation protection infrastructure.

An interesting example for a radical and reforming policy is the change from a centralized to a decentralized management system concerning radiation protection issues in Zambia in 1990, described by E.M. Malikana. One of the main recognized deficiencies in establishing an effective radiation protection infrastructure is the lack of a clear national radiation protection policy to provide necessary guidelines. Also, the technical base is not well developed and no clear priorities are recognizable. The advantages, disadvantages and challenges of such a change should be discussed.

A well functioning radiation protection infrastructure with clear responsibilities for authorities and utility sections in Iran was presented by M. Ghiassi Nejad (and others). In Iran, 20 000 radiation worker have to be monitored in 3760 radiation centres. Based on international recommendations, the policy and legislation was recently rationalized. The only competent authority is responsible for inspection, control and supervision of radiation sources; some administrative activities, such as dosimetry services, are performed by separate institutions. In this paper, as well as in other presentations, no procedures to approve services including criteria were mentioned.

Saving resources through good management is shown in the example of the control of T-NORM in the oil industry of Egypt by A.A. Taha.

6. NATIONAL SERVICES — OUTSOURCING

In addition to the prioritizing of national services in radiation protection, a key point in establishing or increasing an effective national infrastructure is the planning of appropriate resources. Therefore, an optimization of each necessary service should be done. An example is the traditional individual monitoring of radiation workers. If an application of ionizing radiation is licensed, a personal dosimetry has to be conducted. An important factor in establishing services and optimizing resources is the decision about which dosimetric systems will be used and how they should be maintained. High technical standard equipment/devices are very expensive, need highly qualified operators and demand technical maintenance by experts.

If there is a low number of occupationally exposed persons, the monitoring should be centralized also to ensure that accurate measurements and the interpretation of results are done by qualified staff. One of the advantages of a centralized service is that it focuses on the resources. Workplace monitoring should guarantee that working levels are kept at the specific workplace.

A centralized service (dosimeter send out, dosimeter evaluation, calibration, quality assurance, etc.) could be conducted following two choices: nationally or regionally/internationally.

L. Ben Omrane and others from Tunisia reported on the dosimetric management in their country. In Tunisia, 3000 workers are monitored; 80% are working in medical applications. For the personal dosimetry, TLDs are used in 30% of the cases (locally limited around Tunis). It was realized that the maintenance service for the Harshaw TLD System is not an advantage in the absence of a competent manufacture representative in place. The routine evaluation of the film batches which are used in the rest of the country is done by IRSN in France. They also provided Tunisia with the necessary film dosimeters.

As shown in the Tunisian paper, the dosimeters, especially film batches, could be sent out to large international services.

Advantages of international outsourcing could be seen in:

— Expert knowledge (e.g. in NRPB, IRSN);
— Excellent technical equipment for evaluation;
— Renting dosimeters which are at a high technical level;
— Using permanent quality assurance measures;
— No maintenance problems for the user.

Disadvantages are seen in:

— No specially qualified staff nationally;
— Reports on results are very often late;
— Reports are rarely read;
— Reports are often not interpreted correctly;
— Finances.

A clear drawback of such a system is the lack of competent staff to recognize unusual events during the course of work, as well as the lack of competence to carry out the dosimetric clarification at such incidents.

An outsourcing of services on a national level is also a possibility to increase the effectiveness of control in radiation protection. The posters of D. Kubelka and M. Novakovic showed the situation in Croatia. The technical services were outsourced *and approved*, and the dose record keeping was, furthermore, managed centrally by the regulatory body. The competent authority for radiation protection in Croatia is the Ministry of Health which authorized four institutions to perform measurements of ionizing radiation concerning occupational exposures. Furthermore, the responsibility for field inspections lay in the hands of health inspectors of the Ministry. It was noted in the presentation that the number of inspectors was low compared with the necessary tasks, and very often their background and technical knowledge was insufficient to cope with complex radiological problems. To change this situation, additional training should be a prime option of the regulatory body.

To reduce the chronic lack of human and financial resources, M. Novakovic proposed in his paper, on one hand, using the knowledge of the authorized technical services for measurements of ionizing radiation, as well as for rendering inspection procedures and, on the other hand, these technical services could be contracted to the licensees to give them support in fulfilling their obligations pursuant to the law and regulations. This proposal should be discussed — in fact, it was mentioned that the ultimate judgement lies with the competent authority. In my opinion, the independence of inspectors has to be kept. One of the main characteristics of an effective radiation protection infrastructure is a clear line of responsibility, as already mentioned.

The use of external experts, like technical services, can supplement and enhance the skills of inspectors.

From my point of view, an outsourcing of dosimetric services from the administrative work of a regulatory body can be advantageous. The decision should be done on the results of the analysis of the national situation and the establishment of an effective national infrastructure in the application of ionizing radiation, together with a cost-benefit analysis by the regulatory body. Also, political aspects have surely an influence on that decision. Regional or international outsourcing of dosimetric services (also parts of it, e.g. whole body counting) can be helpful in developing countries.

7. REGIONAL SERVICES

An excellent example for a regional service is given by the European Union with its European Radiation Dosimetry Group EURADOS. With its network activities, the group:

— Advances the scientific understanding of the dosimetry of ionizing radiation;
— Promotes the technical development of dosimetric methods and instruments;
— Ensures consistency of dosimetric procedures.

C. Wernli from Switzerland is a member of the EURADOS Council. A few activities highlighted in his presentation include:

— Search for suitable sensors for personal dosimeters;
— Properties of radiation protection instruments;
— Improved dosimetric techniques;
— Characteristics of radiation fields;
— Internal dosimetry.

In addition, details on different working groups, on international intercomparisons, on the contribution to the European Education and Training Programme and on published reports are given.

In the paper presented by L. Katzarska of Bulgaria (see the attached CD-ROM), the focus was on its successful participation in an intercomparison of EURADOS concerning internal dosimetry even though they had no written requirements of the quality of dose assessment in the laboratories for internal dosimetry. It is the scientific responsibility of the members of staff to follow actual tendencies, recommendations and recent developments in this area, which leads to good results. Furthermore, Bulgaria took part in international research projects like the IAEA Co-ordinated Research Programme on Intercomparison for Individual Monitoring of External Exposure from Photon Radiation (1996–1998).

8. QUALITY ASSURANCE — CALIBRATION SERVICE

A quality management system should be applied to all licensing processes. It should be commensurate with the scale of operations. Its programme should cover all facilities and activities during the life time of a radiation source. That means quality assurance has to be part of all services and also for the establishment of a regulatory body.

A typical example for a quality assurance system adapted on national requirements is given in the contribution by M.A. Noriah (see the CD-ROM) from Malaysia. In Malaysia, 11 000 radiation workers have to be monitored at 1500 different workplaces. For instance, 130 000 dosimeters were issued in 2002. It was seen as necessary to provide adequate confidence in the results. They documented their policy and all procedures in a quality manual. A very important factor is the fact that the instructions are written in lay person's terms to ensure that they can be understood by the supervisor as well as the operator. The Malaysian Quality Assurance Programme was certified on ISO 9002 in February 2002 and they are ongoing in their quality assurance measures.

Main parts of such a quality assurance system are:

- A sufficiently accurate and reliable dosimetry system which is regularly calibrated and routinely checked;
- Well trained and experienced dosimetric service personnel;
- Timely delivery of dosimeters to the customers;
- Information about the results to the customers and to the competent authority;
- Safe and sufficiently comprehensive storage of dosimetric results for long periods (national dose registry);
- Procedural quality systems and administration.

It has also to be mentioned that feedback and stakeholder involvement (public confidence) is very important in the quality assurance process.

If personal dosimetry is managed in the country itself, it is necessary to have a sufficient quality assurance including calibration services/equipment to guarantee accurate and comparable results. Secondary standard dosimetry laboratories (SSDL) have to be established, depending on the scope of nationally planned tasks. Appropriate equipment and trained staff have to be provided. Also in such cases, international support is offered and should be used as well as international expertise, e.g. by the IAEA and their laboratories.

Intercomparisons of internal exposures are offered regularly by the IAEA. It is recommended for all laboratories with indirect measurements of incorporated activity to take part, as reported in the presentation (in the CD-ROM) by M. Fikree of the United Arab Emirates. The quality assurance of their highly technically equipped laboratories are supported by international calibrations, e.g. in the SSDL of GSF in Germany and in the SSDL of the IAEA. It is a good example of fruitful international co-operation which increases the effectiveness of a national infrastructure.

9. CONCLUSIONS

- Fitted priorities in the provision of different services should be determined considering the results of the assessment of the national situation.
- Outsourcing of dosimetry services could be recommended but the decision on outsourcing regionally or internationally should be done carefully on the results of the evaluation of the national situation. In special cases, regional outsourcing could be preferable.
- Dosimetry services with administrative business should be approved by the regulatory body by means of selected criteria.

— A decentralized system particularly for licensing and inspection of practices concerning radiation sources could be advantageously established for countries with extensive use of radioactive sources. Such a system can be more efficient because of the proximity to the user of the source, local knowledge of specific issues, etc.
— The independence of competent authorities and inspectors has to be kept, even though resources are small.
— The dose record keeping system should be organized centrally as well as the registry of sources with a high potential to cause severe harm.
— Good communications and exchanges are one of the main promoters for increasing the effectiveness of a national infrastructure in radiation protection.
— Developing national guidelines on international standards is highly recommended.
— National and international expertise should be used for establishing and operating services.

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SUSTAINABLE EDUCATION AND TRAINING: DEVELOPING SKILLS

(Topical Session 5)

Chairperson

P.N. LIRSAC
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Keynote Address

RADIATION PROTECTION EDUCATION AND TRAINING PROGRAMMES IN THE SYRIAN ARAB REPUBLIC
National needs and regional solutions

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Abstract

Education and training in radiation protection are the main methodologies used to ensure the proper application of the IAEA Safety Standards. In some countries, where there is widespread use of radiation sources and radiation generators, a national training centre can be the way to develop skills and sustain education and training programmes. However, for developing countries with few radiation sources and generators (e.g. countries in West Asia), a fully functioning and adequately staffed and equipped national training centre in each country might not be justified and, more importantly, may be difficult to sustain. The solution in this case has to be the establishment of regional training centres, which can be sustained collectively among Member States in the region or with the assistance of the IAEA. The centre will be able to fulfil the national and regional needs in terms of radiation protection and the safe use of radiation sources, and will constitute an important and essential element for a sustainable education and training programme. A good example is the West Asia Regional Training Centre in the Syrian Arab Republic, where significant national, regional and inter-regional training has been conducted with the support of the IAEA.

1. INTRODUCTION

To attain sustainability in implementing its national education and training programme, a Member State should have an adequate number of trained people, sufficient numbers of trainees, trainers and training facilities. At the present time, there are several national and regional training centres that offer the IAEA Post-Graduate Educational Course (PGEC) and other specialized courses. Hosting these courses takes on special significance due to the need for establishing a collaborative agreement with an educational institution in the Member State. This contributes to the sustainability of regional training centres. The training centres play a critical role in the success of the IAEA training strategy mentioned. They provide a regional or national point of reference where training in radiation protection may be obtained and, hence, it is important that the level of training provided is of the appropriate quality and that suitable training facilities and equipment are available. With this in mind, a systematic approach must be followed in the selection and development of these training centres.

To achieve sustainable training, it is necessary to provide it on a national or regional basis as part of the Member State's national training programme or in terms of regional needs. The IAEA should engage in agreements with the regional training centres, especially in connection with the PGECs and specialized training events and fellowships. The existence of regional training centres is a real asset in the implementation of the training strategy to ensure long term sustainability because they (a) provide training courses in local languages; (b) improve the efficiency of training delivery; (c) ensure a fast adaptation to standard training material from the IAEA, conveying it to the Member States in the region; and (d) optimize the use of staff, facilities and equipment for multiple purposes with the expectation of a consistent quality of results.

2. ESTABLISHMENT OF NATIONAL AND REGIONAL TRAINING CENTRES

Member States are encouraged to establish national or regional training centres, and the IAEA may also identify a need for such centres in geographic locations based on the training needs analysis in the country profiles and the needs of the region.

The demand for training in the country or region should be assessed using the available country radiation safety profiles, any training needs analysis carried out by the national authority, and proximity of other training centres. The ability of the candidate centre to fulfil the IAEA requirements related to training should also be considered.

In the short term to the medium term, while the IAEA is actively involved in the provision of training, the establishment of a regional training centre will generally be more cost effective than one or more national training centres within the region due to the larger target audience. This will enable the regional centre to run more frequent training courses, and to provide these in a cost effective manner. An important aspect of a regional training centre is also the exchange of information and experience among countries within the region. The course will be provided in the spoken language of the region.

Member States, with a large number of radiation practices and personnel to be trained, may benefit from the establishment of national training centres. The target group (in terms of the number of trainees in a national training centre would include radiation protection officers (RPOs), operators, health professionals and workers. The provision of effective and practically relevant training to this target group can have a very beneficial effect on the radiation safety culture in the country. The establishment of a national training centre should also be a long term objective of every Member State, since such a centre will enable it to fulfil its obligations on training, and provide self-sustaining training.

3. NATIONAL TRAINING CENTRES

The establishment of national training centres is a national responsibility. It would be advantageous for the individual institutions to be recognized by the IAEA. The following criteria should be used for this purpose (as recommended by the IAEA Committee on Education and Training):

— It should be recognized as a national centre by the competent authority of the country.
— It should have the capability to develop and conduct training courses in an effective way in terms of the quality assurance system.
— It should have an adequate administrative capacity for the training course, training facilities, infrastructure, selection of participants and trainers, and a formal system for assessing the students.

4. REGIONAL TRAINING CENTRES

In addition to the criteria for a national training centre, the following criteria should be applied for the establishment and recognition of regional training centres, which should be met at least by 2010, as recommended by the IAEA Committee on Education and Training. The regional centres will be more effective if they have post-graduate educational courses in addition to fulfilling the following requirements:

(a) Location in a region where a need for training and education has been identified.
(b) The distribution of actual and potential training centres shall be taken into account.

(c) Training conducted in a language widely used in the regional language.
(d) Adequate radiation protection infrastructure.
(e) Easy access for foreign participants from the region.
(f) Compliance with the IAEA's requirements related to training is an important element.
(g) Resources to carry out the experiments and practical exercises.
(h) Provision of high quality training and education.
(i) Appropriate quality assurance system in place for these training activities.
(j) Ability to carry out on-the-job training for fellowship candidates, conducting seminars, hosting workshops and refresher courses.
(k) The necessary training and information technology infrastructure.
(l) Mechanism to award academic diplomas or degree for the PGECs.

5. THE WEST ASIA REGIONAL TRAINING CENTRE IN THE SYRIAN ARAB REPUBLIC

The Atomic Energy Commission of Syria (AECS) has strengthened education and training in radiation protection since the early 1990s. Recently, this training has been coupled with the IAEA Model Projects RAW/9/008 and RAW/9/009, and the achievement of their five associated milestones. The AECS has been successful in achieving most of the major parts of these milestones, primarily focusing on the fulfilment of the training needs associated with these milestones. The AECS has made use of all main training modalities, including various training courses, scientific visits, on-the-job training and fellowships.

5.1. Training courses, 1999–2002

The AECS has been successful in designing and conducting large numbers of national, regional and inter-regional training courses with and without the assistance of the IAEA. As shown in Table I, 126 training courses have been conducted during the period 1990–2002; an average of 10 training courses, 283 trainees and 156 training days per year. In addition, regular national workshops and short courses have been implemented, for example, an annual workshop for RPOs with an average of 75 participating every year; workshops on radiation protection for medical doctors and radiation workers in the medical field; and radiation protection awareness courses for new employees in the AECS.

TABLE I. NATIONAL, REGIONAL AND INTER-REGIONAL TRAINING COURSES CONDUCTED IN THE AECS BETWEEN 1990 AND 2002

Year	Number of training courses	Number of trainees	Training duration (days)	Total training duration (person–day)
1990	7	93	118	10 974
1991	8	107	149	15 943
1992	5	88	108	9 504
1993	10	129	337	43 473
1994	8	182	92	16 744
1995	7	160	74	11 840
1996	10	199	139	27 661
1997	10	230	134	30 820
1998	9	417	280	116 760
1999	7	256	143	36 608
2000	18	841	186	156 426
2001	10	472	98	46 256
2002	17	502	168	84 336
Total	126	3676	2026	7 447 576
Average per year	10	283	156	572 890

5.2. On-the-job training

In the last five years (1999–2003), the AECS has been hosting an annual average of 18 IAEA fellowships, as shown in Table II. A total of 90 trainees from 17 different countries have been trained in the Syrian Arab Republic for a period equal to 4900 training days.

TABLE II. IAEA ON-THE-JOB TRAINING IN THE AECS DURING THE LAST FIVE YEARS (1999–2003)[a]

	1999		2000		2001		2002		2003		Total	
Country	A[b]	B[c]	A[b]	B[c]	A[b]	B[c]	A[b]	B[c]	A[b]	B[c]	A[b]	B[c]
Bangladesh	2[a]	17		7					1	7	3	24
Egypt							2[a]	28			2	28
Iran	1[a]	90					1[a]	7			2	97
Iraq					1	7					1	7
Jordan	1	90	2[a]	81			1[a]	7			4	178
Kenya							1[a]	90			1	90
Kuwait							1	90			1	90
Morocco							1	7			1	7
Pakistan					1[a]	14	4[a]	141	2[a]	210	7	365
Qatar					1	60			1	60	2	120
Saudi Arabia	1	60	1	60					1	60	3	180
Sudan	1	12									1	12
Tajikistan									2	14	2	14
Tunisia			1[a]	45	1[a]	7	1[a]	7			3	59
U.A.E.							1	7			1	7
Uzbekistan					1[a]	90					1	90
Yemen	2	60	17	878	15	981	11	794	10	824	55	3537
Total	8	329	21	1064	20	1159	24	1178	17	1175	90	4905

a The training is not related to radiation protection.
b Number of trainees.
c Time in days.

5.3. Post-graduate educational courses

In its efforts towards achieving training sustainability and self-sufficiency, in 1997 the AECS with the support of the IAEA started a nine week post-graduate training course in the field of radiation protection and safety of radiation sources. This course was then repeated in 1999. Due to the need for recognition and accreditation by employers, and by the respective authorities of the students attending these courses, the AECS and the IAEA, in collaboration with the Higher Institute of Applied Science and Technology (HIAST), upgraded this PGEC into a full year academic post-graduate specialized diploma.

Such post-graduate specialized diploma courses have been running for the last three years and it is planned that they will continue for the coming years. In total, 112 Arab trainees from 16 different Arab countries have graduated from it (30 of them are from the Syrian Arab Republic, as shown in Table III). This PGEC is the only educational programme for Arab countries. According to the special evaluation review of the IAEA's education and training activities in radiation protection from 1994 to 2000, the Syrian Arab Republic was the first country in West Asia and the third country in the world in the number of foreign participants attending IAEA training courses hosted

TABLE III. PGEC PARTICIPANTS BY COUNTRY (1997–2003)

Country	PGEC 1997	PGEC 1999	PGEC diploma 2000–01	PGEC diploma 2001–02	PGEC diploma 2002–03	Total
Algeria	1	1	-	-	-	2
Egypt	2	3	-	1	1	7
Iraq	2	2	-	-	-	4
Jordan	2	1	1	3	-	7
Kuwait	2	-	-	1	1	4
Lebanon	3	1	2	2	2	10
Libyan Arab Jamahiriya	-	2	-	-	2	4
Morocco	1	-	-	-	-	1
Palestinian Authority	-	-	-	-	3	3
Qatar	1	2	-	-	-	3
Saudi Arabia	2	1	4	2	2	11
Sudan	1	1	-	2	1	5
Syrian Arab Republic	8	8	4	5	5	30
Tunisia	1	1	-	-	-	2
United Arab Emirates	1	2	2	1	-	6
Yemen	2	2	3	3	3	13
Total	29	27	16	20	20	112

by the Syrian Arab Republic. One third of all trainees between 1994 and 2000 from West Asia did their training in the Syrian Arab Republic. The AECS is also host to a significant number of on the job training for trainees from all countries in West Asia.

6. SUSTAINABILITY OF EDUCATION AND TRAINING IN THE REGIONAL CENTRE IN THE SYRIAN ARAB REPUBLIC

AECS staff, trained through IAEA sponsored training, are contributing effectively to the setting up and implementation of national and regional training programmes. The AECS has been very successful in hosting all kinds of IAEA training modalities, in addition to several radiation protection training courses which have been staged and conducted without IAEA assistance or support. This demonstrates the AECS's ability to provide all the basic radiation protection competencies required to meet the five milestones of the Model Project. Participants in all training activities held in the AECS find the training better or similar to IAEA sponsored activities held elsewhere. Many of the PGEC graduates have already assumed main or leadership positions related to radiation protection in their respective institutes and countries. According to the same evaluation report mentioned, there is strong evidence that the AECS actively supports and engages in a 'train the trainers' approach to propagate radiation protection skills and knowledge.

The national training centre in the Syrian Arab Republic fulfils all the requirements which might be needed by the regional centre, namely:

(a) The need for training and education in the West Asia region has been identified by the fact that most of the countries in the region are receiving IAEA assistance through the Model Project.
(b) There are no other regional training centres in the region.
(c) Training is conducted mainly in the Arabic language which is the spoken language in the region.
(d) There are adequate radiation protection infrastructures.
(e) It has easy access for foreign participants from the region.
(f) It complies with IAEA requirements related to training.
(g) There are the necessary resources to carry out the experiments and practical exercises.
(h) It provides high quality training and education.
(i) An appropriate quality assurance system is taking place for these training activities.

(j) It has the ability to carry out on the job training for fellowships candidates, conducting seminars, hosting workshops and refresher courses.
(k) The necessary training and information technology infrastructures are available.
(l) There is a collaborative educational agreement to confer academic diplomas for the PGEC.

7. SUMMARY AND CONCLUSIONS

Education and training in radiation protection are the main methodologies used to ensure the proper application of the IAEA Safety Standards.

For developing countries, a fully functioning and adequately staffed and equipped national training centre in each country might not be justified and, more importantly, may be difficult to sustain.

The main element in this case is the establishment of a regional training centre which can be sustained collectively with some assistance from the IAEA. The centre will be able to fulfil the national and regional needs in terms of radiation protection and the safe use of radiation sources, and will constitute an important and essential element for a sustainable education and training programme. A good example is the West Asia Regional Training Centre in the Syrian Arab Republic, where significant national, regional and inter-regional training courses have been conducted with the support of the IAEA.

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Keynote Address

STATUS OF THE RADIATION PROTECTION EXPERT IN EUROPEAN UNION MEMBER STATES AND APPLICANT COUNTRIES

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Abstract

The paper describes a survey of the present situation of radiation protection experts (RPEs) in the member States of the European Union and the applicant countries. In addition, the plans to establish a European Radiation Protection Education and Training Platform to allow for a better harmonization of education, training and recognition requirements in the different areas of radiation protection are addressed.

1. INTRODUCTION

On behalf of the European Commission, a study was carried out to survey the situation of radiation protection experts (RPEs) in the member States of the European Union and the applicant countries (see contract number B4-3040/2000/311262/MAR/C1, reference ENV.C.1/ETU/2000/0104r). Such a study was recommended by the Working Party on Education and Training (WPET) of the Group of Experts according to Article 31 of the Euratom Treaty, which deals with harmonization of education, training, qualifications and recognition requirements of RPEs, specifically in relation to the implementation of the qualified expert (QE), as defined in Council Directive 96/29/Euratom [1], in the national regulations. The study covered all qualification aspects of RPEs, including current definitions and other regulatory provisions and requirements, the legal status, pre-educational requirements and the duration of the education and training trajectory.

The objectives of the survey were:

— To survey the present situation of RPEs in all member States and applicant countries;

- To identify the needs, requirements and procedures to move towards the mutual recognition of QEs in the context of the European single market and enlargement process;
- To review the current strategy on training and education in the field of radiation protection;
- To encourage the establishment of a Radiation Protection Education and Training Platform at a European level for the exchange of information on education and training relating to radiation protection of RPEs.

2. METHODOLOGY

In order to meet the objectives of the study, it was decided to draw up a questionnaire. To ensure a high percentage of adequate responses, a network of national correspondents had to be established. Clearly, the results could only be obtained, firstly, by involving local know-how in the various countries, taking into account the highly specific nature of the subject; and secondly, by being aware of the problems of interpretation and translation that may arise. To that end, local radiation protection experts and organizations were contacted that were thought to be able to contribute to the study, by making use of existing networks.

2.1. Preparation of the questionnaire

In drafting the questionnaire, special attention was paid to formulating the questions in such a way that clear and comparable answers on the different subjects were possible. In order to analyse the responses properly, the questions were divided into the following five parts, each addressing specific aspects:

- *Legal:* How are RPEs defined in the different countries? Is the definition comparable with the definition of the QE in the Directive 96/29/Euratom? What is their legal status?
- *Level and classification:* What are the requirements for RPEs in the different work areas? What should be their level of expertise and experience?
- *Education and training:* What is the primary radiation protection course level of the expert? How often do they have to attend refresher courses? Is there an accreditation system for the organizers of radiation protection courses?

— *Recognition and registration:* Is there a registration of experts? Do the certificates have a limited validity?
— *Mutual recognition:* Is there a legal provision for mutual recognition? What are the barriers for mutual recognition?
— *Discussion platform:* Is there a need for a discussion platform? What is its role? Is there interest in participating?

2.2. Establishing the network of national correspondents

It was decided to use the presidents of the national radiological protection societies as a first entrance in a country for mailing the questionnaire. There were two reasons for this choice:

— In March 2000, representatives of the radiological protection societies of the European Union drew up a discussion paper on the minimum requirements for mutual recognition of qualified experts [2].
— The International Radiological Protection Association (IRPA) made a statement at the 10th IRPA Conference in Japan where training and education of radiation protection experts was identified as an increasingly important component of the IRPA's activities. In 1991, members of the IRPA Executive Council were assigned to a task force to review the certification and training issue. The Task Force has conducted two surveys in 1991 and 1994. The large difference in formality, legal requirements, recognition and training methods found in the 1991 and 1994 surveys illustrated how difficult it could be to unify professional recognition on a worldwide scale. The problem of the recognition of transient radiation workers was also pointed out at the 10th IRPA Conference as something the IRPA could look at in the future.

Given the broad participation of European Union radiation protection societies in writing the discussion paper [2], and because of the IRPA's interest in training and education issues, it was concluded that the presidents of the radiological protection societies would recognize the importance of responding to the questionnaire. Therefore, the questionnaire could best be distributed to them. In the accompanying letters, they were asked to facilitate in the response by forwarding the questionnaire to the right contact point in their country. In some applicant countries, however, no radiological protection society exists. For those countries, use was made of two databases: one belonging to the applicant countries' missions to the European Union in Brussels (environment contacts); the other belonging to the applicant countries' correspondents in the distinct Ministries of Environment.

2.3. Compilation and analysis of the data

In the fourth phase, a database of responses was established. The database contained the national information of all responding countries and allowed for all sorts of 'crossings' of modalities of questions. Furthermore, the database allowed for a clustering of answers. In the last phase, the compiled data were analysed. In doing so, areas were identified where large differences between the countries exist as well as areas where a fair degree of harmonization was already present.

3. RESULTS AND CONCLUSIONS

Responses were received from all 15 European Union member States (100%) and from seven of the applicant countries (54%): from the Czech Republic, Estonia, Hungary, Latvia, Malta, Poland and Romania.

For the European Union member States, the survey gave an overview of the status of the RPE at a moment when almost all member States had incorporated Directive 96/29/Euratom in their national regulations, although some of them indicate that specific provisions related to the QE still had to be implemented. The definitions of the RPE in the national regulations are, in general, close to the definition of the QE. Therefore, in principle, the definition and the status of the RPE in the regulations of the member States are reasonably comparable.

The responding applicant countries claimed to have implemented the provisions related to the QE in their regulations, or will do so in the near future, but only one country used a definition of an RPE that is equal to the definition of the QE. In most countries, there is no clear definition of an RPE.

There is a broad variety of subdivisions of RPEs, both in member States and in applicant countries. Some countries subdivide their RPEs either on the level of expertise or on the sector of work. Most of the countries use both possibilities. When subdivision is based on the level of expertise, it would seem sensible to define which level of expertise is compatible with the definition of the QE. Though the responses indicated that the expertise of the QE is commonly restricted to the higher educated RPE, it is difficult to draw any common, unambiguous dividing line between an RPE and other experts.

Most countries require an academic educational level of training for the RPE, specifically in the medical and nuclear sector. It is, therefore, obvious that many training courses are given at universities, though other training centres exist. Training courses generally address the topics mentioned in the basic syllabus [3], but the information received so far is insufficient to compare the courses.

In many countries, training centres are formally recognized or certified by the competent authorities. In some cases, formal recognition is only necessary in certain sectors, such as the medical sector.

Almost all European Union member States have their own national education systems for the training of RPEs. Luxembourg does not offer training courses, so their pool of RPEs is educated in other countries. In some countries, international bodies such as the European Commission, the IAEA and the European Association for Nuclear Medicine support some courses, depending on the sector of work.

About half of the European Union member States consider their own current education systems sufficient to train QEs, as defined in Directive 96/29/Euratom. A more detailed study of the training material would be necessary to allow a comparison of national training courses with, for instance, the European Radiation Protection Course or the training courses of the IAEA.

In most of the responding applicant countries, the education and training programmes are supported by the IAEA. RPEs from those countries should, therefore, be comparable in quality. But only in some special cases do the responders consider the education system sufficient to train people to the QE level.

Practical work is part of the training programme in most European Union member States and in about half of the applicant countries, although requirements are not always specified. Continuous training is incorporated in about half of the countries, both European Union members and applicant countries. In some cases, this is restricted to certain sectors, such as the medical sector.

Professional experience is needed to become a recognized RPE in most of the countries, but not in all. The time period varies considerably, from no waiting period up to several years, depending on the sector.

In most of the European Union member States and all the responding applicant countries, the RPE (and also the QE) is formally recognized by the competent authorities. Certification is only operational in some countries, while some other countries are implementing a registration system.

Except for Luxembourg and Latvia, there is no formal mutual recognition of RPEs from other member States or applicant countries, although some countries indicate their intention to do so. Recognition is allowed in some countries on a case by case basis, though such countries normally require candidates to demonstrate an adequate knowledge of national regulations and language skills.

Almost all countries welcomed the establishment of a discussion platform and expressed their interest in participating. Such a platform is considered valuable as a means for exchanging information on education, training, recognition and registration of RPEs, and may be a vehicle for moving forward to mutual recognition. The platform could address many of the topics mentioned.

4. RECOMMENDATIONS

Based on the conclusions of the survey, some recommendations were made, including the following:

— In the context of the single market and the enlargement process, it is recommended to try to achieve harmonization in the qualifications of the RPE, according to the definition of the QE. This would help promote the achievement of the aims of the Directive on the free movement of workers in the European Union and should take due note of the Directive on safety at work.

— As a means of achieving this goal, it is recommended to establish a Radiation Protection Education and Training Platform that could serve as a means for exchange of information on education, training, recognition and registration of RPEs. This platform may provide a vehicle for moving forward to mutual recognition. The topics mentioned in the recommendations hereunder could be addressed in such a platform.

— Definition, tasks and provisions for recognition of the RPE in the national regulations of European Union member States and applicant countries should be compared in detail, in order to expose the obstacles preventing a harmonized implementation of the concept of the 'qualified expert'.

— The subdivision of RPEs according to their expertise, in connection with their tasks and duties in radiation protection in the various countries should be compared, in order to make a distinction between radiation protection experts and radiation protection officers. This is a prerequisite for mutual recognition.

— The subdivision of RPEs according to the sector of work should also be compared. The additional requirements for recognition of an RPE in the different sectors should be exposed.

— Training programmes and material, including practical work, should be evaluated and compared with, for instance, the European Radiation Protection Course and the training courses of the IAEA.

— There is a trend to move to registration (or certification) of RPEs, as a means of ensuring the quality of RPEs in the longer term. Continuous training is part of such a system, as well as professional experience. The requirements and procedures for registration of RPEs, including quality assurance procedures, should be studied in more detail. This is also considered as a prerequisite for mutual recognition.

— It is recommended that the Radiation Protection Education and Training Platform should co-operate with other international bodies that are active in the field of training, education and recognition of RPEs.

The results and recommendations of the survey have been adopted by the WPET. The European Commission has taken notice of these recommendations, in particular to establish the Radiation Protection Education and Training Platform. It is expected that the European Commission will launch a feasibility study for this purpose in a short time.

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Topical Session 5

SUSTAINABLE EDUCATION AND TRAINING: DEVELOPING SKILLS

DISCUSSION

M. BAHRAN (Yemen): A large number of Yemenis have benefited from the training which the Atomic Energy Commission of Syria is providing. An important aspect of that training is that it is provided in Arabic, which is the only language spoken by many of our employees.

What we need in addition, however, is degree oriented training in fields such as health physics and radiation protection, and also training courses that will produce professional inspectors.

I. OTHMAN (Syrian Arab Republic): Producing professional inspectors through training courses is a difficult issue. I cannot sign a certificate declaring that someone who has completed one of our training courses is now a qualified professional inspector. In addition to what you acquire through a training course, you need experience in the field and also the ability to deal effectively with people. Not everyone who has received training is cut out to be a professional inspector.

P.N. LIRSAC (France): I would mention in this connection that a 'train the trainers' module — Module 11 — has been added to the material developed for the post-graduate educational courses in radiation protection and the safety of radiation sources, and been tested in pilot runs. Also, the IAEA has material for specialized 'train the trainers' courses at the pilot stage.

K. SKORNIK (IAEA): Further to what I. Othman just said, I would emphasize that a person can be certified as a professional inspector only by an appropriate national authority of his/her country. So each country needs a system for the assessment of qualifications and for certification.

C.J. HUYSKENS (Netherlands): Further to what M. Bahran said about training being provided in Arabic, I would like to emphasize the importance of training being provided in the local language of the trainees. Different languages have different cultural associations, and the amount of emphasis placed on a particular issue in one culture may differ from the amount of emphasis placed on that issue in another culture.

In the planning of education and training, greater account should be taken of what is being done by professional medical bodies and by academic institutions worldwide. In my view, the educational and training courses arranged within the IAEA framework should complement what those bodies and institutions are doing.

E.C.S. AMARAL (Brazil): Regarding the certification of professional inspectors, there is a difference between knowledge and competence. In this connection, I would mention ISO 1720, which gives information about the skills that inspectors need. I would also mention that the IAEA is working on a document about the skills which a person needs in order to be a safety inspector for nuclear facilities; I have seen a draft, and it is very good.

Rapporteur's Summary

SUSTAINABLE EDUCATION AND TRAINING
Developing skills

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1. INTRODUCTION

This session consists of papers describing a range of approaches to education and training. Before looking at these papers and considering the variety of approaches, a fundamental question needs to be asked: *Why do we train?* This question is answered very concisely in the paper 'Systematic approach to training for competence building in radiation safety' (CN-107/37 — Ghana, in the CD-ROM). There are three reasons for training:

— Development of worker skills for the competent performance of tasks;
— Enhanced awareness of the risks associated with radiation work — ownership of issues;
— Reduction in accidents, promotion of ALARA (development of a safety culture).

The term 'competence' is very important in radiation protection and the paper also provides information on the building blocks to competency. The four attributes to competence building are knowledge, skills, operating experience and attitude to radiation safety.

Training takes place, therefore, to raise awareness, to encourage safety culture and to aid the development of competency by providing appropriate knowledge and skills.

2. WHO DO WE TRAIN?

There are four primary categories of individuals that require training:

— operators

— radiation protection officers (RPOs)
— qualified experts (QEs)
— inspectors

The extent and depth of training required for each category will depend on the work being carried out, and the IAEA has already provided detailed guidance on this. By definition, the QE, both as described in the IAEA BSS and the European Union BSS, needs to be recognized as having the appropriate level of expertise, either by licensing or certification. One of the keynote addresses presented the differing approaches to recognition of the QE in Europe, and the situation is even more diverse and complex outside the European Union.

Nevertheless, many countries have established systems for the accreditation and licensing of the various categories of individuals, and several papers describe such systems. Romanian legislation, for example (that is, the new Romanian regulation for issuing practice permits for nuclear activities and for the designation of radiological protection QEs), requires individuals to hold a practice permit before they are permitted to use radioactive sources. The paper (CN-107/17, in the CD-ROM) describes the legislation under which permits are issued. Permits fall into three categories: Level 1 — operator level; Level 2 — RPO level; and Level 3 — QEs. The permits are issued by the national authority, after assessment and examination of the individual.

One paper, 'Brazilian experience on qualification of radiation protection officers for industry installations' (CN-107/90 — Brazil, in the CD-ROM), describes the qualification system for RPOs in industrial practices: RPOs must be graduates in a suitable subject. Qualification involves proof of suitable training (by certificate), examinations on general radiation protection matters and specific examinations for the type of practice. The certificate is valid for five years.

3. TRAINING PROGRAMMES

The approach to the development of training programmes within countries is dependant on the legislative approach adopted by the regulatory authorities. Many countries incorporate within their legislation detailed requirements for the following:

— Authorizing operators, RPOs, QEs;
— Content of training courses;
— Authorizing training establishments;
— Authorizing trainers.

This approach has both advantages and disadvantages, is adopted by many countries and is well described in several papers. The advantages include that it creates a framework for comprehensive training activities, and it ensures that training is received. The disadvantages include that the approach is inflexible, and it can result in lengthy and detailed training that may not fulfil the customers' needs.

The paper from Ghana describes such an approach, where the regulatory authority has established minimum educational, training and experience levels. This is part of a national policy for training. Ghana has only limited resources for training activities, hence the individuals involved and the practices have been prioritized to ensure the effective use of resources: 40 training events have been held over the last 9 years, with 423 individuals trained. The paper also identifies the problem of some organizations that give a low priority to radiation protection.

By contrast, a country that legislates detailed training requirements is France. The paper 'Needs and requirements in industrial and research fields' (CN-107/108, in the CD-ROM) describes the wide range of people who need training in these areas in France, and the legislative system that has been put in place to ensure comprehensive training is provided. In contrast to Ghana, France has many radiation practices and radiation workers: 82 000 monitored staff members in the nuclear industry; 177 000 people monitored for X rays; and 40 000 radiation sources. The content of training courses is determined by decree, and the national authorities approve training organizations.

This paper also discusses the development within Europe of training programmes for QEs and the need for a common approach.

The paper from Kazakhstan, 'The system of training and authorization of personnel involved in the nuclear activities in Kazakhstan' (CN-107/7, in the CD-ROM), also describes a systematic approach to training and qualification that consists of a series of training activities and examination for different categories of people, all provided in accordance with the requirements of the national regulatory body.

The paper 'Progress in implementation of national education and training framework for the groups professionally connected with nuclear radiation' (CN-107/101 — Poland, in the CD-ROM) describes the Polish system where legislation defines the posts that require authorization. The scope of training and requirements for training bodies are also specified in the regulations. A number of national centres within Poland offer professional level training courses. A need for adequate basic education in nuclear science is identified. The paper proposes a development to encourage greater coverage of the required material.

The alternative approach to the training provision is that resulting from the use of goal setting legislation. This approach makes use of legislation that requires the provision of appropriate training, and the appointment of suitable people but does not specify the details of the training required, or the qualifications of the persons using radiation in practice. The advantages include market forces — ensure training is focused on customers' needs, and it is flexible.

The disadvantages include market forces, and the onus is on the employer rather than the State to determine appropriateness of training. This approach is well illustrated in the paper 'Radiation and waste safety training and education: Malaysian experience' (CN-107/66, in the CD-ROM). This very interesting paper describes the development of training in a competitive commercial environment. To be successful, the product must be competitive in price, customer focused, relevant and attractive. The use of stimuli — fiscal, professional and personal — to obtain market leader status in a competitive environment is also discussed.

It is probably fair to say that this approach is in the minority: most countries appear to use prescriptive legislation to ensure adequate training is received.

4. IDENTIFIED TRAINING NEEDS

In order to draw up an effective programme of training, it is important, firstly, to carry out an analysis of the training needs of the persons involved. The paper 'Algerian experience in radiation protection training and education' (CN-107/117, in the CD-ROM) describes the identified training needs of the relatively small number of radiation workers in the country. While the needs of the users and emergency personnel (fire brigade, etc.) are fulfilled by the country's own training programme, a need for training at the higher professional level has been identified.

Similarly, the paper 'Training as a major challenge to sustainable development of radiotherapy practice in Nigeria' (CN-107/111, in the CD-ROM) identifies an acute shortage of RPOs, therapy nurses, radiographers and medical physicists in radiotherapy, and an urgent demand for a suitable training programme. The paper also notes that the cost of overseas training for specialists is not affordable.

5. NATIONAL TRAINING PROGRAMMES

Several papers give detailed descriptions of national training programmes at both the post-graduate and user levels.

The Greek Atomic Energy Commission provides a range of post-graduate training courses (CN-107/114, in the CD-ROM). These include the inter-university post-graduate course on medical and radiation physics, and the University of Patras' post-graduate course on medical and radiation physics. The objective of these courses is to provide highly qualified medical physicists. It should be noted that the medical field covers 90% of radiation applications in Greece. (The Greek Atomic Energy Commission has also recently hosted in Athens the PGEC for the Eastern European region.)

The paper 'Design of the national training course on radiation safety, its insertion in the Cuban system of education and training' describes the National Training Course in Cuba, which has been provided for nine years by the Centre for Radiation Protection and Hygiene (CN-107/110, in the CD-ROM). The course is aimed at those who organize and implement radiation protection programmes. The paper shows how this course fits in with the national system of education and training on radiation safety.

6. SUSTAINABILITY OF TRAINING PROGRAMMES AND THE DISSEMINATION OF TRAINING MATERIAL

It is clear from all of these papers that many countries have well established arrangements for training activities and that a wide range of approaches is adopted to achieve a well trained workforce. However, it is very difficult to assess the overall success of these activities. It is also apparent that while some countries have self-sustaining training programmes, others require outside assistance and guidance for certain training activities.

There is very little reference to the dissemination of training information to assist Member States in the development of self-sustaining training. This subject will be discussed in Topical Session 6, but it is worth noting that the paper 'Training tools standardization project: Design of a web site to hold radiation protection training materials (CN-107/129 — Spain, in the CD-ROM) describes the development of a training web site to aid the dissemination of training material.

7. THE EXPERIENCE OF THE UNITED KINGDOM

I will finish by saying a few words on the current situation within the United Kingdom on training activities. Legislation in the UK requires radiation workers to be suitably trained but gives only very limited advice on the required content and level of training. The onus is on the employer to determine the suitability of training. Several organizations, including the National Radiological Protection Board (NRPB), offer training courses to customers and these courses generally vary from one day to one week's duration. Commercial forces apply! Hence, training courses have developed into focused, short duration training events, rather than education ones.

A certification scheme for Radiation Protection Advisers (QEs) has been set up to comply with the requirements of the European BSS, and the UK Health and Safety Executive has specified the areas of knowledge that the RPA must have and the competencies that the individual must hold. The requirement for all RPAs to hold certification takes effect from 1 January 2005, and there is currently some concern that many RPAs will not have achieved certification by this date.

The process of certification involves the preparation and submission of a portfolio demonstrating knowledge and experience. NRPB provides professional level training courses that cover the knowledge requirement, but some customers complain that these courses are too expensive, both in terms of time lost and fees. The total duration of training to cover the knowledge requirement is approximately five weeks.

Because of these concerns, the UK Health and Safety Executive has reworded the RPA requirement to make it clear that competency may be demonstrated with a *combination* of knowledge and experience. The knowledge requirement is very broad and not practice specific. It is up to the employer to determine the suitability of RPAs for their specific practice.

NEEDS FOR INTERNATIONAL EDUCATION AND TRAINING

(Topical Session 6)

Chairperson

K. MRABIT
IAEA

Keynote Address

IAEA ACTIVITIES ON EDUCATION AND TRAINING IN RADIATION AND WASTE SAFETY
Strategic approach for a sustainable system

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Abstract

The IAEA education and training activities follow the resolutions of its General Conferences and reflect the latest IAEA standards and guidance. Several General Conference Resolutions have emphasized the importance of education and training [1–4]. In response to General Conference Resolution GC(44)/RES/13, the IAEA prepared a Strategic Approach to Education and Training in Radiation and Waste Safety (Strategy on Education and Training) aiming at establishing, by 2010, sustainable education and training programmes in Member States [5]. This strategy was endorsed by General Conference Resolution GC(45)/RES/10C that, inter alia, urged the Secretariat to implement the Strategy on Education and Training, and to continue to strengthen, subject to available resources, its current effort in this area, and in particular to assist Member States' national, regional and collaborating centres in conducting such education and training activities in the relevant official languages of the IAEA. A technical meeting was organized in Vienna in March 2002 to advise on the implementation of the strategy. The meeting concluded with an action plan for implementing the strategy up to 2010, the immediate action being the formation of a steering committee by the middle of 2002. The steering committee would have the general remit to advise on the development and implementation of the strategy, as well as monitoring its progress. In the 2002 General Conference, the IAEA was urged to continue to implement the strategy, including the convening of the steering committee. The first Steering Committee Meeting took place 25–29 November 2002. The paper presents the IAEA's past experience and the newly established Strategic Approach to Education and Training in Radiation and Waste Safety.

1. INTRODUCTION

The statutory safety functions of the IAEA cover the establishment of and provision for the application of Safety Standards for the protection of health, life and property against ionizing radiation. The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the BSS) are based on the presumption that a national infrastructure is in place, enabling governments to discharge their responsibilities for protection and safety. Education and training is an essential element of the infrastructure and is one of the main IAEA mechanisms of the provision for the application of Safety Standards.

The education and training provided by the IAEA follow the resolutions of its General Conferences and reflect the latest IAEA standards and guidance. Several General Conference Resolutions have emphasized the importance of education and training (see, for example, [1–4]).

In response to General Conference Resolution GC(44)/RES/13 in 2000, the IAEA prepared a Strategic Approach to Education and Training in Radiation and Waste Safety (Strategy on Education and Training) aiming at establishing, by 2010, sustainable education and training programmes in Member States [5]. This strategy was endorsed by General Conference Resolution GC(45)/RES/10C in 2001 that, inter alia, urged the Secretariat to implement the Strategy on Education and Training, and to continue to strengthen, subject to available resources, its current effort in this area, and in particular to assist Member States' national, regional and collaborating centres in conducting such education and training activities in the relevant official languages of the IAEA. In General Conference Resolution GC(46)/RES/9C, adopted in September 2002, the IAEA was requested to continue implementing the strategic plan, including the convening of a steering committee to oversee and advise on the implementation of the strategic plan for a sustainable education and training programme. In addition, it encouraged the IAEA to implement 'e Learning' in radiation protection, which is presently paper-based distance learning.

2. CURRENT MODALITIES AND SUPPORT FOR EDUCATION AND TRAINING

The range of education and training in radiation protection activities currently undertaken by the IAEA can be summarized as follows:

— Post-Graduate Educational Courses in Radiation Protection and Safety of Radiation Sources (PGECs);
— Specialized training courses;
— On-the-job training (OJT);
— Scientific visits;
— Workshops and seminars;
— Distance learning.

In addition, the IAEA carries out other activities that support the training modalities mentioned. These support activities include the preparation of standardized training aids and material; the promotion of and assistance to regional training centres, and co-operation with collaborating centres; and publications relevant to education and training.

2.1. Post-graduate educational course in radiation protection and safety of sources

The Post-Graduate Educational Course in Radiation Protection and Safety of Radiation Sources (PGEC) is a comprehensive training programme aimed at training young professionals at graduate level or the equivalent for initial training to acquire a sound basis in radiation protection and safety of radiation sources. Some of the participants would be expected to become trainers in due time. The PGEC is designed to provide both theoretical and practical training in the multidisciplinary scientific and/or technical bases of international recommendations and standards on radiation protection and their implementation. The IAEA has been assisting the organization of regular PGECs in different regional centres and in different IAEA official languages. These include in various countries in Africa (English), Argentina (Spanish), Belarus (Russian), Germany, Morocco (French) and the Syrian Arab Republic (Arabic).

2.2. Practice specific specialized training courses and workshops

The specialized or task specific and practice specific training courses are usually shorter in duration. These courses last one or two weeks and are usually given to those who have already attended the PGEC. Workshops are also task specific or practice specific and provide more opportunity to the participants for hands-on training and exchange of information. The training courses and workshops cover, inter alia, a wide range of topics including regulatory framework, occupational exposure (external and internal), patient protection (diagnostic radiology, radiotherapy and nuclear medicine), radioactive waste management, transportation of radioactive materials, emergency response and preparedness, safety and security of radioactive sources, safety in industrial applications, etc. They are frequently organized as national, regional or inter-regional courses for different target audiences such as regulators, radiation protection officers, technicians, etc. The IAEA annually supports more than 50 national and regional events.

2.3. Fellowships and scientific visits

In addition, fellowships and scientific visits supplement the education and training courses. They are meant to provide individual practical training in well recognized national or regional centres. The duration of fellowships ranges from one month to six months. Scientific visits are shorter in duration, ranging from one week to a maximum of one month for visiting one or more centres in other organizations abroad. They are usually meant for decision makers and managers, senior level employees, and specialists requiring exchange of information and the opportunity to observe how other facilities transfer know-how, joint collaboration, etc. The IAEA arranges annually more than 150 fellowships and scientific visits on radiation and waste safety from approximately 100 countries.

2.4. Distance learning

Distance learning is a further complementary IAEA radiation protection training programme for strengthening national infrastructures. This type of paper-based training is very useful for people who live far from training centres. It can be used as refresher training or for equalizing/harmonizing purposes to prepare individuals to reach a certain level for successfully attending a training event. An ongoing involvement of the IAEA's Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific (RCA) is the project on paper-based distance learning in radiation protection. The participating countries are Australia (co-ordinator), Republic of Korea, Indonesia, Mongolia, Thailand, the Philippines and New Zealand. The results of the first and second trials and feedback have proved this to be one of the effective mechanisms of radiation safety training. The feasibility of web-based training is also being considered by the IAEA. This would reduce the global resources required and would potentially address a much larger audience.

3. NEW APPROACH TO TRAINING

The past approach to education and training in radiation protection and waste safety has been reactive rather than proactive. The training packages developed had different approaches and lacked a corporate image. This was reflected in the training packages as differences in the treatment of subject matter or as duplication. The weaknesses were identified and are addressed. This prompted the IAEA to set up a strategy for a progressive shift from the present reactive approach to training, to a proactive approach aimed at helping Member States to develop a sustainable education and training system compatible with the requirements of the BSS and other safety standards. This is meant to operate in the context of a combination of regional and international collaborations in which the IAEA would continue to play a primary role.

One of the first steps in the implementation of this strategy by the IAEA is the development of guidance on how to build competence in Member States in order to help them to achieve the ability to put in place a sustainable and self-sufficient education and training programme in radiation protection.

This has been done so far by issuing Safety Guide RS-G-1.4 on Building Competence in Radiation Protection and the Safe Use of Radiation Sources (2001) [6] and Safety Report Series No. 20 on Training in Radiation Protection and the Safe Use of Radiation Sources (2001) [7]. The Safety Guide presents recommendations on how to meet the BSS requirements concerning education and training in radiation safety, guidance to regulatory authorities on the establishment of minimum qualification requirements for personnel involved in radiation protection activities, as well as guidance on a national strategy for building competence in this area. The Safety Report provides detailed guidance on the organization, implementation and evaluation of education and training activities. The Standard Syllabus for the Post-graduate Educational Course in Radiation Protection and Safety of Radiation Sources has been revised, taking into account the requirements of the BSS [8].

4. THE NEW VISION AND STRATEGY

The new vision and approach to the strategy is to:

- Optimize the effectiveness of its education and training programme to ensure short term and long term availability of necessary expertise and competence.
- Answer the need for harmonization, and quality of training and education according to the BSS and other relevant standards.

— Optimize the finite resources of both Member States and the IAEA.

The main components of a comprehensive strategy proposed for the future are described in detail in the Strategic Approach to Training: Strategic Plan 2001–2010, Report of the Advisory Group Meeting on Education and Training of April 2001 [9]. The main lines of action adopted for the implementation of the strategy are to:

— Enhance/encourage the 'train the trainers' approach;
— Promote and strengthen national, regional and collaborating training centres;
— Continue to promote exchange of information.

The specific activities proposed for the IAEA to implement the strategy are to:

— Set up a steering committee in charge of advising on the implementation of the strategy;
— Continue developing the network of regional and national training centres;
— Put in place a robust mechanism for the development and updating of appropriate training aids and materials, and optimize the direct involvement of specialist IAEA personnel in training activities;
— Put in place a procedure to facilitate the development of trainers in radiation safety;
— Set up a databank on feedback from monitoring the evaluation process, the questions, as well as references to enable the Secretariat to improve training.

With the commitment of the Member States to develop a sustainable training programme in radiation safety, the IAEA will assist with a supporting programme that has three major elements:

— Harmonized approach for the delivery of education and training courses;
— Standardized education and training material prepared and made available;
— Information exchange through a network of participating national and regional training centres.

Besides representatives from regional and collaborating centres, the Steering Committee will have representatives from international organizations such as the European Union. The representatives of the European Union who participated in the Technical Meeting on the Implementation of the Strategy on Education and Training in Radiation Protection in March 2002 showed interest in participating in the Steering Committee as well.

The Steering Committee was formed in 2002, with nominated members representing regional, collaborating training centres, the European Union and the International Radiation Protection Association (IRPA). The first meeting was held in Vienna in November 2002 with 19 members. The Steering Committee is chaired by the IAEA.

The objective of the meeting was to provide the IAEA with relevant advice on its education and training activities, to review the standardized training material that has been developed, and advise on the establishment of the Inter Centre Network. The meeting concluded with several recommendations on the implementation of Strategy for Education and Training.

5. CONCLUSION

The ultimate effectiveness of the strategic approach to education and training and other IAEA initiatives rests upon the commitment of Member States to develop sustainable training programmes in radiation safety. By working together, more progress can be made towards the realization of a harmonized approach for education and training. These steps are essential ingredients for maintaining high standards of radiation safety worldwide.

Standardized training packages have been developed for a few modules of the PGEC, and for specialized training courses. In general, contents of the training packages for specialized training are PowerPoint slides for the presenters, narrative lecture notes for students, practical or student exercises, and multiple-choice questions. The training packages developed for regulators in different practices also include a detailed on-the-job training programme. Training packages for 16 practice specific training were submitted to the Steering Committee for their review. The training package for paper-based distance learning in radiation protection has 22 lessons completed out of 23. This includes a workbook and self-check questions. The Steering Committee acknowledged the IAEA's effort in developing the training packages, and recommended launching a project to establish the Inter Centre Network, and establishing and maintaining an adequate pool of recognized trainers for each area of interest through 'train the trainer' workshops.

6. RELEVANT IAEA PUBLICATIONS

Safety Standards Series No. RS-G-1.4, Building Competence in Radiation Protection and the Safe Use of Radiation Sources [6] provides guidance for regulatory bodies on the establishment of training and qualification requirements and a strategy for building competence. This publication is jointly sponsored by the WHO, PAHO and the ILO.

Safety Reports Series No. 20, Training in Radiation Protection and the Safe Use of Radiation Sources [7], provides assistance to trainers and training providers on how to set up training courses, distance learning and on-the-job training as well as how to establish training centres. It addresses the development and provision of training in protection and safety in a range of activities involving work with ionizing radiation. It supersedes IAEA Technical Reports Series No. 280 on Training Courses on Radiation Protection, published in 1988. Published in 2001, Training Course Series 18, Standard Syllabus for the Post-graduate Educational Course in Radiation Protection and Safety of Radiation Sources, is intended to facilitate the implementation of such courses by universities and training centres, and is aimed at professionals in the early stage of their careers [8]. The structure of the syllabus follows the BSS and supersedes the one published in 1995.

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Keynote Address

RADIATION PROTECTION TRAINING IN ARGENTINA
A historical overview

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Abstract

The paper describes the national evolution of radiation protection training activities in the medical and industrial areas. In addition, the relationship between the development of the regulatory systems and related training activities is explained. A summary is provided of the training activities not directly related to users of radioactive materials or operators of ionizing radiation devices. Finally, a picture is given of the historic evolution of the training of radiation protection experts and, as conclusions, some general facts are presented for discussion.

1. INTRODUCTION

Radiation protection training activities (RPTA) in Argentina can be traced back to the end of the 1950s and are closely linked to the promotion of the use of radioisotopes and ionizing radiation, as well as to the regulations aimed at protecting health and property against associated risks. Although such activities are also linked to developments in the nuclear area, this paper focuses on the training activities associated with the use of radioisotopes and ionizing radiation in medical and industrial areas.

The National Atomic Energy Commission of Argentina (CNEA) was created in 1950. From the beginning, one of its functions was to protect health and property against the risks of 'atomic radiation'. The evolution of the CNEA has been described in several papers (see, for example, [1]), and the evolution of its regulatory functions in the period 1950–1976 is detailed in [2]. In addition, a paper presented at this conference, "Radiation protection and nuclear safety post-graduate courses in Argentina: Facing the changes" [3], appropriately summarizes the evolution of the regulatory functions up to the present day.

For the purposes of this paper, the evolution of RPTA has been divided into the following three parts:

— Initiation and consolidation;
— Other radiation protection training activities;
— Training of radiation protection experts. Radiation protection regulatory aspects are addressed only to the extent necessary to explain some training activities.

2. INITIATION AND CONSOLIDATION

From 1956 to 1957, the CNEA radiation protection professionals (though few in number) had adequate consolidated knowledge and know-how to afford new responsibilities (i.e. there was a 'critical mass'). Therefore, they developed and promoted the approval of the first regulations for the safe use of radioisotopes in the areas of medicine, industry and research and, by 1958, these regulations were in force [4]. This initial regulatory system was quite simple and stated the basic principles in an appropriate way that allowed its use until 1994, when the regulatory functions were formally separated from the CNEA [5].

The regulations established that an authorization of the CNEA was required for using, importing, exporting and transferring (in a broad sense), radioactive materials. Briefly, two kinds of authorizations were defined, one for facilities and the other for the responsible operator of each facility:

— A person would be authorized if properly trained for the specific application (for medical applications, that person shall be a physician).
— A facility would be authorized when properly designed and equipped so as to ensure its safe operation *and* when operated by an authorized person.
— A system of inspection was imposed.
— Enforcement measures were established that included the cancellation of the authorization of a person and the suspension of the authorization of a facility.
— An Advisory Committee was created that included representatives of the Ministry of Health and of the University of Buenos Aires. The main function of the Advisory Committee was to consider each application and to make recommendations to the CNEA, particularly regarding authorizations of personnel (including training requirements). The other major function was to provide advice with respect to each potential violation of

the regulations reported by the inspection system and the applicable penalty.

— Radiation protection measures would be those issued by the CNEA or those recommended by international organizations, such as the ICRP, the International Commission on Radiation Units and Measurements (ICRU), the WHO, the ILO or other international organizations.
— Staff members already using or having radioactive materials at the time the regulations entered into force were compelled to register at the CNEA and to allow inspections to verify the safety status. These situations would be addressed on a case by case basis.

As the regulatory system imposed educational and on-the-job training, the CNEA developed training courses and made arrangements to facilitate on-the-job training either at its facilities or at other existing facilities in the country. The first educational courses took place during 1958; radiation protection was part of the syllabus of all courses and CNEA 'regulators' gave the lectures and conducted the related practices. At the end of the courses, a formal evaluation of the participants took place and 'regulators' were part of the evaluation team. In the following steps towards authorization, recognized professionals shall testify that on-the-job training requirements were fulfilled. In addition, as the proper implementation of radiation protection requests services, several services were implemented by the CNEA, such as individual monitoring, source calibration, radiation protection equipment calibration and maintenance, and guidance for designing facilities.

Wisely, as the regulatory functions were not fully separated from other functions (e.g. services), the CNEA maintained the expertise necessary for the effective implementation of such functions. Furthermore, research projects in radiation protection subjects were implemented, increasing the expertise of the 'regulators'. It was also wise not to copy regulations from other countries, though they were analysed, and to provide a legal basis for the application of recommendations of international organizations when appropriate.

As a result of inspections, specific requirements were imposed and, occasionally, a penalization process was triggered. In spite of that fact, after a few years, an interesting effect was observed in the relationship between 'users' and 'regulators'. As the first contact among future users and regulators took place during a training course and, later, regulators provided advice in design and operation of facilities, as well as services and assistance in the case of a radiological emergency, they were respected by the users because of their knowledge in the field of radiation protection. Reciprocally, regulators frequently asked users to give lectures regarding a new application, or requested their advice about new requirements under consideration, meaning that users were respected because of their knowledge about a specific application or practice. This fine effect significantly facilitates the proper implementation of radiation protection measures and speeds up the process of improving radiation protection in the country. At present, the system is more complex, the regulatory authority does not provide services, and part of this exquisite relationship has been missed.

Personalities and circumstances usually play a significant role in any historical evolution. In this case, there is no doubt that D. Beninson, former Chairperson of the International Commission on Radiological Protection, among other things, has played a major role in the evolution of radiation protection in Argentina. With regard to the circumstances, an accident that happened in 1968 promoted a critical revision of the regulatory activities [6].

With the continuous support of the CNEA, the number and types of training courses for users of radionuclides increased continuously over the years, mainly because of their incorporation as specialized courses by universities and specific organizations. Although the subjects and extent of these training courses have evolved, the concept of training courses for each specific application included in the syllabus, which is tailored to radiation protection topics, has been maintained until now. At present, there are 11 training courses recognized by the Nuclear Regulatory Authority (ARN) as the educational part of the training for users of radioisotopes in medicine and industry. A similar evolution took place on the subject of on-the-job training.[1]

The case of X ray equipment follows a different evolution. Several radiation protection courses and lectures took place before the regulatory system was established. In the 1960s, the CNEA co-operated with an enthusiastic group of professionals of the Ministry of Health and, by 1967, the corresponding regulations entered into force [7]. In this area, the Ministry of Health is the national authority, being the operational implementation of the regulatory control that is the responsibility of each province. Gradually, the provinces effectively assumed their responsibilities in the regulatory system, with the federal support of the Ministry of Health and the co-operation of the CNEA (and now also of the ARN.)

Several problems, including economic troubles, have generated obstacles for the provinces to carry out their duties: maintaining qualified professionals, for instance, and the replacement of equipment. In spite of the difficulties, at present, radiation protection is a mandatory part of the training of operators of

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[1] For nuclear facilities, and some radioactive facilities with high inventory, such as industrial irradiation facilities, a more sophisticated process applies that is not addressed in this paper.

X ray equipment. Every year, hundreds of short courses and special lectures addressing radiation protection topics related to the use of such equipment take place all across the country.

It is interesting to note that in the use of radioisotopes, regulatory and training activities arose practically at the same time, while the training activities associated with X ray equipment started well before a proper regulatory system was established. Furthermore, it appears that radiation protection improvements in this field were, and to some extent are, more a consequence of training than of a systematic regulatory control. This fact confirms the assumption that radiation protection can always be improved by appropriate training, even without a well established regulatory system.

3. OTHER RPTA CARRIED OUT IN ARGENTINA

Since the 1960s, it has been clear that the effective implementation of a radiation protection system at the national level requires the involvement and co-operation of different governmental organizations, as well as professional associations and even private companies. The ‘net’ of concerned organizations started with the Ministry of Health as described above, and was gradually developed over the years, usually starting with general awareness lectures and technical discussions. Short training courses were organized for members of security forces linked to physical protection activities, or for those likely to be needed in case of a radiological emergency, or necessary in other cases, such as the loss of a radioactive source (e.g. fire brigades, police, border control security forces). A close interaction with customs authorities was also necessary for controlling the export and import of radioactive materials. Tailored training courses were also organized to that end. The national organization for standardization was also involved, and the process of developing standards needed for radiation protection began in the 1980s. As part of the national radiological emergency system, a scheme involving hospitals and physicians was developed for taking care of individuals exposed to high radiation doses or significant intakes of radioactive materials. Regular training activities are a key element of such a scheme. Close co-operation was established with the national agency responsible for regulating the safe transport of dangerous goods and, again, training was part of this co-operation. Training was and still is provided on an ad hoc basis to personnel responsible for storing radioactive materials at airports or for personnel involved in the transportation of radioactive materials. This summary is not complete and is only intended to show that training activities embrace more than users of radioactive materials or operators of ionizing radiation generators.

Recognizing the importance of training as the main engine for improving radiation protection, the former regulatory branch of the CNEA (and now the ARN) also promotes the inclusion of radiation protection topics in several university courses not aimed at fulfilling the requirements for a formal authorization. To the extent possible, lecturers are provided on request for covering specific radiation protection topics in such courses.

4. TRAINING OF RADIATION PROTECTION EXPERTS

The initial training of new personnel of the former regulatory branch of the CNEA was not systematic until 1978 and was organized on an ad hoc basis. As an example, when I entered the CNEA in 1969, in the area of control of users of radioisotopes in medicine, industry and research, I was given a chair, a desk and a thick radiation dosimetry book. I was also informed that in two weeks, I was to discuss the first ten chapters with senior members of the team. By 1970, I was carrying out inspections and providing some services (e.g. design of shielding rooms for teletherapy equipment and beam calibration). By 1971, I was already giving radiation protection lectures in training courses. The same year, I become an expert in detecting leaking radon 226 sources and in decontamination — after having contaminated one of our laboratories with radon 226!

In other words, the training of radiation protection experts was basically on-the-job. The fact that there were only a few of us made it necessary to deal with several fields, and forced a continuous exchange of information and internal discussions. Also, a policy of special lectures and discussions of selected topics encouraged the study of new subjects and the corresponding technical discussions. In addition, in topics where national expertise was scarce, some professionals were sent to another country for training (usually the United States of America or European countries). Mention should be made of the co-operation received from selected experts from abroad and the effect of the policy of encouraging our professionals to participate in national, regional and international radiation protection forums.

Although some staff members of the regulatory branch were 'stolen' by other CNEA branches (mainly by the area of nuclear power plants), and others were transferred to other branches when services started to be separated from the regulatory function (during the 1980s), the core of the regulatory branch remained technically qualified to carry out an effective regulatory control. Personnel, facilities and equipment were transferred to the formally independent regulatory authority in 1994.

The former eclectic process of training radiation protection experts was not appropriate to face the needs of a significant increase in human resources foreseen by the end of 1970 in the framework of an ambitious nuclear programme. In this context, the syllabus of an educational training course was developed during 1977 and a 10-month training course was successfully run during 1978 and 1979. By the end of 1978, it was decided such courses would be given a formal academic framework. From 1980 to 2002, it was a post-graduate course in radiation protection and nuclear safety with a diploma from the School of Engineering of the University of Buenos Aires. Furthermore, since that year, the course has been sponsored by the IAEA. In the indicated period, the post-graduate course has had 635 participants (286 Argentinians and 349 from other countries, mainly from the Latin American region). This year, a new cycle started and two post-graduate courses are now being run, the first one (25 weeks) in radiation protection and safety of radiation sources and the second one (10 weeks) in nuclear safety. The history of the course and the changes recently introduced are described in a paper presented in this conference [3] and will not be repeated here.

In the author's opinion, there are two main factors that have contributed, and will continue to contribute, to the success of the post-graduate courses:

- Lecturers are selected primarily on the basis of their experience in the field;
- Close co-operation in training between the ARN and the CNEA, the Ministry of Health and other national and private organizations allows the use of well established laboratories and facilities for carrying out practices.

Regarding the last aspect, it should be mentioned that technical visits, demonstrations and practical exercises are carried out at several facilities, including ARN laboratories (e.g. whole body counter, gamma spectrometry, thermoluminescence dosimetry (TLD), environmental measurements and biological dosimetry), CNEA facilities (production of cobalt 60 sealed sources, radioisotopes production, multipurpose industrial irradiation, research reactors and others); private companies (teletherapy machines production, specific industrial irradiation facilities, industrial radiography); as well as state and private hospitals (nuclear medicine, teletherapy, brachytherapy, X ray diagnosis and others).

5. CONCLUSIONS

The evolution of radiation protection training activities is different in each country as is the evolution and the current status of each regulatory system. The history, the existing legal framework, the culture, particular situations and the influence of some personalities may explain the differences. However, experience indicates some key facts that seem to be general and can be summarized as follows:

— Training is the main engine to improve radiation protection in a country.
— Training should not be limited to those directly involved in the use of radioactive materials or ionizing radiation devices but should also involve, to the extent necessary, all concerned organizations and associations.
— International co-operation is an important element for improving training, particularly of radiation protection qualified experts.
— National regulatory authorities should work in close co-operation, and all concerned organizations shall be involved for a proper implementation of a radiation protection regulatory system.
— The formal separation of regulatory functions from other activities (e.g. radiation protection services) should take place only after having gained enough experience and enough qualified personnel so as to be able to maintain an effective regulatory control.
— Regulators should have real technical knowledge and should promote and be involved in training activities.

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Topical Session 6

NEEDS FOR INTERNATIONAL EDUCATION AND TRAINING

DISCUSSION

A.L. BIAGGIO (Argentina): We have been, during our previous discussions, insisting on the separation between promotional, operational and regulatory activities. However, in the early days, all countries which now have good systems had promotional, operational and regulatory activities all together. They did not split them up until they had enough knowledge.

K. MRABIT (IAEA): You may recall that, during the Background Session, T. Taniguchi talked about the integration of IAEA safety activities, the idea being to improve and integrate both the IAEA's Safety Standards and the mechanisms for applying them.

One of the mechanisms for applying safety standards is appraisals and services.

The IAEA already has a system for appraising radiation and waste safety infrastructures as a whole. The appraisals, based on international standards, produce recommendations relating to different regulatory infrastructure elements, and the IAEA plans to carry out, whenever justified, separate modular appraisals of the different infrastructure elements in the light of those recommendations. One of the infrastructure elements, for which we recently finished developing an appraisal module, is education and training.

A. ALONSO (Spain): In many countries, owing to 'radiophobia', fewer and fewer young people are studying subjects such as nuclear physics and reactor technology. How are the high standards of the radiation safety infrastructures in some of those countries going to be maintained under such circumstances?

A.L. BIAGGIO (Argentina): I simply do not know. In my organization, about a hundred people will be retiring over the next ten years, and I do not see how they will be replaced. This is a problem common to many countries — developing and developed.

A.M. SCHMITT-HANNIG (Germany): The most important way of counteracting the problem is to improve communication with the public.

M.A. BERRADA (Morocco): Persons who complete training courses in order to become radiation protection practitioners receive a certificate. Should the certificate be valid for life or only for a limited period?

A.M. SCHMITT-HANNIG (Germany): In Germany, such certificates are valid for five years, at the end of which the holders must undergo refresher training unless they can demonstrate that they have kept up to date.

J. VAN DER STEEN (Netherlands): It differs from country to country. In the Netherlands, such certificates are valid for life, but that is due to change soon. Then they will be valid only for five years, as in Germany, the United Kingdom and several other countries.

SEONG HO NA (Republic of Korea): With more and more experienced people retiring, I think it is particularly important to emphasize the ‘train the trainers’ approach.

In addition, I propose the establishment of an international database with details about those experienced people, including details of how to contact them, so that use can continue to be made of their experience. An important issue in that connection would be the mutual recognition of qualifications.

A. ALONSO (Spain): I am sure that the IAEA will consider that proposal.

K. MRABIT (IAEA): I agree with Seong Ho Na about the importance of emphasizing the ‘train the trainers’ approach.

The post-graduate educational course on radiation protection and safety of radiation sources material now includes a specific module on communication and teaching skills, as do the other training packages on specific thematic subjects such as radiation protection in medical practices.

Rapporteur's Summary

NEEDS FOR EDUCATION AND TRAINING AT THE INTERNATIONAL LEVEL

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Abstract

In order to meet changing demands and to achieve or maintain an equivalent level of competence in radiation safety worldwide, action should be taken beyond national systems and different approaches to harmonize curricula, the duration and recognition of qualifications, and experience acquired in courses and during practical training. The formulation of guidelines for minimum requirements of the technical content, duration and recognition of training incorporated in the regulatory framework should be a first step followed by a thorough assessment of the national needs for training and development, and the implementation of a sustainable national or regional training programme in radiation safety.

1. INTRODUCTION

In order to take responsibility in working in the field of radiation safety, proper education and initial training as well as continuous professional development in conceptual, administrative and operational radiation safety is essential. The obligation for appropriate training and information of personnel occupationally exposed to ionizing radiation or personnel who have potential contact with radiation is, therefore, set out in the relevant safety standards [1, 2].

2. IAEA PROGRAMMES ASSISTING IN ESTABLISHING ADEQUATE INFRASTRUCTURES

The Basic Safety Standards (BSS) are based on the presumption that a national infrastructure is in place enabling governments to discharge their responsibilities for protection and safety. Education and training are essential elements of the radiation safety infrastructure. IAEA education and training activities follow the resolutions of its General Conferences and reflect the latest IAEA standards and guidance.

The range of education and training activities in radiation safety currently undertaken by the IAEA can be summarized as follows:

- Post-graduate Educational Courses in Radiation Protection and Safety of Radiation Sources (PGECs);
- Specialized training courses;
- On-the-job training (OJT);
- Scientific visits;
- Workshops and seminars;
- Distance learning.

In addition, the IAEA carries out other activities that support the training modalities mentioned. These support activities include the preparation of standardized training aids and material; the promotion of and assistance to regional training centres, and co-operation with collaborating centres; and publications relevant to education and training.

3. IAEA STRATEGY ON EDUCATION AND TRAINING

In response to General Conference Resolution GC(44)/RES/13, the IAEA prepared a Strategic Approach to Education and Training in Radiation and Waste Safety (Strategy on Education and Training) aiming at establishing, by 2010, sustainable education and training programmes in Member States. This strategy was endorsed by General Conference Resolution GC(45)/RES/10C that, inter alia, urged the Secretariat to implement the Strategy on Education and Training, and to continue to strengthen, subject to available resources, its current effort in this area, and in particular to assist Member States' national, regional and collaborating centres in conducting such education and training activities in the relevant official languages of the IAEA. The strategy is implemented by:

- Assessing the needs for training;
- Enhancing/encouraging the 'train the trainers' approach;
- Promoting and strengthening national, regional and collaborating training centres;
- Continuing an exchange of information.

With the commitment of the Member States to develop a sustainable training programme in radiation safety, the IAEA will assist with a supporting programme that has three major elements:

— Harmonized approach for the delivery of education and training courses;
— Standardized education and training material prepared and made available;
— Information exchange through a network of participating national and regional training centres.

4. NEED FOR INTERNATIONAL TRAINING ACTIVITIES AND RELEVANT EXPERIENCE IN MEMBER STATES

4.1. New orientation phase

As a consequence of political changes, the regulatory authority for radiation safety had to be re-established in a number of countries. In this phase, specific needs are:

— Formulation of new regulation or modification of existing radiation protection regulation;
— Implementation of the IAEA BSS and, in some countries, of the European Union BSS;
— Education and training of qualified personnel.

The process of formulating new regulatory requirements in line with the BSS provides a good chance to include and specify education and training requirements in radiation safety in the regulation and make it a prerequisite for the authorization of practices involving radiation sources and radioactive substances. It is also in this phase of new orientation that international assistance to trigger the process of developing a sustainable national training programme is of greatest importance. The IAEA Model Project is a good example of such an initiative.

4.2. Development and implementation phase

In order to develop and implement a national education and training programme in radiation safety, a proper analysis of a country's training needs is essential. Only when the long term needs are known can it be decided whether efforts should focus on establishing a national training infrastructure or whether it would be more cost effective to send trainees abroad for post-graduate education and training in radiation safety and/or OJT supported by fellowships. In addition, it could be very useful to receive or carry out expert visits (including experts from the region), and to establish a maintenance network to repair defective equipment — activities which would increase the level of safety.

When the decision has been made to establish a national education and training programme, the development and implementation should follow the IAEA guidance documents in this field [3–5].

4.3. Consolidation phase

Also in the consolidation phase, the IAEA Model Project has provided and is still providing a lot of support for training to complement long term national training programmes for professional education and training, or short term national training activities in radiation safety. In the consolidation phase, national training courses with and without IAEA support are carried out according to the regulatory requirements, and methods to reach sustainability of the training activities are explored.

4.4. Sustainability phase

In the sustainability phase, the regulatory system requires trained personnel and specifies training details, such as the following:

— A national education and training programme is in place, training courses and OJT are developed (including evaluation and recognition) and are:

- Linked to services, such as individual monitoring, source calibration, radiation protection equipment calibration and maintenance, guidance for designing facilities (this helps to maintain the necessary scientific expertise and to develop self-sustainability of training programmes);
- Linked to radiation protection research projects (increasing the expertise of the ‘regulators’);
- Supported by a fruitful interaction between regulators and users (respect on both sides helps to implement radiation protection measures);
- Different governmental organizations (including organizations for standardization), as well as professional organizations and private companies (join forces, create networks) are involved and co-operate;

— Specialized training is provided, for example, for physicians: medical handling of overexposures;
— Awareness training and short courses for members of security forces linked to physical protection activities or emergency preparedness, for personnel at airports in charge of transport and/or storage of radioactive substances are carried out on a regular basis;
— A 'train the trainers' programme has been implemented.

A good example for this stage of development is Argentina, where the national training centre at the same time serves as regional training centre for other countries in Latin America.

Examples for training activities of countries in all these phases at a national and/or international level can be seen in the contributions to this conference of Argentina, Belarus, Egypt, Indonesia, Portugal, and Serbia and Montenegro.

The duration of each phase can vary considerably, depending on the political and economic development of a country or a region. There may be some long transition phases and sometimes drawbacks. However, in the long term, international co-operation in radiation safety training will contribute to an increased level of safety worldwide.

5. THE EUROPEAN EXPERIENCE

In relation to education and training in radiation, there are two major issues of concern at the present time in Europe:

— Maintaining safety competence;
— Harmonization of the qualification and mutual recognition of the radiation protection expert.

5.1. Maintaining safety competence

The area of radiation protection covers the nuclear fuel cycle as well as the use of radiation sources and radioactive substances in medicine, industry and research, and the management of natural sources of radiation. In certain parts of these disciplines, a lack of comprehensively trained young scientists is eminent [6]. For example, as regards the medical application of ionizing radiation, too few experts in medical physics are available in several Member States.

Over the years, a shift in competencies needed can be observed. The safe management and disposal of radioactive waste will continue to have a high priority until disposal systems have been implemented for high level and long lived wastes, and requires specific competencies, among others also in radiation safety. This is also the case for activities related to the decommissioning of nuclear as well as non-nuclear facilities. The application of safeguards' measures and the development of procedures to fight against illicit trafficking require sophisticated measuring methods and technological tools and, therefore, adequately trained personnel competent in radiation safety is needed.

The OECD/NEA recommends that countries should co-ordinate their activities to maintain and further develop safety competence, and has already provided assistance in identifying the problem. The European Commission will play a valuable role by funding education and training structures through their framework programme.

5.2. The status of the radiation protection expert

In the context of the single market and the enlargement process of the European Union, harmonization of the qualification of the radiation protection expert (RPE), according to the definition of the Qualified Expert (QE) in the BSS of the European Union (Council Directive 96/29/Euratom) is of vital importance for the free movement of workers.

On behalf of the European Commission, a study was carried out to survey the situation of RPE in the member States. The results can be summarized as follows:

- No clear definition of an RPE;
- RPEs are subdivided by level of expertise or sector of work;
- Most European Union member States have their own national training systems for RPEs;
- Applicant countries are supported by the IAEA;
- Practical work as part of the training programme/professional experience is needed;
- Continuous training is incorporated;
- No formal mutual recognition of the RPE (comparison needed of training curricula, training material, subdivision of RPE according to their expertise in connection with their tasks and duties, distinction between RPE and RPO, requirements and procedures for registration and mutual recognition);

— Establishment of a discussion platform (to exchange information on education, training, recognition, registration of RPEs).

6. THE GERMAN EXPERIENCE

In order to assume full responsibility for working in radiation protection, a proper education and initial training as well as continuous professional training in conceptual, administrative and operational radiation protection is essential. The obligation for appropriate training and information of personnel occupationally exposed to ionizing radiation, or personnel who have potential contact with radiation is, therefore, set out in the relevant European radiation safety directives. The provisions in these directives are binding for the member States and have to be implemented into the relevant national regulations with some flexibility to account for national particularities.

In Germany, the Radiation Protection Ordinance [7] requires that each licensee needs at least one person who is in charge of radiation protection matters in relation to the licensee's type of 'practice'. This person, who could be, for example, a technician, a physicist, a medical doctor, etc., needs the following:

— Adequate education and training in radiation protection, in a form which depends on the type of practice and on his or her level of qualification and the radiation protection tasks to be accomplished;
— Practical experience in a typical relevant practice, ranging in general from a few months (i.e. for small sources) up to two years (i.e. for medical physicists or radiation protection personnel in nuclear power plants) or three years (i.e. for medical therapy — this period of time may be included in the physician's professional training as a specialist in a specific therapeutic field);
— Task-specific training courses in radiation protection (mainly regarding legal requirements, guidelines, practical issues) lasting for a period of a few days up to several weeks, and ending with an examination; the training centres that provide the courses need to have an accreditation from the competent authority.

All requirements are regulated, in general, in the Radiation Protection Ordinance and, at the detailed level, in a number of regulatory guidelines relating to different types of practices and professional groups. These guidelines include the content of training courses and periods of practical experience.

If these prerequisites are fulfilled (appropriate verification and certificates are required), the person has attributed recognition (following assessment of supporting documents and certificates) by the competent authority (or an appropriate institution when the competent authority has delegated allocation of recognition) either in an individual accreditation document for physicians or medical physicists, or within the scope of licensing procedures, for all other persons trained — or later, when personnel change through reporting to the competent authority.

Recognition of the qualification of all persons trained in radiation safety as well as subsequent regular 'refreshment' training courses (i.e. every five years) is a requirement in the Radiation Protection Ordinance and the respective guidelines.

In order to achieve an equivalent level of qualified competence in radiation protection, and to facilitate the international exchange of personnel and recognition of their competence in radiation safety, action should be taken, beyond national systems and different approaches, to harmonize curricula, the duration and the bases for recognition of the qualification, and experience acquired in courses and during practical training. To meet these requirements, the revised Guideline on the Qualified Competence in Radiation Protection introduces a modular design of the curriculum, allowing for acquiring those parts of the training which are not related to the national regulatory framework abroad.

7. CONCLUSION

The Evolution of training is as different in each country as the regulatory requirements (due to history, culture, radiation applications, particular situations, influence of individuals, etc.), however, there are some more general factors:

- Training is the motor to improve radiation safety in a country;
- National co-operation is an important element (training should involve all concerned governmental, academic and research organizations, as well as professional associations);
- International co-operation is an important element, particularly concerning the training of qualified experts;
- Training should not be limited to those directly involved in the handling of radiation sources or radioactive substances (include radiation protection modules in other university curricula, provide awareness training for groups potentially involved, such as staff from hospitals,

members of security forces linked to physical protection activities or emergency preparedness, personnel at airports in charge of transport and/ or storage of radioactive substances, police, fire workers, etc. and inform medical doctors, teachers, journalists, etc.);
- Adequate training in radiation safety should be a prerequisite for granting a licence/authorizing a practice;
- Training curricula as well as the IAEA Standard Syllabus have to be updated continuously to meet modern needs (for example, include more specialized computer training and new technologies); training material, standardized and translated into the languages of the region, have to be updated continuously;
- National/regional courses have to be held in the main language of the country/region; countries with a different language than the main one in their region should send their trainees to regional courses in a region with their language, if available (for example, in Belarus);
- Training subjects should be enlarged when necessary: include security issues and include protection against non-ionizing radiation (NIR), ultraviolet, ultrasound, microwaves, electromagnetic fields, etc.;
- A discussion platform on training issues should be established at an international level (European Union initiative);
- A network of collaborating training centres should be established (IAEA initiative);
- Links between training (which is the motor), research, operational radiation protection, communication (stakeholder involvement), development and implementation of radiation protection standards, and establishment of specific regulatory requirements should be identified and used to improve the radiation protection infrastructure in a country.

8. DISCUSSION POINTS

- Need for international training activities.
- European Radiation Protection Course, regional centres supported by IAEA.
- Establishment of a discussion platform on radiation protection training issues at an international level (European Union initiative to exchange information on education, training, recognition and registration of RPEs).
- A network of collaborating training centres (IAEA initiative).
- Necessity of appraisal methods and procedures to ensure an adequate and harmonized level of training.

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Round Table 2

STRATEGY FOR DEVELOPING AND SUSTAINING KNOWLEDGE AND COMPETENCE

DISCUSSION

Chairperson

M. REPACHOLI
WHO

ROUND TABLE 2

A.J. Al-KHATIBEH (Qatar): The post-graduate educational courses being given at regional training centres are attended by only a few persons from any one country in a given region, but in our region (West Asia) there are some countries with several thousand radiation workers. In my view, therefore, what we also need are national training courses which are supported by the IAEA initially and which we run on our own later. That would make for sustainability.

Moreover, I believe that consideration should be given to converting the diploma awarded to those who complete the post-graduate educational courses into a higher degree — perhaps a Master's degree.

Something that I would very much welcome is standardization with regard to the qualifications necessary in order to become a radiation protection officer. We have people who have been certified as radiation protection officers after only a few days of training, but I have heard of training courses for radiation protection officers that last up to 12 weeks. In my view, this is an issue for the IAEA.

A similar issue is that of the qualifications necessary in order to become a radiation worker, for example, a radiologist or an industrial radiographer. Some radiation workers do not even have a secondary education, while others have higher degrees. If we had guidelines regarding minimum requirements, each country could follow them in a flexible manner in the light of its human resources situation.

The 'train the trainers' idea is an excellent one, but I do not consider 'train the trainers' courses lasting one or two weeks to be very useful. Such courses should last at least four weeks.

Perhaps the IAEA could convene an international meeting — or a number of regional meetings — devoted solely to issues of education and training in radiation safety.

K. MRABIT (IAEA): Regarding what A.J. Al-Khatibeh just said about 'train the trainers' courses, I would point out that the people who take such courses are already experts in their own technical fields. What they acquire through 'train the trainers' courses is not still more special technical knowledge but communication skills: an ability to convey the message and to become familiar with the IAEA's standardized training package for the field of specialization in question.

Regarding what A.J. Al-Khatibeh said about qualifications for radiation protection officers, the IAEA and the European Commission are — within the framework of the Article 31 Working Group on education and training — examining the question of harmonization and mutual recognition of diplomas by Member States. In that connection, training packages prepared by the IAEA will be used by the European Commission with only a few adjustments, for example, adjustments relating to occupational radiation protection.

Regarding what A.J. Al-Khatibeh said about the diploma awarded at the end of the post-graduate educational courses, I believe the important issue is the status which the home countries of the course participants accord to that diploma. The courses are based on a standard syllabus which we developed and which we would like to see incorporated into all relevant curricula of universities in IAEA Member States.

M. DAUD (Malaysia): Further to what A.J. Al-Khatibeh and K. Mrabit said about the post-graduate educational course, I would mention that the course held at our regional training centre in 2001 was attended by four participants from Myanmar who, on returning to their home country, organized a radiation protection training course for radiation workers.

M.Y. OSMAN (Sudan): We have benefited greatly from training provided through the IAEA but, as head of a radiation protection department, I would note that, both with courses lasting one or two weeks and with courses lasting 9 to 12 months, we have found the emphasis to be theoretical rather than practical.

I would prefer training courses of one to three months on very specific subjects, such as personal dosimetry or radiation safety inspections at medical facilities, so that use can be made of the trainees immediately upon their return home.

Also, I would prefer national training courses, as they can be attended by more people than the few whom we are allowed to send to regional courses and the training takes place at local facilities, with local equipment and under local conditions. Trainees on courses held outside their home countries are often trained with equipment far more sophisticated than the equipment which they will have to use when they return home.

At the end of each training course organized within the IAEA framework, the trainees are requested to complete a questionnaire designed to provide the IAEA with information on what the trainees thought about the course. In my opinion, the institutions that assign the trainees to the course should in due course also be invited to complete a questionnaire in which, in the light of the trainees' subsequent performance at home, they can express their views about the course.

I.A. GUSEV (Russian Federation): In my country, when we need to train a fairly small number of people for a fairly long period, we usually organize on-the-job training rather than training courses.

P.N. LIRSAC (France): The IAEA is currently establishing guidelines for on-the-job training. The guidelines will spell out things such as the skills to be acquired and methods of assessment.

K. MRABIT (IAEA): Regarding what M.Y. Osman and I.A. Gusev just said, I would say that the post-graduate educational courses are admittedly rather theoretical — or general. The idea is, however, that after completing such a course you take a specialized course, for example, on carrying out radiation safety inspections in radiotherapy departments. Even then you will not be a qualified inspector — you will still need on-the-job training. As I explained in my presentation, to become a qualified expert in a given field, one needs, in accordance with the IAEA policy on education and training, to attend the post-graduate course followed by a specialized course and on-the-job training.

J. VAN DER STEEN (Netherlands): There is often talk about the desirability of a global strategy for education and training. K. Mrabit just now referred to co-operation between the IAEA and the European Commission on harmonization, but I was wondering how much co-operation there is among the organizations that jointly sponsored the BSS: the FAO, IAEA, ILO, OECD/NEA, PAHO and WHO.

M. REPACHOLI (WHO): Of the six organizations that jointly sponsored the BSS, the IAEA is the only one that deals with all aspects of radiation safety. The others deal only with particular aspects.

Where there is an overlap, the organizations in question co-operate. For example, the IAEA and ILO have recently co-operated in drafting an action plan for occupational radiation protection, and the IAEA and the WHO have together, inter alia, designed training courses for physicians on the recognition of injuries caused by ionizing radiation.

I would like to see closer co-operation, however, including closer co-operation in education and training.

F.A. METTLER (USA): I was involved in the drafting of the IAEA's International Action Plan for the Radiological Protection of Patients, where one of the actions under 'Education and training' is "to explore the potential uses of information technology and distance learning, identifying application areas and types of information technology". Accordingly, I am surprised that no mention of information technology and distance learning has been made in this discussion.

M. REPACHOLI (WHO): Distance learning is definitely something we should be looking at. The WHO is using distance learning as a supplement to training courses — for filling in gaps.

P. JIMÉNEZ (PAHO): Regarding co-operation among the organizations that jointly sponsored the BSS, we are working with the IAEA on guidelines for the implementation of the BSS in radiotherapy, radiology and nuclear medicine.

P.N. LIRSAC (France): The IAEA helps to train the trainers, but it is not involved in training the radiation protection officers responsible for day to day radiation protection at facilities — that is the job of the trainers who have been trained with the IAEA's help. Perhaps the IAEA could facilitate the work of these trainers, however, by preparing packages for the training of radiation protection officers.

A.L. BIAGGIO (Argentina): I doubt whether such training packages would be accepted in my country, where, if you are going to work as a radiation protection officer in, say, the nuclear medicine area, you must be a physician, have completed an educational course relating to nuclear medicine and have undergone on-the-job training in nuclear medicine where radiation protection is an integral part rather than a separate activity. Training packages dealing only with radiation protection would not be considered enough by our relevant authorities.

A. DELA ROSA (Philippines): Given the declining numbers of people working in the radiation safety field, I would like to see the IAEA supporting — through co-sharing and in other ways — post-graduate programmes for education and training up to the Ph.D. level. The courses could take place at universities in Member States, the local course material being supplemented with IAEA training modules, and it would be helpful if the IAEA were to facilitate the placement of course participants at appropriate laboratories abroad, where they could complete their dissertations.

With regard to the regional training centres, I would like to see each of them making maximum use of the expertise available in the region where it is located — in line with the spirit of technical co-operation among developing countries (TCDC).

K. MRABIT (IAEA): With regard to on-the-job training, it is provided for in the action plan prepared for each country participating in the Model Projects. In the case of the IAEA Member States which are not participating in the Model Projects but are nevertheless receiving IAEA assistance with education and training in radiation safety, provision is made for the on-the-job training of their nationals also.

In this connection, I would mention IAEA Safety Standards Series No. RS-G-1.4, Building Competence in Radiation Protection and the Safe Use of Radiation Sources. This guide is not automatically reflected in the assistance being provided to all the IAEA Member States receiving its assistance in education and training in radiation safety outside the Model Projects, but it is an integral part of the assistance being provided to the Model Project participating countries.

With regard to J. Van der Steen's comment about co-operation among different organizations, the IAEA has a Steering Committee that advises on the implementation of its 'Strategic Approach to Education and Training in Radiation and Waste Safety'. The European Commission and IRPA participate in the work of the Steering Committee, but we would also welcome the participation of the FAO, ILO, OECD/NEA, PAHO and WHO.

P.M.C. BARRETTO (IAEA): In response to M.Y. Osman and A. Dela Rosa, I would emphasize that the training provided within the IAEA framework is on the whole project oriented; it is designed to increase the usefulness of a person involved in an IAEA technical co-operation project to that project, not to improve that person's level of education in the general field where he/she is working. The IAEA is not in the business of helping people to obtain Master's and Ph.D. degrees.

Moreover, the requests of individuals in Member States regarding training ultimately have to be transmitted to the IAEA by the appropriate authorities in those countries, in accordance with established procedures. The IAEA's Department of Technical Co-operation then [tries to] determine the main priorities of the requesting Member States. In doing so, in the area of education and training it has to maintain a proper balance between basic education and specialized training.

A.W. Al-MUSLEH (Qatar): Does the IAEA have a mechanism for assessing the impact of education and training programmes in Member States?

K. MRABIT (IAEA): Yes, it recently established a service Education and Training Appraisal System, for carrying out such assessments at the request of Member States.

In the case of Member States participating in the Model Projects, such assessments but in a systematic way, were being carried out already before the establishment of that service.

A.W. Al-MUSLEH (Qatar): Regarding the nomination by Member States of persons to take education and training courses organized within the IAEA framework, I suspect that the IAEA sends invitations to nominate such persons only to the authority in each Member State with which it has the most regular dealings. That may not be the appropriate authority for making the nominations. I should like to see the IAEA ensuring that the invitations to nominate are sent to the appropriate authorities in Member States.

Regarding the regional training centres, I should like to see the IAEA considering the establishment of subregional — and even national — training centres. I am sure that there are countries which would provide financial support for their establishment if they were convinced that it would lead to sustainability in the area of education and training.

K. MRABIT (IAEA): The IAEA will seriously consider proposals from Member States for the establishment of subregional and national training centres. This is in line with the existing IAEA strategy on education and training.

A. KISOLO (Uganda): In Africa, we find that, beside a decline in the number of people studying subjects in the field of science and technology, those who are studying such subjects are then being attracted in large measure to information technology. What can be done to attract more of them into radiation protection?

K. MRABIT (IAEA): In Topical Session 6, in response to a similar question, A.L. Biaggio said, “I simply do not know.” It would be interesting to hear whether any IAEA Member States have found a solution to the problem.

SEONG HO NA (Republic of Korea): In Topical Session 6, I proposed the establishment of an international database with details about people’s experience in radiation protection. In addition, with the declining numbers of people taking up radiation protection, I think that more emphasis should be placed on the feedback of experience.

K. MRABIT (IAEA): I agree. Our ‘Strategic Approach to Education and Training in Radiation and Waste Safety’ provides for the feedback of experience from the regional training centres, from national training centres and from collaborating centres.

A.M. NYANDA (United Republic of Tanzania): P.M.C. Barretto said that the IAEA was not in the business of helping people to obtain Master’s and Ph.D. degrees. In my view, however, sustainability in the field of radiation safety requires a critical mass of people with such degrees, and I should like to see education and training in that field integrated into countries’ normal university education and training systems.

I.A. GUSEV (Russian Federation): As someone working for his country’s Ministry of Health, I should like to see more emphasis being placed on the health effects of ionizing radiation in education and training being provided within the IAEA framework.

That having been said, I congratulate the IAEA on what appears to be the very wide acceptance of its ‘Strategic Approach to Education and Training in Radiation and Waste Safety’.

K. MRABIT (IAEA): I welcome the very wide acceptance that the strategy on education and training appears to have received, and I would simply emphasize the importance of commitment on the part of IAEA Member States to its implementation. We in the IAEA are highly committed.

AUTHORIZATION, INSPECTION AND ENFORCEMENT, AND INDEPENDENCE OF REGULATORY AUTHORITIES

(Topical Session 7)

Chairperson

HUA LIU
China

Keynote Address

EXPERIENCE OF ARRANGEMENTS FOR AUTHORIZATION, INSPECTION AND ENFORCEMENT

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Abstract

Milestone 1 of the IAEA technical co-operation Model Project on Upgrading Radiation Protection Infrastructures requires that the participating Member States should draft and promulgate radiation protection laws and regulations, designate and empower a national regulatory authority and establish a system for the notification, authorization and control of radiation sources through inspection and enforcement. The effectiveness of the national regulatory authority can be measured by the presence of a legislation and regulation establishing it, the number and quality of its personnel, logistics and facilities at its disposal and the level of compliance of users of radiation sources in its domain. These parameters generate the hypersphere from which the lessons and experience of the national regulatory authority can be assessed in terms of authorization, inspection and enforcement. The paper highlights the experience of arrangements from various national regulatory authorities in terms of authorization, inspection and enforcement. The experience of the Nigerian Nuclear Regulatory Authority (NNRA) in the past two years of its existence may be paradigmatic and therefore instructive.

1. INTRODUCTION

Authorization, inspection and enforcement are three of the components of the regulatory control programme for radiation sources. This regulatory control is derived from the law and in the case of Nigeria, this is the Nuclear Safety and Radiation Protection Act 19 of 1995 [1]. This Act provides for the establishment of the Nigerian Nuclear Regulatory Authority (NNRA). The Act was, however, not implemented until May 2001 with the establishment of the NNRA. The promulgation of the Act and the establishment of the NNRA constitute only the necessary conditions but are not sufficient for an effective regulatory regime. On the basis of the Act, regulations have been drafted and submitted to the Federal Ministry of Justice for gazetting. These are known as the Basic Ionizing Radiation Regulations of Nigeria (BIRRON) [2], which cover all uses of radiation sources in the country. The existence of the NNRA was tested in September 2001, ostensibly by an investor who purportedly wanted to import radioactive material for radiotherapy practice. This was stopped. The incident, as reported by the London Times on 6 October 2002 [3], demonstrated the efficacy of the authorization procedure of the NNRA. The lessons and experience of the NNRA in the past two years of its existence amply demonstrate this relationship. The Act places some responsibilities on the NNRA, and gives it some powers to implement the law. The responsibilities and powers of the NNRA are listed below.

1.1. Responsibilities

According to Section 4(1) and (2) of the Act, the NNRA has the responsibility for nuclear safety and radiological protection regulation in the country. These include:

(a) Regulating the possession and application of radioactive substances and devices emitting ionizing radiation;
(b) Ensuring protection of life, health, property and the environment from the harmful effects of ionizing radiation, while allowing beneficial practices involving exposure to ionizing radiation;
(c) Regulating the safe promotion of nuclear research and development, and the application of nuclear energy for peaceful purposes;
(d) Performing all necessary functions to enable Nigeria to meet its national and international safeguards and safety obligations in the application of nuclear energy and ionizing radiation;
(e) Advising the Federal Government on nuclear security, safety and radiation protection matters;
(f) Liaising with and fostering co-operation with international and other organizations, or bodies concerned having similar objectives;
(g) Regulating the introduction of radioactive sources, equipment or practices, and of *existing sources, equipment and practices* involving exposure of workers and the general public to ionizing radiation;
(h) Regulating, as appropriate, the exploration, mining and milling of radioactive ores and other ores associated with the presence of radioactive substances.

1.2. Powers

The NNRA is empowered by Section 6 of the Act to (among other things):

(a) Categorize and license activities involving exposure to ionizing radiation, in particular, the possession, production, processing, manufacture, purchase, sale, import, export, handling, use, transformation, transfer, trading, assignment, transportation, storage and disposal of any radioactive material, nuclear material, radioactive waste, prescribed substance and any apparatus emitting ionizing radiation;
(b) Establish an appropriate register for each category of sources or practices involving ionizing radiation;
(c) License operators of nuclear reactors and other critical facilities;
(d) Issue codes of practice which shall be binding on all users of radioactive and prescribed substances, and of sources of ionizing radiation;
(e) Review and approve safety standards and documentation;
(f) Protect the health of all users, handlers and the public from the harmful effects of ionizing radiation;
(g) Provide training, information and guidance on nuclear safety and radiation protection;
(h) Establish, in co-operation with other competent national authorities, plans and procedures which shall be periodically tested and assessed for coping with any radiation emergency and abnormal occurrence involving nuclear materials and radiation sources;
(i) Undertake investigations and research into ionizing radiation sources and practices;
(j) Do everything necessary to ensure that all concerned persons and bodies comply with laid down regulations under the Act.

Furthermore, the control of radiation sources, and premises where they can be used or stored, is strengthened by Section 15 of the Act. In fact, no person can carry out any activity under the Act and, at the end of the activity, abandon, decommission or rehabilitate installations thereof without a licence issued by the NNRA. This essentially is a codified demonstration of the 'from cradle to grave' principle of the IAEA [4]. In this regard, the NNRA has at its inception taken steps to put in place the proper regulatory framework, within the context of its enabling Act, to effectively *register, authorize and inspect* practices involving ionizing radiation and to *enforce* nuclear safety and radiological protection nationwide. It has also taken necessary measures to have in place the basic administrative and technical capability to support its activities.

These have been achieved through a very rigorous regulatory control programme.

2. AUTHORIZATION

Section 6(1) of the Act empowers the NNRA to issue authorization for all activities involving exposure to ionizing radiation, including the possession, production, processing, purchase, sale, import, export, handling, use, transformation, transfer, trading, assignment, transportation, storage and disposal of any radioactive material, nuclear material, radioactive waste, prescribed substance and any apparatus emitting ionizing radiation. According to Section 19 of the Act, no source or practice shall be authorized except through a system of application, notification, registration or licensing as established by the NNRA. The authorization presently can be in the form of notification, permit, certificate or licence. The NNRA issues the certificate of exemption, the certificate for premises, the licence to practise, the licence to import radiation sources, the permit to transport radioactive sources within the country and the licence to export radioactive sources. The validity of all forms of authorization expires on December 31 of the year of issuance. The authorization procedure involves the following stages:

(a) Notification/registration by a prospective user or importer in writing;
(b) Completion and submission of the Authorization Application Form, which demands specific answers to names of responsible officers, competencies of staff, state and manufacturer of equipment, sites of operation/storage, radiation protection programme, calibration records, waste disposal agreement and local rules; the submitted form is accompanied by the certificate of incorporation from the Corporation Affairs Commission, the certificate of registration with the appropriate trade regulatory body such as the Department of Petroleum Resources [5], and the Nigerian Medical and Dental Council [6];
(c) Programme for the security of radioactive sources during use, transportation and storage to prevent sabotage, theft, fire, flooding and unauthorized use;
(d) Evaluation of the submitted Authorization Form is carried out by the NNRA and the State Security Service within two weeks of receipt;
(e) Comments on the submitted Authorization Form are sent with notice of pre-authorization inspection of the premises and facilities of the registrant and transportation vehicle, where applicable;

(f) Pre-authorization inspection is carried out by two inspectors to confirm the submissions made and review of the application;
(g) Report of the inspection is submitted to the registrant with the advice to remedy inadequacies within a specified period of 6 to 12 weeks. A compliance inspection may be carried out;
(h) Issuance of the appropriate authorization for a specific period (usually 12 months) with specific terms and conditions;
(i) Copies of authorization are sent to the Comptroller-General of the Nigerian Customs Service, the State Commissioner of Police, the State Director of State Security Service and the State Commissioner of Health;
(j) Licensee informs the NNRA of the date of arrival of consignment or export.

3. INSPECTION

Inspection is one of the oversight functions of the NNRA. The NNRA conducts three types of inspection. Section 37(1) of the Act empowers the NNRA to appoint inspectors and inspect practices and installations licensed or proposed to be licensed by it. In this regard, the inspectors can enter without hindrance at any time during the normal working hours of the establishment concerned, into any premises, vehicle, ship or aircraft with such equipment as may be required for the performance of his duty as specified under the Act. Section 38 makes it a punishable offence for a prospective licensee to knowingly make a false or misleading statement to an inspector; or deliberately obstruct or hinder, or attempt to obstruct or hinder, an inspector carrying out his or her functions under the Act.

In addition to the pre-authorization inspection discussed in the previous section, the NNRA also carries out an audit inspection of the various practices. This is carried out on a peer review basis. It has helped to benchmark radiation safety in radiotherapy practice in the country. In carrying out the audit inspection, the team usually includes not only the staff of the NNRA but also representatives of the professional organization for that particular practice. The third form of inspection is carried out as part of an investigation, whenever there is a basis to do so, either from information arising from official reports from the licensee or from information from other sources. Examples of these are given in section 5.6. Usually, this type of inspection is carried out in the company of one or more security organizations.

4. ENFORCEMENT

Enforcement is yet another oversight function of the NNRA, which is usually carried out in collaboration with other regulatory bodies and sometimes with the co-operation of law enforcement agencies, such as the police and the security service. In this regard, the Act provides adequate empowerment for the enforcement of the law and, where necessary, imposition of sanctions.

Accordingly, Section 35 of the Act empowers the NNRA to suspend any authorized activity if, having regard to an inspection report submitted under Section 39 of the Act, the activity does not comply with the provisions of the Act, until the operator has taken appropriate corrective measures to ensure the safety of the workers and the public.

Additionally, Section 45 of the Act provides that any person who contravenes any of the provisions of the Act or does not comply with a limitation or condition subject to which he or she is registered, exempt or licensed under this Act, is guilty of an offence and liable on conviction to a fine or to imprisonment for a minimum term of not less than two years or more than 10 years, or to both such a fine and imprisonment. In addition, the NNRA may cancel, revoke or suspend any registration, exemption or licence that might have been effected or granted to the person.

Furthermore, any person who knowingly obstructs an authorized officer or inspector in the exercise of his or her functions is guilty of an offence and liable on conviction to a fine or to imprisonment for a term of not less than one year, or to both such fine and imprisonment. In the event that an offence under this Act has been committed by a body, whether corporate or not, is proved to have been committed with the consent or connivance of or is attributable to any act or default on the part of any person or persons in apparent control of the body, the person or persons in apparent control as well as the body shall be deemed to have committed the offence and shall be liable to be proceeded against and punished accordingly.

Sanctions have been imposed on three different organizations during the past 12 months, one each in the health sector, the petroleum industry and in a research establishment.

5. LESSONS AND EXPERIENCES

The lessons and experience of the NNRA over the past two years can be grouped into six sections: funding and independence; personnel and training;

retroactive authorization; inventory of sources; emergency response and enforcement.

5.1. Adequate funding and independence

The Act provides adequate independence with a Board of Governors comprising seven Federal Ministers and the President as the Chairperson, but this has turned out not to be very practical. The Board has not met in two years. Funding of the NNRA comes through the annual budget approved by the Parliament and, therefore, is subject to the capricious whims of the national economy. The first year of the NNRA in the national budget was 2002, but it turned out to be a year of undeclared austerity measures, during which capital grant was not released nationwide, while the recurrent grant was greatly reduced. Consequently, the recruitment and training of personnel could not be carried out.

5.2. Personnel and training

The first batches of staff recruited in the first quarter of 2002 were mainly fresh graduates from the universities. Over the past quarter of a century, Nigeria has trained a good number of cadres in the various fields of nuclear science and technology. Some of these experts participated in developing BIRRON but could not be recruited from the research centres because of budgetary constraints in 2002. Consequently, the training programme developed for the fresh graduates could not be executed, except through the IAEA's training courses, which are more effective for personnel who are already trained. Thus, the budgetary constraint of 2002 propagated into the quality of personnel and, therefore, into the efficacy and effectiveness of the NNRA.

5.3. Inventory of sources

In Nigeria, peaceful applications of nuclear energy are used in various sectors, including health, petroleum industry, mining industry, industry, education and research. In 2002, about one third of the country was covered, while the remaining part was to have been covered in the first half of 2003. This did not happen because of the budgetry challenges. Thus, the survey of all users of radiation sources in the country is still in progress. The completion of the inventory and the associated retroactive authorization of such practices remain a major challenge. Inventory of radiation sources is a veritable tool for radiation protection and security of radioactive sources. This is a major goal of

Milestone 1 of the Model Project. It is a necessary condition for an effective security system for radioactive sources. The software distributed by the IAEA, the Regulatory Authority Information System (RAIS), has not been found useful. The version of the software given to the NNRA has always had problems with units. Hence, retrieval of information has been tedious and cross-referencing has not been very practical. This is also a challenge.

To complement the survey exercise, in January 2003 the NNRA also contacted the embassies of some 10 countries for assistance. They were countries from which radioactive sources have been imported to Nigeria. The assistance sought was to use the good offices of the embassies to contact the respective national customs service for data on radioactive sources exported from their respective countries to Nigeria between 1995 and 2002. Unfortunately, only two embassies responded. The inventory and, therefore, the regulatory control programme have been greatly assisted through various international co-operation programmes, such as the IAEA Model Project. Similarly, the exchange of information between Nigeria and other African States (e.g. Ethiopia and Ghana) on the movement of radioactive sources has provided vital data for the inventory and strengthened the regulatory control. This arrangement, however, needs to be formalized at least in the West Africa subregion.

5.4. Retroactive authorization

The majority of the uses of radiation sources in Nigeria predate the Act and, therefore, the establishment of the NNRA. The only exceptions to this are the major facilities, such as the research reactor, gamma irradiation facility and the Van de Graaff accelerator. All these are still under construction and are gradually being brought under regulatory control. In spite of several newspaper announcements, most operating organizations still claim or feign ignorance of the law or of the NNRA. The NNRA has now embarked upon workshops and training courses for each sector of the economy. In this regard, two workshops were held in February and June 2003 for the health sector and the petroleum industry, respectively. This effort is yielding positive results, however, most practices are still not under regulatory control.

5.5. Emergency response

Without an adequate budgetary allocation and, therefore, an appropriate number and quality of staff, the NNRA had to respond to three emergency cases in the last two years. According to Section 27, the NNRA is empowered and directed to establish an intervention plan which shall deal with any foreseeable situation that could lead to the accidental exposure of workers or members of the public to nuclear material or to sources of ionizing radiation. Furthermore, the NNRA shall carry out exercises to demonstrate the efficacy of such planned countermeasures. In the same vein, the Act compels the operating organization to report immediately to the NNRA any emergency or accidental exposure to radiation. In addition, such incidents or accidents must be investigated by the operating organization and a full report of the investigation must be submitted to the NNRA. To date, there have been three cases of emergency calls to which the NNRA responded promptly. Furthermore, Section 6(h) empowers the NNRA to establish, in co-operation with other competent national authorities, plans and procedures which shall be periodically tested and assessed for coping with any radiation emergency and abnormal occurrence involving nuclear materials and radiation sources. There exists a National Emergency Management Agency (NEMA) [7], to which the radiological emergency shall be integrated. In fact, there is a 2001 draft National Disaster Response Plan, which is yet to be approved by Government. The NNRA is yet to develop a National Radiological Emergency Preparedness Programme (REPP), which will form an integral part of the National Disaster Response Plan.

In November 2001, the NNRA received one emergency call connected to a fire incident in a research facility that makes use of radioactive sources. The emergency incident was in a fixed facility and was, therefore, easier to manage. Similarly, in December 2002, the NNRA received another emergency call which was connected to the loss of control of radioactive sources. In the second case, the sources were itinerant and that made the incident difficult for the NNRA to handle. Hence, the NNRA invoked the Notification and Assistance Conventions by requesting the IAEA's assistance. The assistance was given.

5.6. Enforcement

From the foregoing, enforcement of the Act is adequately provided for through several measures, such as invalidation, suspension or revocation of authorization (Section 32), fine or imprisonment (Section 45). Some examples in this regard include the following:

(a) Based on a newspaper report in September 2001 [8], an audit inspection was carried out on a radiotherapy facility. After months of investigation, the facility was shut down to allow for repair work to be carried out. The Federal Ministry of Health, the owner of the facility, supported this decision. It should, however, be stated that after 10 months of closure, the radiotherapy facility has fully and satisfactorily complied with all the directives of the NNRA. In February 2003, the institution was granted full authorization to resume its practice. This is a major achievement of the regulatory control programme of the NNRA.

(b) An operating organization formally reported a fire incident which involved a building that housed two radioactive sources which were used in research. The incident was investigated by the NNRA to determine the integrity of the sources. The facility was shut down and taken over by the NNRA pending final decommissioning of the sources.

(c) A source was reported lost or stolen by an oil well/logging company. The case was investigated with the assistance of the IAEA. The search for the sources is ongoing. The operation of the company has been suspended.

(d) Radiological audit inspections were carried out in all five radiotherapy centres in the country, with a view to assessing their level of performance, radiation protection of patients and personnel, security of sources and emergency response. This exercise has provided a benchmark for radiation safety in the medical institutions in the country.

(e) An investigation was carried out at a radiotherapy facility on the basis of some concern over the clinical radiation dosimetry of the facility. The IAEA also assisted in the investigation. The facility has now been given a clean bill of health.

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Keynote Address

EUROPEAN FRAMEWORK FOR AUTHORIZATION, INSPECTION AND ENFORCEMENT FOR RADIATION SAFETY*

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1. GENERAL REMARKS

The European Framework for Radiation Safety is based on the Treaty establishing the European Atomic Energy Community, and in particular in its Articles 2(b) and in Title II, Chapter 3, of it.

While the European legislation provides for a binding framework as far as authorization, inspection and enforcement are concerned, the responsibility for implementing such European legislation corresponds to the member States.

The main European pieces of legislation on radiation protection are the following:

— Council Directive 96/29/Euratom, laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (OJ L 159, 29.6.96).
— Council Directive 97/43/EURATOM on health protection of individuals against the dangers of ionizing radiation in relation to medical exposure (OJ L 180, 9.7.97).
— Council Directive 90/641/EURATOM on the operational protection of outside workers exposed to the risk of ionizing radiation during their activities in controlled areas (OJ L 349, 13.12.90).
— Council Directive 89/618/EURATOM on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency (OJ L 357, 7.12.89).

* The views expressed in this paper are personal and do not necessarily reflect those of the European Commission.

— Council Directive 92/3/EURATOM on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community (OJ L 35, 12.2.92).
— Council Regulation (Euratom) No. 1493/93 on shipments of radioactive substances between Member States (OJ L 148, 19.6.93).

This existing framework will be completed soon with the ongoing proposal for a Council Directive on the control of high activity sealed radioactive sources (COM/2003/0018 final), for which the adoption procedure is ongoing.

2. AUTHORIZATION, INSPECTION AND ENFORCEMENT REQUIREMENTS

2.1. BSS Directive

This Directive requires that member States subject to a *reporting obligation*, at least, of all practices which involve a risk from ionizing radiation emanating from an artificial source, or from a natural radiation source in cases where natural radionuclides are or have been processed in view of their radioactive, fissile or fertile properties, the Member States have to put in place a system of authorization and reporting of a number of practices. Cases exempt from reporting because of non-radiological concern are identified in the Directive.

Under the BSS Directive, member States shall require prior *authorization* for the following practices:

— Operation and decommissioning of any facility of the nuclear fuel cycle and exploitation and closure of uranium mining;
— The deliberate addition of radioactive substances in the production and manufacture of medicinal products and the import or export of such goods;
— The deliberate addition of radioactive substances in the production and manufacture of consumer goods, and the import or export of such goods;
— The deliberate administration of radioactive substances to individuals and, insofar as radiation protection of human beings is concerned, animals for the purpose of medical or veterinary diagnosis, treatment or research;
— The use of X ray sets or radioactive sources for industrial radiography or processing of products or research of the exposure of individuals for

medical treatment, and the use of accelerators except electron microscopes.

In order to be authorized, the following tasks shall be ensured:

- Examination and approval of plans for installations and of the proposed siting;
- Acceptance into service of the installations;
- Examination and approval of plans for the discharge of radioactive effluents.

Disposal, recycling and reuse of radioactive substances or materials containing radioactive substances arising from any practice subject to reporting or authorization is also subject to prior authorization. Below certain 'clearance levels', member States can release these practices from such an authorization obligation.

The *justification principle* plays a key role in the authorization system. According to it, member States shall ensure that all new classes or types of practice are justified in advance of being first adopted or first approved by their economic, social or other benefits in relation to the health detriment they may cause.

As a matter of consequence, the deliberate addition of radioactive substances in the production of foodstuffs, toys, personal ornaments and cosmetics shall not be authorized, nor the import or export of such goods.

The BSS Directive provides for the establishment of a system or systems of inspection to enforce the provisions relating to the operational protection of exposed workers, apprentices and students in connection with practices. It also provides for such a system of inspection with regard to health protection of the population. Enforcement of the provisions of the Directive is a matter for the member States.

2.2. Medical Directive

Under the BSS Directive, medical applications of radioactivity are subject to authorization: the deliberate administration of radioactive substances to people and the use of X ray sets for the exposure of people for medical treatment.

The role of the justification principle in this context slightly differs from other practices.

— The general principle: all new practices involving medical exposure shall be justified in advance before being generally adopted.
— If a type of practice is not justified in general, a specific individual exposure of this type could nevertheless be justified in special circumstances to be evaluated (and/or decided) on a case by case basis.
— If an exposure cannot be justified, it should be prohibited.
— Special attention to justification of medical exposures where there is no direct health benefit for the person undergoing the exposure, and especially for 'medico legal exposures'.

The Medical Directive provides that member States shall ensure that a system of inspection enforces the provisions introduced in compliance with the Directive. It defines 'inspection' as an investigation by any competent authority to verify compliance with national provisions on radiological protection for medical radiological procedures, equipment in use or radiological installations.

2.3. Proposal for HASS Directive

The Proposal for a Council Directive on the control of high activity sealed radioactive sources (COM/2003/0018 final), adopted by the European Commission on 24 January 2003, supplements the existing legislation and aims at harmonizing and strengthening controls in place in the member States by setting out specific requirements ensuring that radioactive sources are always kept under control. Such an enhanced traceability of sources will reduce the risk of radioactive sources being misused, for example, for criminal purposes, and will prevent sources from becoming lost from regulatory control.

Main features of this proposal are the requirements concerning authorization, holding of records of sources and source holders, strict obligations for holders, source identification and marking, as well as provisions concerning orphan sources.

2.3.1. Authorization

The Proposal requires prior authorization for any practice involving a high activity source. Before issuing an authorization, the competent authorities shall ensure that arrangements have been made not only for the safe use of the source, but also for the proper management of the source when it becomes disused, which includes financial provisions. The authorization itself has to contain, at least, information on responsibilities, staff competencies, equipment criteria, emergency procedures, work procedures, maintenance of equipment, and disused sources management.

2.3.2. Records

The Directive focuses the control on holders of sources, and not on the sources themselves. It provides for the use of a standard record sheet to be kept by holders of sources with information on the holder, checks and tests performed on the source and on its transfer.

2.3.3. Obligations for holders

Holders of high activity sources are subject to the following obligations:

— Regularly verify that each high activity source is present at its place of use or of storage;
— Ensure that each fixed and mobile high activity source is subject to adequate measures to prevent unauthorized access to or loss, theft, fire and unlawful use of the source;
— Promptly notify to the competent authority loss, theft, unlawful use of a high activity source and any event, including fire, that may have damaged the source;
— Return or transfer each disused high activity source to a supplier or to a recognized installation unless otherwise agreed by the competent authority, without undue delay after termination of the use.

2.3.4. Identification and marking

The manufacturer shall identify each high activity source by a unique number. Each source must be accompanied by additional specific written information.

2.3.5. Orphan sources

The Directive proposes the following measures in connection with orphan sources:

— Assignment of responsibilities for adequate preparedness in the event of interventions following the detection of an orphan source;
— Identification of competent national bodies or points of contact where individuals suspecting that they are in the presence of an orphan source can rapidly obtain advice and assistance;

- Establishment of controls where orphan sources are most likely to appear, such as large metal scrapyards, major metal recycling installations or significant nodal transit points;
- Organization of campaigns for recovering orphan sources, or sources in danger of becoming orphan;
- Exchange of information between member States and international organizations (Art. 10);
- Financial guarantee for intervention costs on orphan sources (Art. 11).

Topical Session 7

AUTHORIZATION, INSPECTION AND ENFORCEMENT, AND INDEPENDENCE OF REGULATORY AUTHORITIES

DISCUSSION

HUA LIU (China): I take this opportunity to mention that in June the National People's Congress of China approved the Radiological Pollution Control Act, which will enter into force on 1 October 2003 and provides for strict regulation in nuclear and radiation safety. Pursuant to the Act, the National Nuclear Safety Administration will be responsible for inspections and other regulatory activities covering, inter alia, nuclear facilities, radiation facilities, uranium mining, NORM industries and radioactive waste management.

With a view to improving the safety of radioactive sources, the Chinese Government has decided to combine the responsibilities for radioactive sources of the Ministry of Public Health and the National Nuclear Safety Administration, establishing a single regulatory body for nuclear safety and radiation safety. From 1 January 2004 onwards, the National Nuclear Safety Administration will be the sole regulatory body in China responsible for licensing civilian nuclear installations and radioactive sources.

K. COY (Germany): In his presentation, S.B. Elegba mentioned the disappearance of two radioactive sources in Nigeria. Those two sources found their way, in a load of stainless steel scrap, to Germany, where they have been disposed of.

S.B. ELEGBA (Nigeria): We had received from Nigeria's security services a notification that the sources had found their way to Germany, and I am pleased that the notification has been confirmed by K. Coy.

In Nigeria there were intensive investigations — and even arrests — in connection with this matter, and our final report was considered not only by the Government but also by the President, who was interested in the matter because it pointed to a breakdown in the customs area.

While I have the floor, I should like to explain, in response to a question that I am often asked, how we have been dealing with the problem of radioactive sources that have been in Nigeria for some years without any form of control.

We wrote to ten countries from which we knew that radioactive sources had been exported to Nigeria, requesting information about all sources exported to Nigeria during the period 1992–2002. Unfortunately, we have received no replies from eight of them.

In addition, we have been in touch with the members of professional associations, such as the associations of industrial radiographers and medical radiographers, and they have provided us with useful information — at the risk of antagonizing their employers.

Furthermore, in newspapers we have requested information about, for example, factories that have been retrofitted or have changed ownership, in case radioactive sources have simply been forgotten in some storeroom there.

A.L. RODNA (Romania): When talking about the HASS (high activity sealed source) Directive proposed within the European Union, A. Janssens said that a sealed source was considered to be of high activity if it contained a radionuclide whose activity at the time when the source was manufactured or first put on the market exceeded 1% of the corresponding A_1 value in the IAEA's Transport Regulations. Is no account taken of the fact that the control over radioactive sources is usually lost when they are no longer in use, that is to say, after decay has substantially reduced their activity levels?

A. JANSSENS (European Commission): I do not know whether radioactive decay is taken into account in the definition of A_1 values. At all events, the values for determining whether a sealed source is of high activity are more restrictive than the values given in the IAEA's Categorization of Radioactive Sources.

A.L. RODNA (Romania): The commitment to safety on the part of the users of radioactive sources tends to decline with time. I should therefore like to know whether the Nigerian nuclear regulation authority issues authorizations for life or only for a limited period and subject to the results of a safety assessment.

S.B. ELEGBA (Nigeria): The authorization for the construction of a facility might not have to be renewed periodically, but authorizations for, say, the importation of radioactive sources would have to be, the importation of a new source being authorized only when we are satisfied that the source covered by the current authorization has been returned to its country of origin.

F.P. CARVALHO (Portugal): In the formulation of the HASS Directive, has account been taken of the possible accumulation of large numbers of sealed sources at particular locations, for example, during the refurbishment of buildings? A large number of sealed sources at one location could constitute a higher risk than the individual sources at different locations.

A. JANSSENS (European Commission): No account has been taken of that possibility.

F.P. CARVALHO (Portugal): There are terminological differences between Directive 96/29 (basic safety standards) of the European Commission and the inter-agency BSS. For example, the Directive speaks of “reporting” and “competent authority”, whereas the BSS speaks of “notifying” and “independent regulatory authority”. Can we look forward to a harmonization of terminology?

A. JANSSENS (European Commission): The terminology used in Directive 96/29 is essentially the same as in earlier Directives and thus derives from the time before the United Kingdom joined the European Community, when such documents did not exist in English. When the United Kingdom joined, the terminology was translated into English, and it has been kept unchanged ever since for the sake of consistency. We hope that everyone understands the terminology.

W. KRAUS (Germany): The title of this topic session refers to the “effectiveness and efficiency of the activities of regulatory bodies”. Does the European Commission intend to assess the effectiveness and efficiency of regulatory body activities, for example, by comparing the numbers of inspectors with the numbers of practices in different countries?

A. JANSSENS (European Commission): We intend to request from the European Union member States detailed information about their inspection regimes and how they handle the results of inspections. We hope that the information received will help us to assess the effectiveness and efficiency of the countries’ inspection regimes.

E.C.S. AMARAL (Brazil): In his presentation, A. Janssens spoke of the deliberate addition of radioactive substances in the production of, inter alia, foodstuffs being regarded as something that is not justified and that would therefore not be authorized. What about the radioactive substances that find their way into foodstuffs owing to the use of [chemical] fertilizers?

A. JANSSENS (European Commission): The key word is “deliberate”. The farmers applying [chemical] fertilizers are adding very small amounts of radioactive substances inadvertently — not deliberately.

That having been said, with the continuing use of [chemical] fertilizers over very long time periods, the concentrations of radioactive substances (for example, radium 226) could rise to seriously high levels. This is an issue about which some European Union member States have expressed concern and into which we intend to look in greater detail.

Rapporteur's Summary

AUTHORIZATION, INSPECTION AND ENFORCEMENT, AND INDEPENDENCE OF REGULATORY AUTHORITIES

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1. INTRODUCTION

The topics covered in Topical Session 7 were the following:

— Scope of comprehensive programme and practical implementation, including a graded approach to regulatory requirements;
— Licensing of cross-border situations;
— Quality assurance issues for regulators;
— Correct balance between enforcement and co-operation;
— Source inventory;
— Independence of regulatory bodies and how the need to develop a 'critical mass' of expertise may have an impact on this.

There were 23 contributed papers from 20 countries submitted to this session, as follows:

— Nine papers from eight African Member States: Angola, Cameroon, Egypt, Kenya, Libyan Arab Jamahiriya, Nigeria, Sudan (two), Tunisia;
— Seven papers from six Asian Member States: Indonesia (two), Kazakhstan, Malaysia, Pakistan, Uzbekistan, Yemen;
— Five papers from four European Member States: Czech Republic (two), Estonia, Ireland, Russian Federation;
— Two papers from two Central American Member States: Cuba, Nicaragua.

Since there are large differences in the amount and variety of radiation sources among individual countries and each of them has some specific features (see Tables I–III), a regional grouping of the submitted papers was selected in preparing the summary of the topics covered by this session.

TABLE I. MAJOR NUCLEAR FACILITIES, INSTALLATIONS AND RADIATION SOURCES IN MEMBER STATES PRESENTED IN TOPICAL SESSION 7

Member State	Type of radiation source														Remarks
	Power reactor	Research reactor	Mining and milling	Accelerator	Neutron generator	Neutron source (Am-Be…)	Large irradiation source	Tele-therapy	Brachy-therapy	Industrial radiography	Nuclear gauge	Large calibration source	Radwaste storage	Radwaste final deposition	
Angola			X					X							Gold mines
Cameroon								X		X	X				
Cuba								X	X	X	X				
Czech Republic	X	X		X	X	X	X	X	X	X	X	X	X		
Egypt		X		X	X	X	X	X	X	X	X	X	X		
Estonia	(X)			X			X	X	X	X	X		X		Under decommission
Indonesia		X		X		X	X	X	X	X	X		X		
Ireland				X			X	X	X	X	X		(X)		Not centralized
Kazakhstan	(X)	X	X	X	X	X	X	X	X	X	X	X	X		Under decommission
Kenya				X		X		X	X	X	X	X			
Libyan Arab Jamahiriya		X		X	X	X		X	X	X	X	X	X		
Malaysia		X	X		X	X	X	X	X	X	X	X	X		Mineral sand mill
Nicaragua								X	X						
Nigeria		X		X	X	X		X	X	X	X	X			
Pakistan	X	X		X	X	X	X	X	X	X	X		X		
Russian Federation	X	X	X	X	X	X	X	X	X	X	X	X	X		
Sudan			X	X	X	X		X	X	X	X	X	X		Phosphate mines
Tunisia				X		X	X	X	X	X	X	X			Phosphate mines
Uzbekistan						X	X	X	X	X	X				NORM
Yemen										X	X				

2. SCOPE OF COMPREHENSIVE PROGRAMME AND PRACTICAL IMPLEMENTATION, INCLUDING A GRADED APPROACH TO REGULATORY REQUIREMENTS

2.1. African Member States

As indicated three years ago (see [1]),[1] the infrastructure for radiation protection was largely inadequate in the following eight countries of the Africa region: *Angola*, Benin, Burkina Faso, Gabon, Liberia, Mali, Senegal, Sierra Leone. Some form of infrastructure was formally in place in the following eight countries: *Cameroon*, Côte d'Ivoire, Democratic Republic of the Congo, Mauritius, Niger, *Nigeria*, Uganda, Zimbabwe; however, the regulatory programme was still to be established or was inadequate for the types of practices used. Main reasons for such a situation were then identified as:

— Institutional instability;
— General infrastructural weaknesses;
— Inadequate support at the decision making level;
— Changes in national development programme priorities;
— Lack of or limited incentives for career development, resulting in a high turnover of staff already trained;
— Inability to solicit and allocate the necessary resources to recruit and/or retain specialists.

Since then, within the framework of the IAEA's technical co-operation programme, the situation in countries such as Angola (CN-107/103 — in the CD-ROM), Cameroon (CN-107/87 — in the CD-ROM) and Nigeria (CN-107/112 — in the CD-ROM) has substantially improved.

Angola is receiving human and technical assistance in order to build a national radiation protection infrastructure and legislation, and a national authority has been designated as responsible for co-operation with the IAEA.

Cameroon promulgated a radiation protection law early in 1995, with the assistance of the IAEA. Nevertheless, the process of establishing a national radiation protection infrastructure suffered a great delay due to difficulties associated with project management and lack of commitment by decision

[1] The comment referred to is in the contributed report on "Regulatory Infrastructure for the Control of Radiation Sources in the Africa Region: Status, Needs and Programmes", by K. Skornik (IAEA), presented at the International Conference on National Regulatory Authorities with Competence in the Safety of Radiation Sources and the Security of Radioactive Materials held in Buenos Aires, December 2000.

TABLE II. RADIATION SAFETY LEGISLATION IN THE MEMBER STATES PRESENTED IN TOPICAL SESSION 7

Member State	General law in force	Regulations to implement BSS	Remarks
Angola	In progress	In progress	Joined IAEA in 1999
Cameroon	Yes	Yes, in progress	New regulations in progress
Cuba	Yes	Yes	New regulations in progress
Czech Republic	Yes	Yes	
Egypt	Yes (old)	Set of regulations exist	Update of regulations is needed
Estonia	Yes	Yes	New regulations in progress
Indonesia	Yes	Yes	New regulations in progress
Ireland	Yes	Yes	1996 European Union Directive implemented in Irish Law
Kazakhstan	Yes	Yes	New regulations in progress
Kenya	Yes (old)	Set of regulations exists (old)	Revision of the law and regulations in progress
Libyan Arab Jamahiriya	Yes	Set of several regulations and codes of practice	Update in progress to comply with BSS since 2001
Malaysia	Yes	Yes	New regulations in progress
Nicaragua	Yes	Yes	New regulations in progress
Nigeria	Yes	Yes	New regulations in progress
Pakistan	Yes	Yes	New regulations in progress
Russian Federation	Yes	Yes	
Sudan	Yes	Yes	New regulations in progress
Tunisia	Yes (old)	Set of several regulations and codes of practice	Revision of the law and regulations in progress
Uzbekistan	Yes	Yes	New regulations in progress
Yemen	Yes	Yes	

makers. Notwithstanding, the country participation in AFRA activities and the strengthening of technical co-operation with the IAEA have allowed significant progress, highlighted by a recent decree creating the regulatory authority for radiation protection (NRPA) which will house the system for notification, authorization and the control of radiation sources in the country.

A similar process took place in Nigeria, where legislation on nuclear safety and radiation protection was promulgated in 1995, providing for the establishment of the national nuclear regulatory authority (NNRA); this goal was achieved in 2001. Both milestones were attained with the assistance of the IAEA.

Presently, the IAEA technical co-operation Model Project for Upgrading Radiation Protection Infrastructure offers the appropriate framework for facing common challenges for these countries, such as staffing regulatory authorities with qualified personnel; completing the legal framework with regulations and guidelines relevant to different issues; planning human resources development; making operational the radiation protection specialized services; securing the supporting budget; identifying national needs; elaborating action plans for training; fostering strong co-operation with other relevant national authorities; and completion of the inventories of radiation sources and retroactive authorizations.

With regard to the other African countries presenting papers at this session, namely, Egypt (CN-107/77 — in the CD-ROM); Libyan Arab Jamahiriya (107/93 — in the CD-ROM); Kenya (CN-107/35 — in the CD-ROM); Sudan (CN-107/5 and 29 — in the CD-ROM) and Tunisia (CN-107/46 — in the CD-ROM), all of them have a radiation protection law in force and have enacted regulations which follow the principal requirements of the International Basic Safety Standards (BSS). They also have a system for notification, authorization and control of radiation sources, although in some cases the systems are not fully operational or are at their early stages. Challenges to be met include lack of co-ordination between licensing committees (i.e. Ministry of Health and Atomic Energy Authority in Egypt); insufficient funding and lack of trained personnel (i.e. control of industrial radiography in Sudan).

TABLE III. ELEMENTS OF RADIATION PROTECTION INFRASTRUCTURE IN THE MEMBER STATES PRESENTED AT TOPICAL SESSION 7

Member State	System of notification, authorization, inspection and enforcement	Cross-border situations	Quality assurance issues for regulators	Correct balance between enforcement and co-operation	Source inventory	Independence of regulatory bodies
Angola	In progress	Past war problems	No	No mention	In progress	In progress
Cameroon	In progress	No mention	No	In progress	In progress	Yes
Cuba	Yes	Yes	In progress	Yes	Yes, in completion	Yes
Czech Republic	Yes	Yes	Yes	Yes	Yes	Yes
Egypt	Yes	No mention	No	No mention	No mention	Partial, concurrent
Estonia	Yes	Yes	Mentioned for licensees	No mention	Yes	Now, partial; in future, yes
Indonesia	In advanced progress	No mention	Mentioned for licensees	Yes	No mention	Yes
Ireland	Yes	No mention	Yes (ISO)	Yes	Yes	Yes
Kazakhstan	Yes	No mention	No mention	No mention	Yes, problems with RAIS	Partial concurrent
Kenya	Yes	Yes	Mentioned for licensees	Yes	Yes, almost completed	Now, partial; in future, yes
Libyan Arab Jamahiriya	In progress	Yes	No mention	No mention	Yes	Now, partial; in future, yes

TABLE III. ELEMENTS OF RADIATION PROTECTION INFRASTRUCTURE IN THE MEMBER STATES PRESENTED AT TOPICAL SESSION 7 (cont.)

Member State	System of notification, authorization, inspection and enforcement	Cross-border situations	Quality assurance issues for regulators	Correct balance between enforcement and co-operation	Source inventory	Independence of regulatory bodies
Malaysia	In progress	No mention	No mention	No mention	No mention	Now, partial; in future, yes
Nicaragua	Yes	No mention	Mentioned for licensees	Yes	Yes	No
Nigeria	Yes	Yes	No mention	Yes	In progress, problems with RAIS	Yes
Pakistan	Yes	No mention	No mention	Yes	In progress	Yes
Russian Federation	Yes	Yes	No mention	No mention	Yes	Yes
Sudan	Yes	Yes	Mentioned for licensees	Challenges to solve	In progress	No
Tunisia	Yes	No mention	No mention	No mention	Yes	Yes
Uzbekistan	In progress, concurrent	No mention	No mention	No mention	No mention	Concurrent
Yemen	Yes	No mention	No mention	No mention	Yes	Yes

2.2. Asian Member States

An assessment carried out by the IAEA [2][2] showed that, by 1996, 14 Member States in Asia did not have an adequate radiation and waste safety infrastructure, in general, and a basic regulatory infrastructure, in particular. (The 14 Member States in Asia are Bangladesh, Jordan, Kazakhstan, Lebanon, Mongolia, Myanmar, Qatar, Saudi Arabia, Sri Lanka, Syrian Arab Republic, United Arab Emirates, Uzbekistan, Viet Nam, Yemen.) Since then, these countries have been participating in the Model Project with the primary objective of establishing or upgrading their basic regulatory infrastructure.

Assistance was provided at a later time by the IAEA, through the new regional project, National Regulatory Control Framework and Occupational Radiation Protection, to those countries which did not complete the establishment of a regulatory framework or to those that were not participating in the Model Project, and for which establishment/strengthening the basic regulatory infrastructure had either been requested by the Member State or identified by the IAEA. Kazakhstan (CN-107/8 — in the CD-ROM); Uzbekistan (CN-107/25 — in the CD-ROM) and Yemen (CN-107/14 — in the CD-ROM) have substantially improved their regulatory activities by elaborating specific legislation and establishing competent authorities. On the other hand, international co-operation from other Member States, by providing expert services and hosting on-the-job training, scientific visits and training courses, was a major contribution to this progress.

A similar process took place in Malaysia (CN-107/57 — in the CD-ROM), Indonesia (CN-107/67/96 — in the CD-ROM) and Pakistan (CN-107/72 — in the CD-ROM), where activities involving ionizing radiation in medicine, industry, agriculture, research and education started 40 years ago, and regulatory control was entirely within the ministries of health or in institutions developing nuclear technologies. However, the rapid expansion of these activities highlighted the need for enhancing such a regulatory control, for instance, by adopting and introducing relevant measures to comply with the BSS. At present, essential elements of a regulatory infrastructure, that is, regulation, licensing and inspection systems, are in place in these countries. When necessary, assistance from the IAEA for maintaining and improving these capabilities is required.

[2] The comment referred to is in the contributed report on “Regulatory Infrastructure in East and West Asia: Present Status and Perspectives”, by B. Djermouni (IAEA), presented at the International Conference on National Regulatory Authorities with Competence in the Safety of Radiation Sources and the Security of Radioactive Materials held in Buenos Aires, December 2000.

2.3. European Member States

Among the four European countries presented at this session, Estonia is the only one which has been participating in the Model Project, as well as in regional and inter-regional projects aimed at establishing an effective legal framework and upgrading its radiation protection infrastructure for adequate regulatory control of the radiation sources used in medicine and industry in the country (CN-107/31 — in the CD-ROM). As a member of the former Soviet Union, Estonia's regulatory control was within the ministries responsible for health care or welfare. At present, a system of notification, authorization, inspection and enforcement is in place, involving several institutions. Recently drafted legislation will designate the Ministry of the Environment as the national regulatory authority.

In a similar context, since 1996, a national infrastructure has been created in the Russian Federation in order to develop, approve and enforce obligatory standards and rules, to license radiation practices, to survey and inspect radiation safety, and to develop and implement protective measures for the population and the environment (CN-107/94 — in the CD-ROM). This comprehensive system is fully coherent with the internationally recognized recommendations in this field.

Another two European Member States, the Czech Republic (CN-107/75 — in the CD-ROM) and Ireland (CN-107/113 — in the CD-ROM) have achieved significant progress in the field of radiation protection during the last ten years. Presently, the radiation protection infrastructure in both countries fulfils recognized international standards governing nuclear and radiation safety.

Within the framework of a comprehensive legal system, in the Czech Republic, an independent regulatory body covers all aspects of the assessment of safety (i.e. authorization, inspection and enforcement) in nuclear power plants, research reactors, uranium industry, radioisotope production facilities, and medical and industrial uses of ionizing radiation.

Similarly, the primary legislation governing safety in uses of ionizing radiation in Ireland provided for the establishment in 1992 of the regulatory body with its corresponding functions and powers. In 2000, previous regulations were consolidated and, in particular, the 1996 European Union Directive was implemented in Irish law, which sets out basic safety standards for the protection of the health of workers and the general public against deleterious effects of ionizing radiations. The scope of activities covered by the regulatory system includes industrial, medical, educational and research uses of radioactive substances and irradiation devices.

2.4. Central American Member States

Contributed papers from two countries of Central America (as a part of Latin America) were selected to be presented at this session: Cuba (CN-107/48 — in the CD-ROM) and Nicaragua (CN-107/102 — in the CD-ROM).

Regarding Cuba, it is worth mentioning that for more than 20 years, the country has been making efforts for strengthening the national infrastructure for radiation safety. Significant progress was achieved as a result of such efforts, mainly in the last ten years, with the establishment of the legal and regulatory framework, the formation of human resources, the introduction and authorization of new practices and the establishment of technical services in the area of radiation safety. Recently, late in 2002, the regulatory authority requested that an external audit be conducted for evaluating its effectiveness under the terms of the IAEA-TECDOC-1217 Assessment by Peer Review of the Effectiveness of a Regulatory Programme for Radiation Safety [3]. As a result of such an audit, the Cuban regulatory programme was considered to be in an early stage of the operational phase. Issues requiring improvement were identified, including the following:

- Complementing the legal regulatory framework by approving Safety Rules and Safety Guides for practices and services;
- Implementing a QA programme for the regulatory authority;
- Improving the database for regulatory control;
- Implementing a licensing process of personnel involved with the use of ionizing radiation;
- Developing a strategy for informing the public;
- Improving the co-operation mechanisms with other national regulatory authorities and implementing appropriate procedures;
- Acknowledging gradually the competence of the technical services provided in the country in the area of radiation safety, in conformance with the relevant rules and guides to be approved.

Technical assistance projects with the IAEA are being carried out for fulfilling these issues and visible progress has recently been noted.

Finally, the establishment of a radioprotection infrastructure in Nicaragua is an example of how the strong support of the IAEA, international co-operation and co-ordinated efforts among national institutions could reverse a situation of extreme weakness in the radiation safety field in a ten-year period. The scope of activities to regulate is mainly related to the use of radiation sources and devices in diagnostic medicine and radiotherapy. The use of radioactive sources in industry and education is also contemplated.

At present, the legal framework and the regulatory authority are in place; specific regulations based on international standards were approved, and licensing and enforcement systems show significant progress.

The process has faced and still faces challenges, such as:

- Co-ordinating the participation of several national institutions in the regulatory authority;
- Calibrating national reference equipments;
- The lack of some international standards in Spanish;
- The need to achieve a technical level to implement the routine measurements.

On the other hand, recommendations from peer review missions are highly appreciated, as well as on-the-job training and equipment provided by the IAEA.

3. LICENSING OF CROSS-BORDER SITUATIONS

The issue of licensing imported/exported radioactive sources, as well as its detection at cross-borders, was raised by most of the Member States presenting papers at this session. It was clearly recognized that such an issue is closely linked to the safety and security of radiation sources.

Illicit trafficking of radioactive materials was also recognized as a problem of growing magnitude for the control of transboundary movement of radiation sources. Therefore, the licensing process and the cross border control of nuclear and radioactive materials necessarily involve several national institutions, i.e. regulatory authorities, customs offices and security forces. The need for close co-ordination among all of them was acknowledged.

In particular, the Czech Republic described the procedures for the seizure of radioactive materials recommended by the national regulatory authority (CN-107/76 — in the CD-ROM). Such a document is mainly intended for customs officers, fire brigades, security forces and persons handling secondary raw materials and municipal waste.

Several situations involving the transportation of radioactive materials (i.e. sources for industrial radiography, industrial control gauges or medical applications) across borders were described. Generally, licensing in the case of such movement is made in collaboration with the licensing counterpart in the country into which the radioactive material is being exported to.

On the other hand, some countries presented difficulties in the licensing process of imported radiation sources due to poor performances of customs officers, and lack of experience in developing and improving licensing forms and applications in order to be more restrictive and informative.

Consequently, some Member States expressed the need for technical assistance from the IAEA in order to strengthen their infrastructure for monitoring radioactive materials and for the detection of illicit trafficking at borders. Such assistance should include guidelines, training on the job and proper detection systems.

4. QUALITY ASSURANCE ISSUES FOR REGULATORS

Several contributed papers related to this session mention the application of quality assurance (QA) or quality management (QM) requirements to licensees or operating organizations by regulatory bodies. Nevertheless, only a few of them explicitly mentioned having adopted a similar approach to QA in their regulatory bodies or initiated its implementation. However, it is worth mentioning that even in those institutions where a QA/QM system is not in place, the management practices that they perform generally have implicit QA features, such as established procedures for authorization, inspection or enforcement.

The development and application of QA to regulatory activities for effectively and efficiently fulfilling the requirements of its mandate should be encouraged. In this regard, publications from the IAEA (see Refs [4, 5]) give information and good practices, as well as identify the functions that support and control activities which are essential for the regulator to successfully perform its main functions.

On the other side, it is generally accepted that an external qualitative assessment of the performance of regulatory bodies is useful, since regulatory oversight improves the performance of licensees.

5. CORRECT BALANCE BETWEEN ENFORCEMENT AND CO-OPERATION

Several contributed papers made reference to this issue, showing that their regulatory authorities are empowered by law to enforce requirements set in legislation, regulations and authorizations, as well as imposing sanctions for non-compliance. Although, in general, enforcement actions are prescriptive, comprising informal or formal instructions, restriction or revoking of licences and legal prosecution — accordingly to the seriousness of the non-compliance — an attitude towards persuasive, but firm, communication with the licensees and stakeholders is taking pre-eminence among the regulatory authorities. In doing so, regulatory actions are moving from a policing approach to an advisory and consensus building one.

Nevertheless, some difficulties in the relationship between regulatory authorities and licensees, particularly in cases where foreign companies were involved, were described. Furthermore, examples of unsuccessful enforcement processes due to budgetary and human resource constraints were also presented.

6. SOURCE INVENTORY

A general consensus on the need for having an updated national inventory of radiation sources was shown in the contributed papers to this session. Such an inventory of sources, as well as the corresponding inspection procedures, were deemed a necessary condition for an effective security system for radioactive sources. Most Member States have such an inventory in place while the rest of them showed visible progress in its implementation.

Experience concerning the implementation of the software distributed by the IAEA (RAIS) in some Member States, through its Model Project, was described. This will allow the upgrading of such software in order to make it useful when large amounts of sources must be dealt with.

Furthermore, a standardized format for the national registries, as well as a labelling system used worldwide for radioactive sources were recognized as useful tools for the retrieval and cross-referencing of information among Member States. Assistance from the IAEA and other international co-operation were also considered necessary to achieve these goals.

7. INDEPENDENCE OF REGULATORY BODIES

Effective regulatory functioning requires the implementation of essential prerequisites. Statutory independence is one of them; regulatory authorities need to be effectively independent of governmental or private organizations that promote the use of nuclear technology or are in charge of the operation of nuclear installations. On the other hand, regulatory bodies need to be provided with financial means and human resources according to their duties and responsibilities. This involves having sufficient qualified and well trained personnel.

Fulfilling both prerequisites presents an evident challenge to most of the Member States at this session which have independent regulatory bodies designated by law, or are progressing in such a direction, and need to develop a critical mass of expertise.

In some cases, mainly for developing countries, partial concurrent responsibilities among institutions is the adopted scheme, while in others, promotional and regulatory functions co-exist in the same institution. Both positive and negative experiences related to this issue were described by contributed papers at this session (i.e. Nicaragua and Egypt).

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Round Table 3

IMPROVING NETWORKING FOR SHARING EXPERIENCES AT THE NATIONAL AND INTERNATIONAL LEVELS

DISCUSSION

Chairperson

J. LOCHARD
France

ROUND TABLE 3

J.R. CROFT (United Kingdom): Like colleagues such as J. Lochard, R. Czarwinski and C. Lefaure, I have spent a lot of time in recent years helping to establish databases.

In the United Kingdom, the Ionizing Radiations Incident Database (IRID) has been established primarily in order to provide the regulatory authority with feedback in the form of write-ups on incidents and to bring together information that can be used directly as training material. You will find in IRID over a hundred write-ups, most of them not exceeding one page in length. The write-ups do not mention the names of the people, institutions or companies involved in the incidents — they simply describe what happened and spell out the lessons learned. They are available on the web site *www.irid.org.uk*.

A similar database, called RELIR, has been established in France (in French), and the IAEA has RADEV (the Radiation Events Database), which contains information on approximately 200 radiation events. The IAEA is going to make the RADEV software available to Member States so that they can create their own databases.

Of course, if you wish to convey information to, say, a Greek industrial radiographer, that information will probably have to be in Greek. We are therefore exploring, within the framework of a project called EURAIDE, the possibility of bringing together information about radiation incidents and having it translated into various European languages with the help of members of various ALARA networks.

SEONG HO NA (Republic of Korea): We are developing a database on occupational exposures, drawing on the experience gained with the International System on Occupational Exposure (ISOE). We are prepared to make our database available regionally or globally once it is ready.

S. MUNDIGL (OECD/NEA): Perhaps I should explain that the ISOE, a joint initiative of the IAEA and the OECD/NEA, at present covers only workers at nuclear power plants (NPPs) — not workers at other facilities. It covers nearly 400 NPPs and is in effect an international information exchange network for NPP radiation protection managers, who meet once a year in the United States of America or Europe and discuss matters such as job planning and how best to make NPP workers contribute to reducing the occupational radiation doses which they incur.

The ISOE could serve as an example for information systems regarding the radiation doses incurred in areas such as mining and industrial radiography.

G. MORKUNAS (Lithuania): When we started creating the network which I am co-ordinating, I thought the task would be much easier than it turned out to be. In particular, I thought that people from the countries participating in the Model Projects under way in our part of the world would be keen to join the network, but problems arose as soon as the time came to conclude formal agreements, so that it took longer than I expected to bring together a critical mass of sufficiently active people.

In that connection, I would like to emphasize that, in my view, a country does not have to wait until it has strong radiation safety infrastructure before starting to participate in a network. In fact, participation in a network may help to strengthen the radiation safety infrastructure.

I believe that our success has been due to the material and moral support of, inter alia, the IAEA and the European ALARA Network, and to the dedication of a number of people in a number of countries who are convinced that networks like the one which we have created are absolutely essential.

M. MARKKANEN (Finland): Databases on radiation incidents are very useful but in Finland, and many other countries with small populations, the number of radiation incidents occurring annually is very low. We have, therefore, not yet established such a database.

Instead, in an annex to an annual report on radiation practices, we included a table briefly describing the radiation incidents that occurred during the year in question and spelling out the lessons learned. The report is sent to all licensees, who therefore do not have to consult a database.

That having been said, a database is a useful tool in a country where many radiation incidents occur.

HUA LIU (China): In my view, in addition to a database on radiation incidents, you need a publication that tells the media how serious the incidents were — perhaps with a scale like the International Nuclear Event Scale (INES).

J. LOCHARD (France): I agree. Anyone can access the web site of, say, the European ALARA Network, and may be alarmed by what is stated there in our specialized jargon. A radiation incident scale might help to put things into the right perspective as far as the general public is concerned.

H. UMEZAWA (Japan): I would welcome the creation of a network of the regulatory authorities in IAEA Member States, the aim being to ensure that the information exchanged is correct.

J.R. CROFT (United Kingdom): Regarding the comment just made by Hua Liu, I would recommend great caution to anyone thinking of expanding INES to cover events other than nuclear events.

A.J. Al-KHATIBEH (Qatar): In Qatar we have radiation workers from about 30 other countries, and in authorizing them to work, we encountered a problem due to the fact that in many cases we were not sure about their qualifications; some of the workers had only a few days' training, while others had undergone training lasting weeks or even months. We decided to authorize those who had been authorized by the regulatory bodies in their home countries but when we wrote to what we thought were the regulatory bodies, we often received a reply to the effect that the organization to which we had written was not the regulatory body and could not help us. In my view, a database on national regulatory bodies would help to solve that problem.

I believe that some of the other problems encountered by regulatory bodies in developing countries like Qatar could be solved through networking. In particular, networking would enable recently established regulatory bodies to learn from the experience of regulatory bodies that have been in existence for many years.

G.A.M. WEBB (IRPA): The most important thing about networking is not the databases that may be created but the contacts which take place between people. Through such contacts you can often discover who knows the best way of solving your particular problem.

IRPA encourages networking through the establishment of radiation protection societies in different countries or regions. This presupposes that in a particular country or region there are, say, 10 to 20 radiation protection professionals willing to make the effort necessary for running the society's activities, for example, the organization of meetings on issues of importance for that country or region.

Regional radiation protection societies are obviously easier to establish in regions where there is a widely spoken common language, for example, Spanish in Latin America and Central America. In that connection, perhaps thought should be given to the establishment of three societies covering Africa and West Asia — one operating in English, one in French and one in Arabic.

M. PRENDES ALONSO (Cuba): You can establish an excellent database, but there may well be countries which do not possess the information technology necessary for accessing it. Perhaps the IAEA could help such countries through its technical co-operation programmes.

G. MORKUNAS (Lithuania): That is an important point. When I approached a radiation professional from one country with an invitation to join the network which I am co-ordinating, he said that he did not have a computer in the building where he was working.

N.A. DROUGHI (Libyan Arab Jamahiriya): Some three to four years ago, many of us filled out questionnaires through which the IAEA was seeking information about radiation protection experts in different countries. Presumably, the information provided by us found its way into an IAEA database. However, none of us has been called upon by the IAEA to undertake missions, to run training courses or to act as lecturers, so we are left wondering what criteria the IAEA applies when hiring experts.

C. LEFAURE (France): Further to what G.A.M. Webb said about networking, I would emphasize that it relies on the commitment and enthusiasm of volunteers. For example, all members of the Steering Committee of the European ALARA Network are volunteers — and I spend, on a voluntary basis, about six months a year on co-ordination and other activities connected with the European ALARA Network.

Against that background, I would also emphasize that the European ALARA Network and similar networks need material support from organizations such as the IAEA.

V. CHUMAK (Ukraine): In this context, I should like to mention the EURADOS database, which is primarily a database for the exchange of scientific knowledge. Unfortunately, EURADOS is probably heading for difficult times, as an agreement with the European Commission through which it has been receiving material support is due to expire soon. Perhaps this conference could express at least moral support for EURADOS.

G. GEBEYEHU WOLDE (Ethiopia): The sustainability of radiation safety infrastructures depends to a great extent on organizational learning, and organizational learning depends to a great extent on the network of relationships which the radiation protection institution maintains internally and externally. Thus, there is a close link between sustainability and networking.

A. SALMINS (Latvia): In my opinion, the IAEA's TC PREFS database is a very useful source of information about, for example, experts and training facilities.

M. BAHRAN (Yemen): I would welcome the establishment of a network that links Arabic speaking radiation protection experts. The existence of such a network might have helped us earlier this year, when the Arabic speaking radiation protection experts whom the IAEA was supposed to provide for a training course in Yemen proved — at the last moment — not to be available. The IAEA did not know of any other Arabic speaking radiation protection experts, since a network of the kind I am advocating does not exist.

M.S. ABDULLAH (Yemen): Much of the information which we would like to see conveyed through databases would be very useful to people at the working level, but many of these do not have access to the Internet. In fact, some of them may never have touched a computer in their lives.

Consequently, I suggest that the IAEA select information from different databases and incorporate it into its training packages. That would also help to overcome the language barrier faced by many people at the working level, since the training packages are available in a number of languages.

A. McGARRY (Ireland): When joining a network, you need to think not only about what you may gain but also about what you will have to contribute. Networking is not a one way process.

In a network, the pattern is usually one of people in more advanced countries sharing their experience with people in less advanced countries, in order that the latter may learn from that experience. In sharing our experience with people in less advanced countries, however, we have found that we also learn from them. The advantages of joining a network may not be immediately obvious to people in a more advanced country, but they should nevertheless join.

C. HONE (Ireland): Many developing countries now have sound regulatory frameworks in place, and the questions to which they would like to obtain answers through networking are very practical ones, such as, "Should the users of small sources, for example, dentists, be subject to individual monitoring?"

K. COY (Germany): Further to what S.B. Elegba and I said in Topical Session 7 about the two radioactive sources that disappeared in Nigeria, I think it might be quite useful to have a database on lost and found sources. At the same time, I am aware of the risk of such a database being accessed by undesirable individuals.

S.B. ELEGBA (Nigeria): The Nigerian Regulatory Authority reported the disappearance of the two sources to the IAEA's Emergency Response Centre, which informed contact points all around the world. So, there may not be a database on lost and found sources, but networking certainly occurred with regard to the two sources.

A. DELA ROSA (Philippines): We have considerable networking within our country, and as part of the networking operation, we organize conferences at which we familiarize the users of radioactive sources with safety standards, codes of practice and so on. At the most recent such conference, the focus was on radioactive source security.

S.B. ELEGBA (Nigeria): Further to A. Dela Rosa's comment, I would emphasize that networks do not have to be international. One can have very useful networks within countries, within organizations and within professions, and one should not wait for the IAEA to assist in establishing them.

M.L. PERRIN (ISO): Sharing experience is an important aspect of the development of ISO standards, which are developed on the basis of consensus among experts who are from many different countries and are working in science, industry or business.

M. RODRIGUEZ MARTI (Spain): I think that networking within Latin America and between Latin America and Spain could be very beneficial, and I would like to see the IAEA promoting such networking through the provision of financial and technical support.

M. PRENDES ALONSO (Cuba): Radiation protection institutions that have little experience can benefit from networking with ones that have more experience, but they can benefit even more from formal co-operation with such institutions. We have benefited greatly from formal co-operation with institutions in France, Spain, Sweden and the United Kingdom.

G. MORKUNAS (Lithuania): When establishing an international network, it may be a good idea to restrict it initially to regulatory bodies, expanding it only later to include people, such as radiation safety officers and radiation workers. With regard to the inclusion of radiation workers, however, one must bear in mind that they may be uneasy about bringing their problems to the notice of regulatory bodies.

I take this opportunity to say to the countries of central and eastern Europe which have not joined the network I am co-ordinating that it is very easy to join. Our constitution is very democratic, and the long term benefits could be substantial.

PERFORMANCE EVALUATION

(Topical Session 8)

Chairperson

I. OTHMAN
Syrian Arab Republic

Keynote Address

PERFORMANCE INDICATORS FOR ASSESSING THE EFFECTIVENESS OF NATIONAL INFRASTRUCTURES FOR RADIATION SAFETY

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Abstract

A two-level quantitative assessment scheme for the national radiation safety infrastructure is proposed. It provides a comprehensive, concise and immediately comparable overview of the infrastructure for radiation safety in a number of countries. The scheme consists of a generic grading of performance indicators, a set of infrastructure components and assigned parameters that are assessed. This quantitative assessment scheme has been used, on a trial basis, to evaluate a number of national infrastructures for radiation safety based on information available in the IAEA. On the basis of this limited trial, it is concluded that the scheme will provide a valuable quantitative assessment tool that meets its objectives. It is also suitable to assist in clarifying the objectives of the Model Projects.

1. BACKGROUND

1.1. International programmes to strengthen national infrastructures for radiation safety

By its Statute, the IAEA is authorized to establish or adopt safety standards for the protection of health and the 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 it. In addition, the adequacy of health and safety standards established by a Member State for handling and storing materials and for operating facilities is a prerequisite for approval by the Board of Governors of the IAEA of any assistance project that involves sources of ionizing radiation (Article XI.E.3 of the Statute).

An adequate radiation safety infrastructure is the major precondition for complying with the requirements of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (known as the BSS) [1]. For more than four decades, the IAEA has been assisting its Member States in establishing and improving their radiation safety infrastructure. As a result, safety infrastructures and general awareness on safety issues have been improving over time. However, some Member States of the IAEA still lack adequate radiation safety infrastructures compatible with the BSS. To improve this situation, in a proactive and integrated manner, the IAEA has established and is implementing an integrated radiation safety strategy.

An essential step in implementing the radiation safety strategy has been the IAEA's technical co-operation Model Project on Upgrading Radiation Protection Infrastructures, which commenced in 1994. Within the Model Project, milestones were defined to facilitate in a systematic and harmonized way the setting of priorities, the timing and monitoring of progress and the optimization of resources. The Board of Governors of the IAEA, in 1999, recommended the adoption of the Model Project approach for other national and regional projects on radiation and waste safety.

Other international organizations have also recognized the importance of an adequate radiation safety infrastructure. For example, the Committee on Radiation Protection and Public Health (CRPPH) of the OECD/NEA discusses national approaches to the setting of regulatory priorities in radiation protection, and the European Commission supports relevant activities of its new member States to assist the implementation of the European Union Directives regulating radiation protection.

1.2. The basic problem of infrastructure assessments

A sharp boundary between technical requirements to ensure radiation protection on the one hand, and demands for an adequate infrastructure for radiation safety on the other, as the precondition to meet these technical requirements, does not exist. Whereas in the BSS the Principal and Detailed Requirements mainly refer to *what* has to be done to ensure radiation safety (technical issues), the Preamble deals with *how* this could be achieved, i.e., the meaning of a national infrastructure is explained and essential requirements for the infrastructure are formulated. In Safety Standards Series No. GS-R-1 [2], requirements for the regulatory infrastructure as the most important part of a national infrastructure have been laid down. Thus both Standards contain the most important requirements for the whole radiation protection system in a country.

Figure 1 demonstrates the resulting difficulty for any assessments of a national infrastructure from an international viewpoint. The whole system of radiation protection covers activities of the users (‘legal persons authorized to conduct the practices’) that bear the ultimate responsibility for radiation protection and safety, of the regulatory authority(ies) and of the needed services. It is difficult to separate the assessment of the national infrastructure from the other parts of an assessment of the whole radiation protection system and its functioning in a country. This is mainly because the assessment of the infrastructure has to cover both the establishment of structures and rules and their implementation.

The assessment of the capabilities and activities of the regulatory authorities clearly belongs to an infrastructure assessment. Most of the assessment of the availability and activities of the services is also part of an infrastructure assessment. Problems arise mainly with the user level. An international organization, such as the IAEA, can never be in a position to obtain a direct overview of the actual operational provisions for radiation and waste safety in a Member State. This is because it can never conduct a representative evaluation of the quality and effectiveness of these provisions over a whole country, i.e., for a representative number of users. A compromise that can be

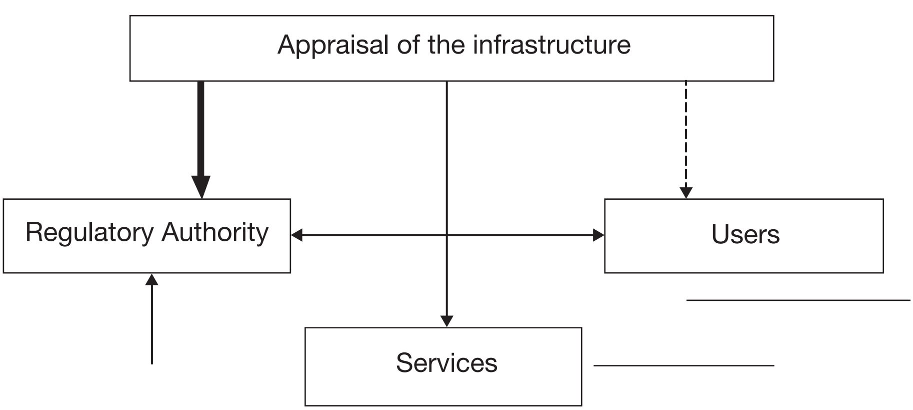

FIG. 1. Appraisal of the infrastructure in the system of radiation protection.

achieved is to place emphasis on assessing the safety provisions from a regulatory authority viewpoint and to undertake only spot checks of the implementation of the provisions with selected users.

For example, an assessment of operational radiation protection programmes as part of the infrastructure needs to reflect the activities of the regulatory authority in ensuring that such programmes are in place and are compatible with national legislation and regulations, and that their implementation is checked by inspectors. Such an approach is even more difficult in areas such as medical exposure, where the gradual implementation of the BSS requirements is regarded as having a higher priority than the establishment and performance of the regulatory infrastructure. It is clear that any infrastructure assessment needs to reflect such limitations.

As a general conclusion to these considerations, a clear scheme of an infrastructure assessment does not exist, and its details depend on the purpose, extent and level of the international programme for which the infrastructure assessment is carried out.

2. OBJECTIVES

2.1. Existing assessment tools

Numerous performance indicators, performance criteria and other assessment tools have been used in the IAEA (peer reviews, expert missions, visitors from the Secretariat, working meetings, etc.) for the judgement of parameters of a national radiation safety infrastructure. Often performance is assessed via a simple yes/no classification as used in the questionnaires forming a part of many of the IAEA appraisals. For example, in IAEA-TECDOC-1217, a comprehensive checklist is published to assist in assessing the effectiveness of a regulatory programme for radiation safety [3]. In spite of striving for objectivity, it has been very often observed that too much subjectivity is associated with an assessment of the overall effectiveness of the regulatory programme, and thus in the determination of the progress made in implementing the safety infrastructure in a Member State. Although the yes/no classification for detailed questions is certainly objective, a significant level of subjectivity is still connected with any attempt to summarize the findings, because of the lack of any quantitative assessment technique.

The presently available, sometimes complex and extremely detailed, assessment tools serve specific purposes within the different units of the IAEA, where they are applied with a degree of flexibility and subjected to a continuous further development.

2.2. Need for a two-level assessment scheme using quantified performance indicators

There is a need for a simpler and more concise, but nonetheless comprehensive and precise assessment scheme for the radiation safety infrastructure. It should provide for a clear, comprehensive and realistic description of the status of the radiation safety infrastructure in a particular Member State and, moreover, it should make possible a direct comparison of the infrastructure status in different Member States. It does not need to be totally consistent with the existing assessment tools, but it must not be inconsistent with them and may be used in parallel. This assessment scheme should be quantitative.

A set of *infrastructure parameters* has to be identified that is comprehensive and sufficiently differentiated. Quantifiable *performance indicators* should measure the achieved level of each parameter. For this assessment, an *assessment criterion* for each parameter has to be established which reflects the relevant requirements in the BSS, other international safety standards and associated, relevant IAEA publications. The level of detail of these parameters and thus of the related performance indicators should approximately correspond to that of the Country Radiation and Waste Safety Profiles (CRWSPs), used at present in the IAEA as a tool which provides for a non-quantitative description of the level of the radiation safety infrastructure of a country.

In addition, there is a need to recognize how far the requirements of the BSS relevant to a particular Member State are met and how this changes with time. For this purpose, a more concise quantitative measure of the progress in developing and implementing the essential components of the radiation safety infrastructure in a Member State would be of value. For this less detailed level, the relevant infrastructure parameters have to be combined to a limited number of *infrastructure components* which, analogously to the performance indicators, should be assessed by means of *component indicators*.

Thus, the principal objective is to develop a quantitative assessment scheme consisting of two parts:

— A generic scheme of performance indicators (PI) used to indicate the level to which an established assessment criterion is met. A unified grading scheme enables the general level of compliance with the criterion to be numerically quantified.
— Establishment of a scheme of infrastructure components and the related infrastructure parameters. For each parameter an appropriate assessment criterion should be defined. This is the basis for the grading of the PI. The grading of the component indicator (CI) should follow the same pattern.

However, the CI should not be assessed by means of an assigned criterion but should be unambiguously calculated from the relevant PIs.

The grading of the PIs for each identified infrastructure parameter is the decisive assessment step for the quantitative appraisal of the radiation safety infrastructure. By assessing the achieved level of compliance with the requirements for all infrastructure parameters, a fairly good reflection of the status of the whole infrastructure should be obtained.

The simplified assessment of the CIs is not a real appraisal but only the summary of the PI assessment for administrative purposes. Therefore, the CIs have to be unambiguously derived from the PIs, preferably by a defined calculation leading to an analogous grading.

3. THE QUANTITATIVE ASSESSMENT SCHEME

3.1. Infrastructure components and parameters

For the purpose of this paper, and to ensure adequate consistency with what has been done in the past, the structures of the CRWSPs and of the milestones in the Model Project have been combined into the following nine radiation safety infrastructure components (a set of infrastructure parameters belong to each component and their number is given in brackets):

(1) Regulatory framework (7)
(2) Activities of the regulatory authority (10)
(3) Control of occupational radiation exposure (6)
(4) Control of public radiation exposure (3)
(5) Control of medical radiation exposure (5)
(6) Safety of radioactive waste management (6)
(7) Transport safety (4)
(8) Radiation emergency preparedness (3)
(9) Education and training (4)

At the moment, 48 infrastructure parameters altogether have been identified. It should be emphasized that new parameters can be established at any time if necessary, i.e., their number can change. The number of the components should be stable.

As an example, the parameters of the first three components are given in Table I.

3.2. Assessment criteria, performance indicators and assessment guidance

For each parameter of each component of the radiation safety infrastructure, an assessment criterion is formulated and this equates to full compliance with the BSS, other international safety standards and associated relevant IAEA publications, as appropriate to a Member State. In this document, compliance with the BSS always means compliance with the full package of safety standards and associated publications. As examples, the assessment criteria for three parameters in Table I are given:

— *Radiation safety regulations:* A system of national radiation safety regulations, codes of practice and guides has been established. These regulations cover administrative and technical requirements that suit the nature and extent of the facilities and activities to be regulated and are compatible with the safety requirements in the BSS, other international safety standards and associated, relevant IAEA publications.
— *Notification and authorization:* The notification and authorization system of the regulatory authority is fully operational and covers all practices and sources.
— *Individual monitoring for external radiation:* One or more dosimetry services are available and are operating to a satisfactory standard including the use of typetested dosimeters, adequate quality management systems and performance testing. These services are agreed by the regulatory authority, or approved by it according to rules established by the Member State, or are independently accredited. They provide needed dosimetry to all relevant workers.

All PIs are classified in a grading scheme that indicates the level to which the assessment criterion is met. The general levels of compliance are shown in Table II. This graded scale of compliance with the assessment criterion provides a transparent and quantified assessment of the progress in achieving compliance with the assessment criterion for each infrastructure parameter.

Very often the application of this generic grading scheme is difficult. Therefore, for each parameter appropriate 'assessment guidance' has been developed, ensuring that the grading is carried out as unambiguously and uniformly as possible by different assessors. The assessment guidance can be understood as a kind of standardization of the assessments even if it is not possible to include all situations that may be met in practice.

The comprehensive assessment guidance cannot be described here, but one example may explain how it is used. For the parameter 'radiation safety

TABLE I. AN EXAMPLE OF THE PARAMETERS FOR THREE INFRASTRUCTURE COMPONENTS

Regulatory framework	Activities of the regulatory authority	Control of occupational radiation exposure
Legislation Radiation safety regulations Regulatory authority: establishment and independence staffing funding Co-ordination and co-operation at the national level International co-operation	Notification and authorization Inventory of sources Inspection and review (complementary monitoring) Enforcement Assessment and verification of operational radiation protection and safety programmes Safety and security of sources Control of orphan sources Technical services availability Communication with the public Quality management system	Individual monitoring for external radiation Calibration of monitoring instruments for external radiation Individual monitoring and assessment of intakes of radionuclides Workplace monitoring Assessment of individual exposure to natural radiation Central dose record keeping for external and internal exposure

TABLE II. PERFORMANCE INDICATOR GRADING SCHEME (GENERIC LEVELS OF COMPLIANCE)

PI grade	Description
3	Assessment criterion is fully met
2	Assessment criterion is not fully met — an action plan* is being implemented to fully meet the criterion
1	Assessment criterion is partially met — actions are underway to make improvements
0	Assessment criterion is not met — no significant efforts are being made to improve the situation

* The term ‘action plan’ denotes a series of planned actions that are intended to be completed within a defined time frame.

regulations', the following instructions regarding the grading of the PI are given:

— PI 2: BSS compatible regulations are in place to cover the most hazardous and most frequent practices and an action plan is implemented to achieve full compliance with the criterion.
— PI 1: Many BSS compatible regulations are in place, but no plan is implemented nor are efforts underway to achieve compliance with the criterion, or one of the following:
  - Old regulations are in place which provide an acceptable standard of protection, but no plan is implemented nor are efforts underway to achieve compliance with the criterion;
  - Many regulations are not BSS compatible and the standard of protection is not adequate, but efforts are underway to achieve compliance with the criterion;
  - No regulations are in place, but the preparation of BSS compatible regulations is underway.

3.3. Calculation of the component indicators and weighting factors

The complete set of graded PIs serves as a comprehensive assessment of the radiation safety infrastructure and the gradual implementation of the BSS. However, as explained in section 2.2., there is a need to easily follow the development of the essential components of the radiation safety infrastructure in different countries, to assess as simply and rapidly as possible how far the requirements of the BSS relevant to a particular Member State are met, and to be able to compare roughly the achieved progress of the radiation safety infrastructure (administrative level of performance assessment).

For this purpose, it will be beneficial to indicate the overall performance achieved for a particular infrastructure component by combining the performances of the more detailed parameters. The achieved level of compliance for each specified infrastructure component should be characterized by a 'component indicator' (CI). Such an assessment should be, to the extent practicable, as simple as possible, and the assessment of each component should be quantifiable like the assessment of the PI for each of its parameters and should be unambiguously derivable from the assessed PIs.

The simplest approach is to calculate the arithmetic mean of the graded PIs. If there are n graded PIs (p_i), the related CI amounts to:

$$CI = \frac{1}{n}\sum p_i$$

Example: There are 6 PI (p_i) graded as follows: 3, 2, 3, 1, 3, 0.

Then the overall level of compliance is characterized by a CI = 12/6 = 2.

However, there is further detail to consider. The PIs that contribute to the average assessment of a component characterized by a CI are often not equally important, or even not relevant for a particular Member State at a particular stage of its development, and should be differently weighted. Therefore, a *weighting factor* for each PI according to the relative significance of an infrastructure parameter within the infrastructure component, characterized by a CI, may be used. Thus the CI is a weighted average of the PIs. For example, if a particular infrastructure parameter is not relevant, the attached weighting factor may be 0. Infrastructure parameters of 'standard' importance within the component may be assigned a weighting factor of 1. If an infrastructure parameter seems to be of greatest (or least) importance, a weighting factor of 2 (or 0.5) could be assigned to it.

The weighting factors can be established arbitrarily (that means that their sum does not have to equate to 1) as long as the CI is calculated according to the following formula from the PIs (p_i) and the attached weighting factors (w_i):

$$CI = \frac{\sum p_i \cdot w_i}{\sum w_i}$$

Example: 6 p_i, graded 3, 3, 1, 0, 1, 2, attached w_i chosen as 2, 1, 2, 1, 0, 2.

CI = 6+3+2+0+0+4/ 8 = 15/8 = 1.86; CI=1.9

(This CI demonstrates a rather high level of compliance because in the example, two PIs that have a relatively low grading are assigned a low weighting factor.)

The example illustrates the point that the CI should only be calculated to the nearest single decimal point, since a greater level of accuracy is both unjustified and misleading.

3.4. Uncertainties and their implications

Despite the assessment guidance, there will inevitably be cases where the assessment of the level of compliance with the criterion is uncertain. This will most probably occur when insufficient information (and possibly, none) can be found in the documents available for the assessment, but may also result when the assessor has genuine difficulty in deciding on the most appropriate grading of the PI.

If no (or insufficient) information is available and a quantitative assessment is required, a default PI range of 0–3 (or 0–1, 0–2, 1–2, 1–3, or 2–3) should be assigned to the level of compliance with the criterion. Very often it will be possible to narrow down this range by a plausible judgement on the basis of other indirect information. When the information is complete but the assessor is having difficulty in deciding on a grading, a narrow PI range of 0–1, 1–2, or 2–3 can usually be assigned, in accordance with the uncertainty of the judgement.

Where uncertainties have caused a PI range to be assessed for a particular infrastructure parameter, this is meaningful, as illustrated by the following examples:

— The bottom end of the range is a measure of the minimum progress likely to have been achieved.
— The upper end of the range is a measure of the maximum progress that could possibly have been achieved, although if the range is wide it is not likely that such a high level of progress will actually have been achieved.
— A wide range indicates a high degree of uncertainty, probably because much information is missing. This indicates a need to improve the availability of accurate and definitive information from the country.
— A narrow range indicates that considerable (possibly indirect) information is available, or that the assessor is having difficulty in deciding on a grading.

Where uncertainties have caused a PI range to be assessed for one or more infrastructure parameters within an infrastructure component, this will lead also to a range being calculated for the CI. Such a CI range has the same meaningful implications as those discussed for the PIs.

In summary, a narrow range of high gradings indicates that most information relevant to the country is available and that the country's infrastructure is close to being fully implemented, and a narrow range of low gradings indicates that most information relevant to the country is available, but that the country's infrastructure is far from being implemented.

4. APPLICATION OF THE ASSESSMENT SCHEME TO THE MODEL PROJECT COUNTRIES

4.1. PI assessments from existing CRWSPs

Although the existing Country Radiation and Waste Safety Profiles (CRWSPs) and the underlying reports were written before the new assessment scheme was created, it was possible to use them for a PI assessment for the majority of Model Project countries by an expert group. Of course, due to the limited information, the ranges of uncertainty are expected to be quite high but this uncertainty will be significantly diminished in the future by a targeted information collection.

The calculated CIs allow an immediate comparison of the national infrastructures, and an identification of issues concerning where the future efforts of the programme should be focused. In Table III, the results of the CI ranges for some countries are given as examples (see section 3.1. for a discussion about CIs).

The countries are arranged in the order of their achievements. Whereas country I has already reached a satisfactory level, country IV is just at the beginning of establishing its infrastructure. As supposed, the uncertainty range is generally too high to allow a reliable and defendable assessment at the moment. More relevant information should be gathered. It is not surprising, either, that control of medical exposures (5), transport safety (7) and emergency preparedness (8) are less developed than other infrastructure components. The relatively high grading of the regulatory infrastructure (1+2) reflects the efforts in the first years of the Model Project

4.2. Clarification of the Model Project objectives

Five milestones have been set within the framework of the Model Project [4]. The primary, top priority Milestone 1 was set in order to meet, in each participating Member State, the minimum regulatory infrastructure. Milestone 1 is the most time consuming activity, and the attainment of this milestone is regarded as the primary indicator of progress by the Member State in meeting its project obligations. .

TABLE III. RANGE OF COMPONENT INDICATORS FOR FOUR MEMBER STATES

Country	Component Indicator								
	1	2	3	4	5	6	7	8	9
I	2.6 / 3.0	1.3 / 3.0	2.2 / 3.0	1.7 / 3.0	1.2 / 3.0	1.8 / 2.5	2.8 / 1.8	1.3 / 3.0	1.8 / 3.0
II	1.9 / 2.1	1.5 / 2.5	1.5 / 2.7	0.7 / 1.7	0.2 / 1.2	0.7 / 2.0	0.3 / 2.8	0.7 / 3.0	1.0 / 2.8
III	2.3 / 2.3	1.1 / 2.0	1.0 / 1.3	0.7 / 1.3	0.8 / 1.6	1.0 / 1.5	0.0 / 1.0	0.7 / 2.0	1.3 / 1.5
IV	0.7 / 1.3	0.1 / 0.6	0.2 / 0.8	0.0 / 0.3	0.2 / 0.4	0.0 / 0.0	0.0 / 0.3	0.0 / 0.0	0.0 / 0.3

In addition, four other milestones were set relating to compliance with the BSS requirements in four basic areas: Milestone 2 covers the establishment of occupational exposure control; Milestone 3 refers to medical exposure control; Milestone 4 is aimed at public exposure control (including management of radioactive waste); Milestone 5 covers emergency preparedness and response capabilities. The effectiveness of the systems to be attained by Milestones 2–5 is strongly dependent on the soundness of the regulatory framework (Milestone 1). Thus the work within the five milestones is interrelated.

The application of the proposed quantitative assessment scheme to the milestones of the Model Project requires a suitable assignment of the PIs to the milestones similarly to the infrastructure components. Accordingly, 'milestone indicators' can be calculated which characterize the overall achievements in a milestone. The five milestone indicators together reflect the status of a country achieved in conducting the Model Project.

It should be emphasized that the Model Project is aimed at attaining sustainability of the regulatory and other components of the radiation safety infrastructure. It is the responsibility of the Member State and not of the IAEA to implement the necessary national radiation safety infrastructure. This implies that full compliance with all the requirements of the BSS (i.e., PI 3) would not necessarily need to be achieved in an IAEA project such as the Model Project. Rather, in this project, the objective is for the activities of the Member State to achieve compliance with some minimum requirements which give reasonable assurance that full compliance with the BSS will be approached within an appropriate time frame. The assessment scheme can also be used to

TABLE IV. EXAMPLES OF MINIMUM REQUIREMENTS (AND ASSIGNED WEIGHTING FACTORS) TO INFRASTRUCTURE PARAMETERS WHICH BELONG TO MILESTONE 1

Infrastructure parameter	Minimum required PI	Weighting factor
Legislation	2	2
International co-operation	1	0.5
Enforcement	2	1
Inventory of sources	2	2
Quality management	1	0.5

clarify the objectives of the Model Projects with regard to each infrastructure parameter. In Table IV, proposed PIs as objectives to be achieved and weighting factors to calculate the milestone indicators are given for some parameters assigned to Milestone 1.

4.3. Assessment of the achievements and of the progress for each milestone

As discussed, the milestone indicator can be used to characterize the progress a country has made in conducting the Model Project. This is not sufficient to assess whether or not a country has reached a milestone. Reaching a milestone means that the required minimum levels of performance have been achieved for *all* the parameters in the milestone. In order to characterize the achievements of a country with regard to this criterion, another number is needed, namely, the *percentage of performance indicators that have reached the required minimum level of performance.* This number, in addition to the milestone indicator, needs to be considered for a complete evaluation of a country's progress within a milestone.

5. CONCLUSIONS AND OUTLOOK

The proposed quantitative assessment scheme provides a comprehensive, concise and immediately comparable overview of the infrastructure for radiation safety in a number of countries. The scheme is flexible, because it is possible to introduce new infrastructure parameters or to alter weighting factors at any time. However, provided any such additions or alterations are carefully controlled, the scheme also provides quantitative assessments with the needed stability as long as the components are not changed.

This quantitative assessment scheme has been used, on a trial basis, to evaluate a number of national infrastructures for radiation safety based on information from CRWSPs. On the basis of this limited trial, it is concluded that the scheme will indeed provide a valuable quantitative assessment tool that meets its objectives. It should be used in any missions concerning infrastructure problems in addition to the original task and assessment tools, thus allowing a fast and automatic update of the quantitative assessment.

In the future, the PI grading scheme might be used as a universal assessment scheme within the IAEA and thus permeate all assessments in many different areas of the work of the IAEA. If so, it would enable otherwise qualitative assessments to become predominately quantitative and so reduce the residual subjectivity of the outcome of the assessments.

ACKNOWLEDGEMENT

The authors are particularly thankful to A. Hudson and O. Ilarias, as well as to numerous colleagues in the IAEA Division of Radiation and Waste Safety, for the intensive discussions that have significantly contributed to the development of the ideas in this paper.

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Topical Session 8

PERFORMANCE EVALUATION

DISCUSSION

A.J. Al-KHATIBEH (Qatar): With regard to W. Kraus's presentation, I feel that the weighting factor scheme described by him could give a false sense of success in that a radiation safety infrastructure with no regulatory framework and no regulatory authority could score higher overall than one with a regulatory framework and a regulatory authority simply because it scored higher in respect of other infrastructure components. Perhaps one should compare only those infrastructures where there is a regulatory framework and a regulatory authority in place.

W. KRAUS (Germany): There could admittedly be countries where there is no regulatory system but, say, a high level of individual monitoring. The question then is "What is the purpose of the assessment that you wish to make and how do you use the assessment system described by me in order to achieve that purpose?"

The assessment system is applicable at any stage in the development of a radiation safety infrastructure. It could even be applied to the infrastructure of an advanced country like Germany, which would achieve less than the maximum score in respect of many infrastructure parameters.

E.C.S. AMARAL (Brazil): The title of W. Kraus's presentation was 'Performance Indicators for Assessing the Effectiveness of National Infrastructures for Radiation Safety'. In my view, however, the effectiveness of a national radiation safety infrastructure is indicated by things like the reduction achieved in the radiation doses received by workers or in the number of incidents involving radioactive sources, not by the existence of various infrastructure components.

The assessment system described by W. Kraus may be suitable for the Model Projects, but Brazil is not participating in the Model Projects, and the Model Projects are not the sole topic of this conference.

Note: The last 13 minutes of this topical session discussion were not recorded, resulting in the exclusion of several interventions.

A national radiation safety infrastructure could score low with the assessment system described by W. Kraus and still be very effective because, for example, it is run by well qualified people.

K. MRABIT (IAEA): I would emphasize that the assessment system described by W. Kraus is applicable to the radiation safety infrastructures not only of countries participating in the Model Projects but also of other countries. With other countries, you would simply use some different or additional parameters, for example, the reduction achieved in the radiation doses received by workers.

What we in the IAEA immediately need the assessment system for is the preparation of reports to our policy making organs on the progress of the Model Projects. We are using it this year — on a trial basis — for the first time, and it seems to be working well. However, as I just indicated, it could be used for assessing the radiation safety infrastructures of countries not participating in the Model Projects.

E.C.S. AMARAL (Brazil): Perhaps this discussion would not have arisen if the title of the presentation given by W. Kraus had more accurately reflected the nature of the assessment system which he described.

W. KRAUS (Germany): Perhaps the expression “performance indicators” in the title of my presentation was unfortunate, as is perhaps the title of this topical session: ‘Performance evaluation’.

K. SKORNIK (IAEA): Further to what K. Mrabit just said about our need for the assessment system described by W. Kraus, I would compare the assessment of radiation safety infrastructures to the judging of quality in gymnastics or figure skating competitions — ultimately, it is necessary to quantify. We have found the performance indicators in that assessment system to be very useful for that purpose, and I believe that they could also be used by regulatory bodies for self-assessment.

Regarding E.C.S. Amaral’s intervention, I do not think that the effectiveness of a national radiation safety infrastructure is indicated by, say, the reduction achieved in the radiation doses received by workers. This is an indicator of the performance of the employer — the licensee. It may reflect the enforcement capability of the regulatory body, which is an indicator of infrastructure effectiveness.

A.L. RODNA (Romania): In my view, there could be improvements as regards the weighting factors used in the system described by W. Kraus. Firstly, reference was made by W. Kraus to a zero weighting factor, which I think is nonsense. Secondly, I think it would be better to have percentages as weighting factors rather than the weighting factors in that system.

K. MRABIT (IAEA): Regarding A.L. Rodna’s point about a zero weighting factor, in a country where, say, no nuclear medicine procedures are carried out, it is appropriate to have a zero weighting factor for nuclear medicine.

Before we had the assessment system described by W. Kraus, we in the IAEA had to deal with the problem of subjectivity: one expert visiting a Model Project participating country would return with a certain picture of that country's radiation safety infrastructure and another expert would return with a very different picture. The assessment system makes it possible to reduce the subjectivity through quantification.

Perhaps "performance indicators" is not the right expression in this context, but we need an assessment system of the kind which W. Kraus described.

I. OTHMAN (Syrian Arab Republic): I would mention that some time ago, the IAEA's Standing Advisory Group on Nuclear Applications (SAGNA) called for quantification in the area of project performance assessment.

Rapporteur's Summary

PERFORMANCE EVALUATION

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The main issues discussed in most of the contributions submitted to this session were upgrading and improving the regulatory infrastructures by using different means, such as:

— Implementation of the IAEA Model Project.
— Making use of regional co-operation.
— Local activities guided by the IAEA Safety Standards and related documents.

Also presented in some papers were trials to reduce personal exposure to radiation due to some activities, as well as discussions about the mechanism of the existing national regulation.

The main features of each contribution are given below:

Uruguay: Uruguay has established a draft law of radiological safety to be reviewed by the Congress. At the same time, some basic regulations were issued by Ministerial Resolutions. Training programmes are being run to train regulatory staff. All these activities are undertaken within the IAEA Model Project.

Belarus: The authors presented the established national nuclear legislation which depends basically on the normative documents of the former Soviet Union and the IAEA Safety Standards.

Mali: The paper addressed the difficulties in establishing a national infrastructure within the implementation of the IAEA Model Project.

These difficulties included:

— The existence of different national authorities with overlapping responsibilities.
— Lack of training of the inspectors and users.
— The national authority acts as a regulator and a user at the same time.

Bangladesh: In Bangladesh, an Act was issued in 1993 and ISRC Rules were issued in 1997 which represent the legal basis for the control of ionizing radiation sources. The paper presented the mechanism to execute the Act and the Rules. Also presented were the obstacles encountered during the course of implementation of the regulatory programme.

United Republic of Tanzania: The paper addressed the exposure of radiation workers and how the annual doses were reduced by 23% in 2000 after applying ALARA principles. The importance of inspecting the quality of X ray machines and how they discovered that 80% of the machines were unqualified were also discussed.

Estonia: The paper reviewed the national legislation in Estonia during the period 1996–2002. Also presented was the implementation of the IAEA Model Project for training radiation personnel in medicine and for establishing a national system of authorization.

Philippines: The paper discussed the attempts to regulate the nuclear applications in the Philippines with the collaboration of the Regional Cooperation Agreement (RCA) for Asia. This agreement enabled the country to maintain a core of highly trained professionals in radiation protection. It was also stated that such regional co-operation was complementary to the Model Project.

Spain: Based on the abstract sent to the rapporteur, the paper presented actions taken to reduce the personal doses, the analysis of doses received during the period (1995–2002) and actions taken to implement the safety culture from manager to worker level.

Mexico: Given in this paper was an evaluation process to qualify the effectiveness and efficiency of the national regulatory body. Also presented were achievements of goals for the past years and co-operation with the IAEA through the International Regulatory Review Team (IRRT).

Yemen: This paper reviewed the Yemen experience to implement the IAEA system of notification, authorization, inspection and enforcement through the Model Project. The focus was on the establishment of a simple, powerful and cost effective system to ensure safety and security of radiation sources at the same time.

RAPPORTEUR'S COMMENTS

Topical Session 8 provided effective feedback from Member States concerning the mechanisms of applying the IAEA Safety Standards. The IAEA Model Project represents a common tool to upgrade the infrastructure of radiation protection, however, several remarks were made after a careful reviewing of all contributed papers. These remarks can be summarized as follows:

— In several Member States, the competent authority acts as a regulator and a user at the same time which might affect the credibility of enforcement.
— Local training in radiation protection is lacking or not adequate in some countries. It is recommended to encourage establishing regional programmes (by common language) to train trainees.
— Physical security of radiation sources has become an important issue. It needs more effort in order to establish an effective control system.

SOURCE SECURITY AND EMERGENCY PREPAREDNESS

(Topical Session 9)

Chairperson

C.L. MILLER
United States of America

Keynote Address

DEVELOPMENT OF APPROACHES TO THE SAFETY AND SECURITY OF SOURCES

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Abstract

Even prior to the terrorist attack of 11 September 2001, it was clear that there was a significant orphan source issue arising from the poor safety and security of radioactive materials around the world. The objective of the paper is to globally review, through a series of examples, the variable state of the existing source security arrangements and some of the driving forces and consequences. This will provide a background against which subsequent papers will develop emergency preparedness arrangements.

1. INTRODUCTION

The radiological accident in Goiânia, Brazil, in 1987 [1] provided something of a wake-up call on the potential serious consequences that can arise from the loss of control of radioactive sources. One of the positive outcomes from that accident was the start of a series of IAEA accident investigation publications that identified lessons to be learned [1–11]. Sadly, many accidents are still either not reported in the open literature or, in some cases, not even recognized.

Over the subsequent years, there was an increasing stream of reports of sources either ending up in the metals recycling industry with serious economic consequences from the smelting of sources [12]; or in the public domain resulting in serious deterministic effects, environmental and socioeconomic impacts. The IAEA identified that a key root cause globally was the lack in many countries of an effective regulatory infrastructure and a critical mass of appropriate radiological protection expertise. To address this, the IAEA developed the Model Project [13], and while there is clear progress, there is much to do.

The various issues were brought into focus at the international conference on the Safety of Radiation Sources and Security of Radioactive Materials in Dijon in 1998 [14]. Arising from this was the development of the IAEA's Action Plan to address the issues [15]. This was subsequently revised in 2000 [16]. The term 'orphan source' came into common usage, being defined as 'a source which poses sufficient radiological hazard to warrant regulatory control but is not under regulatory control, either because it never has been under regulatory control or because it has been abandoned, lost, misplaced, stolen or transferred without proper authorization'.

The Action Plan was structured around seven areas:

— Regulatory infrastructures
— Source management and control, including the management of disused sources
— Categorization of sources
— Response to abnormal events
— Information exchange
— Education and training
— International undertakings

Implementation of the plans included the organization of the present conference on national infrastructures and a preceding, similarly titled conference in Buenos Aires in 2000 [17].

Thus, even before the tragic act of terrorism of 11 September 2001, there was a significant programme of work in place to improve the safety and security of sources worldwide and to address the issue of orphan sources. To this now has to be overlaid the serious potential for terrorists to maliciously acquire radioactive materials and use them in some form of improvised radiological device. This is a significant change, in that historically the emphasis in respect of source security had been on preventing inadvertent access or loss of control. Now, however, there is the added dimension of deliberate challenges to source security by terrorists.

The objective of this paper is to review some of the threats that national infrastructures have to address in respect of (a) the safety and security of sources throughout their life; and (b) the detection of orphan sources and other abnormal events.

Subsequent papers will address various aspects of emergency preparedness arrangements that are needed to address the various threats.

2. 'FROM CRADLE TO GRAVE'

2.1. Full life-cycle

Figure 1 provides a simple overview of the full life-cycle of sources.

Reactor facilities for the major production of radioisotopes are limited to a small number of countries: Argentina, Belgium, Canada, France, the Netherlands, Russian Federation, South Africa and the United States of America [18]. These are largely under direct government control and hence can be the subject of focused security measures. The same is true for radioactive source manufacturers. However, there is a large number of equipment manufacturers who incorporate radioactive sources in their equipment before dispatching to customers. The equipment manufacturers are diverse and it would be prudent to treat them as being subject to the same challenges of the safety and security of sources as those described for users in sections 2.2. and 2.3.

2.2. Generic threats to source security

The causes for the loss of control of a source are many and varied. It may be due to a single catastrophic failure or, more commonly, a combination of events. Table I provides a list of some of the more common causes.

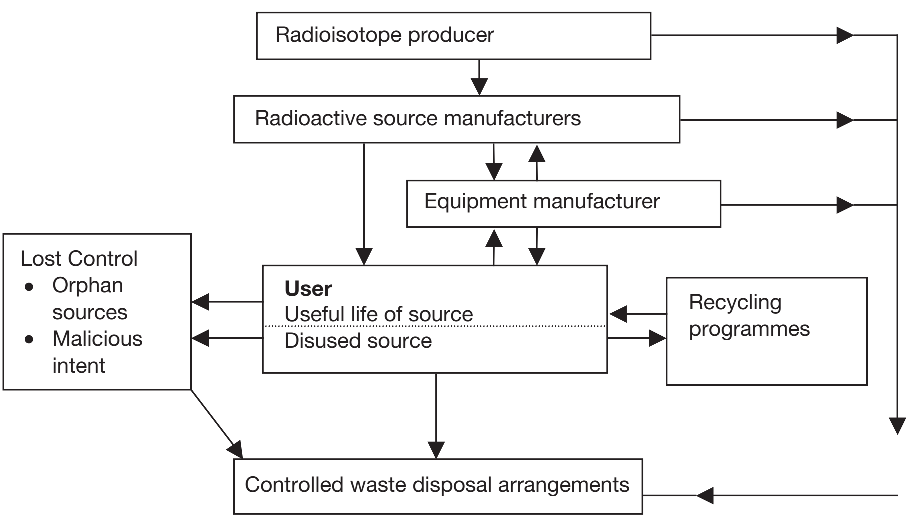

FIG. 1. Life-cycle of sources.

TABLE I. COMMON CAUSES OF LOSS OF CONTROL OF RADIOACTIVE SOURCES

Root causes

- Lack of or ineffective:
  - regulatory bodies
  - regulations
  - regulatory enforcement
- Lack of:
  - national radiation protection services
  - awareness or training of management and workers
  - commitment by management to safety
  - an effective radiological protection programme in the organization

Specific causes

- Lack of or inadequate:
  - prior risk assessment
  - security during storage, transportation and use
  - radiation surveys, e.g. failure to monitor after a g-radiography exposure
  - supervision
  - emergency preparedness plans
- Design or manufacturing fault
- Inappropriate maintenance procedures
- Human error
- Deliberate avoidance of regulatory requirements
- Abandonment
- Catastrophic event, e.g. fire, explosion, flood
- Theft
- Malicious act
- Loss of corporate knowledge due to:
  - loss or transfer of key personnel
  - bankruptcy
  - long term storage of sources
  - decommissioning of plant and facilities
- Death of owner
- Inhibitions to legal disposal, such as:
  - no disposal route available
  - export not possible
  - high costs of disposal

An effective regulatory infrastructure will incorporate measures to eliminate or minimize the above problems. However, it has to be recognized that it is not just a case of having an appropriate set of regulations. The regulators have to have an appropriate knowledge and skills base (in short, be trained) and need the support of a radiation protection infrastructure with a critical mass. By their regulatory enforcement programme, the regulators can set the tone of user compliance. Together with input from qualified experts (from the radiation protection infrastructure), this strongly influences the development of the safety culture among users. A safety culture is an intangible but readily recognizable characteristic that takes time to develop. The consequence is that, although many countries are making significant steps forward to develop a regulatory infrastructure, the development of a safety culture will lag behind, and threats to the safety and security of sources will remain an issue for some time to come.

Even mature regulatory infrastructures cannot completely eliminate the threats. Periodically, the effectiveness of the arrangements needs to be reviewed in the light of accidents and incidents that have occurred or might occur. One aspect of this might be to look at the possible threats through the life patterns of the use of sources. Figure 2 provides a schematic representation of one such approach. In section 3, examples are given of incidents and accidents that have arisen from the listed shortcomings.

3. EXAMPLES OF FAILURES IN SOURCE SECURITY

3.1. Illegal importation/purchase

In 1977, a 37 TBq ^{60}Co teletherapy unit was bought from a hospital in the USA by a hospital in Juarez, Mexico [17]. It was not imported legally and the authorities were unaware of it. The hospital did not have the resources to use it immediately and it was put into storage in a commercial facility without a clear indication of the hazards. The relevant senior staff member left the hospital. In 1983, a junior member of staff, who knew of its existence but had no knowledge of the hazard, removed it to sell as scrap metal. During transportation, the source was ruptured and some small source pellets scattered along the road. The source was smelted in a foundry and was only discovered when a lorry carrying contaminated products set off the alarms at the Los Alamos nuclear facility.

Some 75 people received doses between 0.25 and 7.0 Gy: 814 houses with activity in the steel reinforcing bars had to be demolished, several foundries

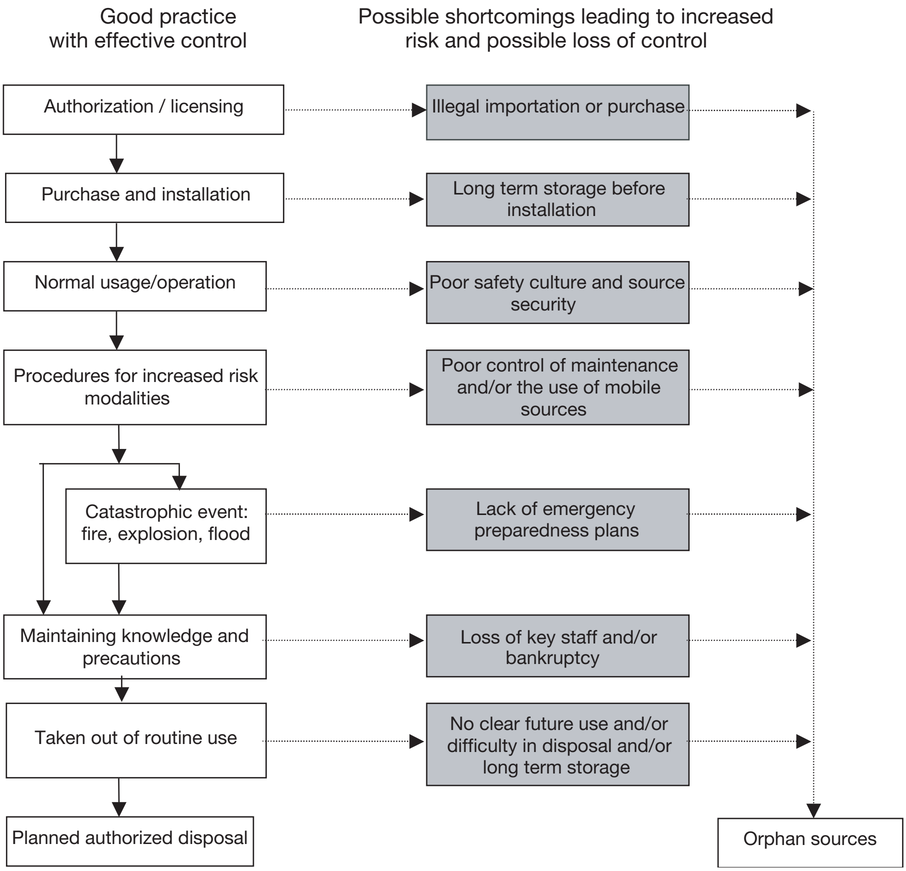

FIG. 2. Challenges to good practice.

required extensive decontamination and the waste generated amounted to 16 000 m^3 of soil and 4500 t of metal.

This accident provides an example of a combination of causes: illegal importation preventing regulatory oversight, together with long term insecure storage before use, and loss of key members of staff. Had regulatory oversight been possible from the start, that is legal importation and authorization, the other causes of the accident could have been prevented.

3.2. Normal usage

Table I includes many possible causes of loss of control of radioactive sources that provide challenges to source security during the normal usage of radioactive sources. Management commitment, training and overall safety culture are key elements in ensuring appropriate safety and security measures throughout the useful life of radioactive sources. However, there are many instances of good systems being introduced at the beginning of usage but not being maintained throughout the useful life of sources.

3.2.1. Brachytherapy sources in hospitals

There are different types of brachytherapy radioactive sources, ranging from 50–500 MBq ^{137}Cs sources, used in interstitial manual techniques, to 400 GBq ^{192}Ir sources used in remote afterloading techniques. A major radiotherapy unit could have several hundred brachytherapy sources that are continually being moved and manipulated. This provides an increased potential for failures in following procedures and sources to be lost. There have been many reported instances of such sources leaving hospitals in refuse, still implanted in patients or cadavers. To address this, countries often require hospitals to have installed radiation detectors at relevant exit points. Even so, there are still reported instances of sources being lost. Typically, this comes about from a combination of:

— Complacency by those manipulating the sources — ‘familiarity breeds contempt’ — leading to a failure to follow procedures;
— Poor maintenance of detector systems, either of the equipment itself or its positioning in what may be a changing environment;
— Lack of management oversight to recognize and address the problems.

3.2.2. Radioactive sources in the nuclear industry

Within a nuclear fuel cycle facility, a high profile is given to the security of nuclear material and fission products. The same may not always be the case for radioactive sources. Following a minor incident at a nuclear facility in the United Kingdom involving the security of a conventional radioactive source, the company carried out a review of the security arrangements for such sources. They found that for the over 2000 sources they had on-site, these arrangements needed improving, particularly in respect of keeping inventories up to date. Although all the sources were accounted for, many were in locations different from those the records showed, having been moved from one location to another for operational reasons. In locating all the sources, they realized that a visual image of each source or device was important. As a result, they now have a policy of having an electronic image of all their sources to supplement the inventory record and to facilitate finding a source were it to be lost.

3.3. Increased risk modalities

Some types of use provide increased challenges to source security. While maintenance of equipment is often an essential element of a radiation safety programme, it can also provide greater scope than normal usage for mishaps. This is because maintenance work often requires the overriding of installed safety systems or working in an environment where the operators may not be fully familiar with the local arrangements or hazards. If the work is not properly planned by well trained staff, the net effect has been, in some cases, that the radioactive source has been left in an insecure manner.

Another increased risk modality is that of mobile sources. Common examples are sources used for industrial radiography (see section 3) and those used in the oil exploration, mining industry and construction work for the determination of density, porosity and moisture or hydrocarbon content of geological structures or building materials. The sources in their containers are transported from site to site in cars or vans, and may be left overnight in the vehicle or temporary storage facilities that may not be secure. There have been instances of the vehicles (with the device in them) being stolen. The thieves may or may not recognize the significance of the contents, and often the devices with the radioactive sources in them are abandoned in public places.

3.4. Industrial radiography accidents

Industrial radiography is in widespread use, and has a high hazard potential. The construction of petrochemical installations, for example, will involve the use of portable radiographic sources of up to 5 TBq for testing welds in pipes and tanks. Some years ago, ^{137}Cs sources were used and some of these may still exist. Currently, sources will most often be ^{192}Ir or ^{60}Co, but ^{169}Yb, ^{170}Tm or ^{75}Se may also be used. The housings for these portable sources contain several tens of kg of shielding material, such as depleted U, Pb or W, which may be perceived as being potentially valuable. Also relevant is the fact that the portable nature of this equipment allows it to be used almost anywhere. Often this is in remote locations or under extreme working conditions. Couple this with often limited or non-existent supervision, and there is a real potential for entire containers with their sources to be lost or stolen. They can end up in the metals recycling industry or lay dormant in random locations in public places.

However, perhaps the most significant threat comes from loss of the source on its own. Most remote-exposure radiography source containers have the same general design. The source capsule is physically attached to a short flexible unit often known as a ‘source pigtail’. This is designed to be coupled, often with a spring assisted ball and socket joint, to a flexible drive cable. When not in use, the source is located in the centre of the source container. In use, a guide tube is attached to the front of the container and the source is pushed down it to the required position by winding out the drive cable. Poor maintenance, incorrect coupling, obstructions in the guide tube or kinking it can all lead to extreme pressures being placed on the various linkages and eventually to the source becoming decoupled from the drive cable. This poses an immediate threat to the radiographer who must monitor after every exposure to ensure the source has fully returned to the safe shielded position. Failure to do so has led to serious exposure of the radiographer and the source dropping out of the equipment unnoticed. To members of the public who find such radiography sources, they look like intriguing items and can easily be picked up and carried back to the family home, often with lethal effects, as illustrated in the following examples.

3.4.1. Morocco, 1984

In this serious accident, eight members of the public died from overexposure to radiation from a radiography source. A 1.1 TBq (30 Ci) ^{192}Ir source became disconnected from its drive cable and was not properly returned to its shielded container. Later, the guide tube was disconnected from the exposure device and the source eventually dropped to the ground, where a passerby picked up the tiny metal cylinder and took it home. The source was lost from March to June, and a total of eight individuals (the passerby, members of his family and some relatives) died; the clinical diagnosis was ‘lung haemorrhages’. It was initially assumed that the deaths were the result of poisoning. Only after the last family member had died was it suspected that the deaths might have been caused by radiation. The source was recovered in June 1984.

3.4.2. Yanango, Peru, 1999

In this accident [10], gamma radiography using a 1.37 TBq ^{192}Ir source in a remote exposure container was being carried out at the Yanango hydroelectric power plant in Peru. At some stage, the ‘source pigtail’ became detached from its drive cable. A welder picked up the source, placed it in his pocket and took it home. The loss of the source was noticed the same day and it was recovered within 24 hours. However, the dose received in this period was such that despite heroic medical treatment, the welder lost one leg and had other major radiation burns. His wife and children were also exposed, but to a lesser extent.

3.4.3. *Cairo, Egypt, 2000*

This was a very similar incident to the previous one. A farmer picked up a 3 TBq ^{192}Ir source, thinking it valuable, and took it home. On 6 May 2000, the farmer and his nine-year-old son went to their local doctor complaining of skin burns. The doctor prescribed medication for a viral or bacterial infection. The youngest son died on 5 June 2000 and the farmer on 16 June. On 26 June, a blood test was done on other family members who were showing similar symptoms. The blood test showed severe depression of the white blood cell count and radiation exposure was suspected. The source was located and recovered. Other family members were hospitalized. Four men were charged with gross negligence, manslaughter and unintentional injury because they had failed to notify authorities that the source, used to inspect natural gas pipeline welds, was not recovered after the job.

3.5. Challenging events

During the life of some sources, there may be some events that challenge the safety and security measures through abnormal situations, e.g., fires, flood, explosions, transportation accidents, etc. The first requirement is recognition that an event may have a source security implication. This should then lead to the triggering of appropriate emergency preparedness plans. The greater the delay in implementing the emergency preparedness plan, the longer there will be uncontrolled exposure and the greater area over which there may need to be searches for lost sources.

3.5.1. *Accident in San Salvador, 1989*

This accident [6] occurred in an industrial irradiation facility containing 0.66 PBq of ^{60}Co in the form of a source rack of two modules, each containing a number of source pencils. At the time of the accident, there was no relevant regulatory or radiation safety infrastructure and the country had been in a civil war for 10 years. The net effect was a degradation of the safety systems and the operators' understanding of radiation hazards. In the accident in 1989, three people gained entry to an irradiation chamber to free the source rack, whose movement to the safety of the water pit had been impeded by distorted product boxes. One person died and another had a leg amputated.

The occurrence was not recognized for two weeks, and during this time, damage to the source rack from the accident caused the source pencils to drop out. Most fell into the water pit, but one fell onto the floor of the irradiation chamber. It is pure chance that none fell into one of the product boxes that could have transferred them out of the facility. The installed monitor on the product exit, designed to detect such an event, had long since failed. Some six months after the accident, an IAEA team visited the plant to carry out an accident investigation. By that time, the source pencil from the irradiation chamber had been recovered and shielded by the supplier, but the other source pencils were still at the bottom of the water pit awaiting recovery. Importantly, no one had confirmed that the total inventory of source pencils had been accounted for and that none had left the plant. At the insistence of the IAEA team, an underwater photograph was taken to confirm that all the source pencils were accounted for.

3.5.2. Tammiku, Estonia, 1994

In this accident [2], a cylindrical radioactive source in a metal frame was found in a consignment of scrap metal imported to Tallin, Estonia. The source, with an activity of up to 7.4 TBq ^{137}Cs was thought to be just a small part of a seed irradiator (leaving the question open of where the rest of it was). In this case, the first part of the emergency preparedness plans worked, and the source was successfully recovered and taken to the national waste disposal facility. Unfortunately, this was just an underground concrete bunker with poor security. Three brothers broke into the facility and stole the source for resale as scrap metal. As a result, one brother died from radiation exposure and the other two brothers, plus two other family members, suffered significant deterministic effects.

The original find of the source in scrap metal imports had raised queries about other possible orphan sources being in Estonia and a Government Commission to assess the situation was set up. During its work, it found a 1.6 TBq ^{137}Cs source in a container that had been abandoned close to a main road in the countryside.

4. MAINTAINING KNOWLEDGE AND PRECAUTIONS

Over the useful life of a radioactive source, which may be decades, there can be challenges to keeping the corporate knowledge of the source security requirements or even of the existence of the sources. For example:

— The knowledge of the source security arrangements may be vested in one or two key members of staff, without it being properly covered in safety documentation or covered by management oversight. When those key members of staff leave, the source security arrangements will degrade.

— A sudden change in ownership can remove all corporate knowledge of the need for source security requirements. The accident described in the following section provides an example of the change of ownership of a facility between nations where knowledge was not passed on.
— Bankruptcy can also remove corporate knowledge. This can happen very suddenly with, in some cases, everybody walking away from the problem and leaving a derelict facility. Although the accident in Goiânia, Brazil described in the following section is not a case of bankruptcy, it has the same characteristics, e.g. abandonment of responsibility.

4.1. Lilo, Georgia

In 1992, with the break up of the former Soviet Union, the Soviet Army abandoned its former facilities in Georgia. One of these was a training camp in Lilo, which was taken over by the Georgian Army. In October 1997, 11 soldiers developed radiation induced skin lesions. A radiation monitoring search of the facility revealed 12 abandoned ^{137}Cs sources ranging from a few MBq to 164 GBq [3]. These had been used by the previous occupants in civil defence training, with the sources being hidden about the site and trainees having to find them. Many were still where they had been hidden. In addition, one ^{60}Co source and 200 small ^{226}Ra sources used on gunsights were also found on the site.

4.2. Goiânia, Brazil

In 1987 in Goiânia [1], a private medical partnership specializing in radiotherapy broke up acrimoniously. No one took responsibility for a 50 TBq ^{137}Cs teletherapy unit that was left in the partially demolished building of the former clinic. After two years, some local people dismantled the source and its housing, and removed it for scrap metal value. In the process, the source was ruptured. The radioactive material was in the form of compacted caesium chloride, which is highly soluble and readily dispersible. For over two weeks, the radioactivity was spread over parts of the city by contact contamination and resuspension. Contaminated items (and people) went to other parts of the country.

The recognition of the existence of the problem was triggered by an increasing number of health effects. Overall, some 249 people were externally contaminated and 129 internally; 21 people received in excess of 1 Gy and were hospitalized of which 10 needed specialized medical treatment, four of whom died. The decontamination and clean-up of the environment took six months of intensive effort and produced 3500 t of active waste.

In passing, it is worth noting that although not an example of terrorism, the Goiânia accident provides a good example of the possible consequences of the use by terrorists of an improvised radiation dispersal device.

5. DISUSED SOURCES

There are a number of similarities between the issues identified in the previous section and the problem of disused or spent sources. Both involve the loss of corporate knowledge or awareness of source security issues, but this section focuses on the end of life issues of radioactive sources. Perhaps the main characteristic here is that, at some stage, there has been a recognition that the sources, or the equipment they are in, have come to the end of their useful life or there is no clear future use for them. This can manifest itself in many ways, for example:

— The sources can simply be removed to storage on-site and, through lack of management, are not disposed of but simply left. Over time, the safety and security arrangements degrade until eventually control is lost and the source may end up in the public domain, especially the metals recycling industry. The accidents described in the following section provide significant examples of this.

— A variation on the above theme is that the sources are left in situ, e.g. in level gauges on a disused part of a petrochemical facility. Eventually, when that part of the plant is demolished, all the metal, including the sources, ends up in the metals recycling industry and the source may be smelted. There are many such recorded events which can be very costly: in the range of one million to one hundred million US dollars [12].

— In many cases, the management takes a conscious decision not to dispose of the source, simply because the costs of disposal are very high. While security arrangements may be maintained to a degree, the effect of this practice is to increase the potential for security to fail over time. It has been estimated that in the USA, half a million of the two million sources may no longer be needed and thus could be susceptible to being orphaned [18] — or a target for malicious intent. In the European Union, some 30 000 sources are in a similar position [19].

5.1. Istanbul, Turkey

In 1993, a licensed operator loaded three spent radiotherapy sources into transport packages for their return to the original supplier in the USA [4].

However, the packages were not sent and were stored in Ankara until 1998. Two were then transported to Istanbul and stored in a general purpose warehouse. After some time, the warehouse became full and the packages were moved to empty adjoining premises. After nine months, these premises were transferred to new ownership and the new owners, not knowing the nature of the packages, sold them as scrap metal. The family of scrap merchants broke open the source container and unwittingly exposed themselves to the unshielded 3.3 TBq ^{60}Co source. Ten people received doses between 1.0 and 3.1 Gy and showed signs of acute radiation syndrome. Fortunately, no one died.

The second source, 23.5 TBq ^{60}Co remains unaccounted for, despite an extensive search and monitoring programme.

5.2. Samut Prakarn, Thailand

One company in Bangkok possessed several teletherapy devices without authorization from the Thailand Office of Atomic Energy for Peace [5]. In the autumn of 1999, the company relocated the teletherapy heads from a warehouse it had leased to an unsecured storage location. In late January 2000, several individuals obtained access to this location and partially disassembled a teletherapy head containing 15.7 TBq of ^{60}Co. They took the unit to the residence of one of the individuals, where four people attempted to disassemble it further. Although the head displayed a radiation trefoil and warning label, the individuals did not recognize the symbol or understand the language. On 1 February 2000, two of the individuals took the partially disassembled device to a junkyard in Samut Prakarn. While a worker at the junkyard was disassembling the device using an oxyacetylene torch, the source fell out of its housing unobserved.

By the middle of February 2000, several of the individuals involved began to feel ill and sought assistance. Physicians recognized the signs and symptoms and alerted the authorities. After some searching through the scrap metal pile, the source was found and recovered. Altogether, ten people received high doses from the source. Three of those people, all workers at the junkyard, died within two months of the accident as a consequence of their exposure.

6. OVERVIEW OF THE ORPHAN SOURCE THREAT

As part of its Action Plan to address orphan source issues, the IAEA had initiated (before 11 September 2001) the drafting of a document on National Strategies for the Detection and Location of Orphan Sources and their Subsequent Management. In order to develop such national strategies, the draft document identifies that there is first a need to identify the scale and profile of the threat — in essence, what is out there already and what the routes are by which sources become orphan sources. Although an assessment of potential malicious intent now has to be added to the threat profile, it is important to recognize that there is already a significant legacy of orphan sources. In addition, continuing gaps in national infrastructures provide the potential for more orphan sources.

Figure 3 provides a schematic representation of the sources of information that may be important to a country assessing the threats from current orphan sources or situations that could give rise to them and from malicious intent.

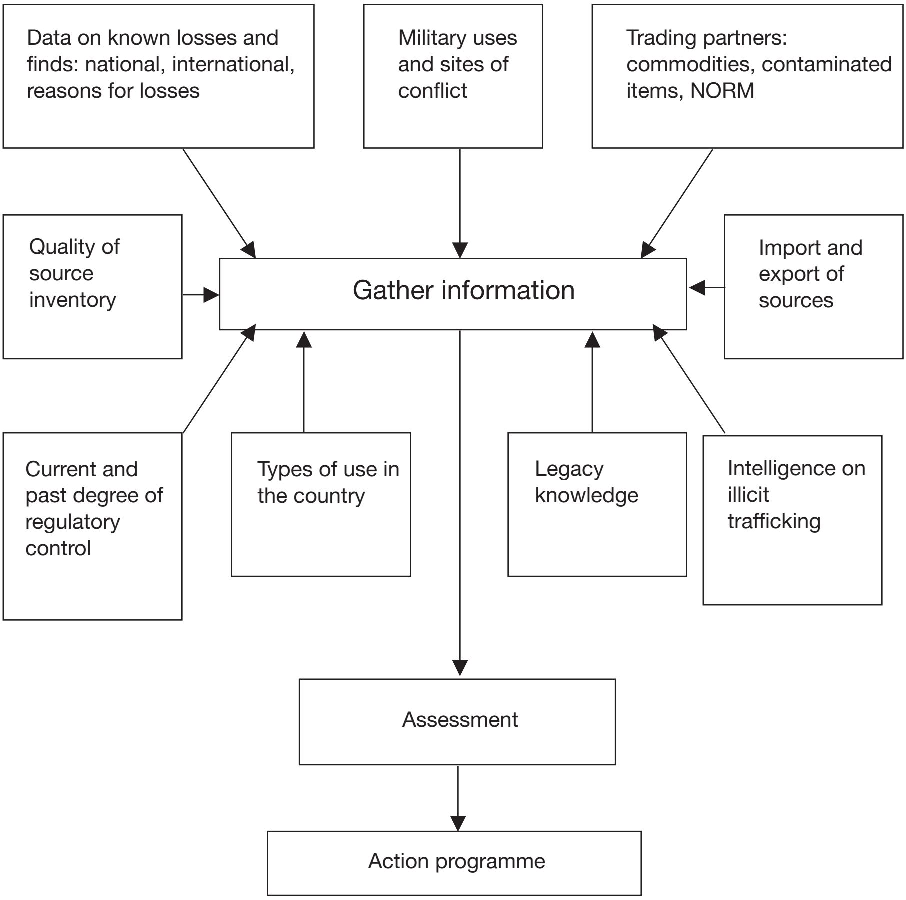

FIG. 3. Assessing the threat from orphan sources.

A few observations are appropriate:

— The importance of each element in Fig. 3 will vary, depending on the circumstances of the country, e.g. mature or embryonic regulatory system, the historic political stability of the country, the status of situations in neighbouring countries and trading partners.
— Legacy sources are those that predate effective regulatory requirements and may not have been disposed of at all, or in an appropriate manner. A common example is that of old radium sources used in research or medical environments. In some countries, legacy sources may be a substantial problem.
— In many countries, military uses of radioactive sources were, and often still are, outside the civilian regulatory infrastructure to some degree. These uses should not be overlooked when assessing the security measures. While many of the uses are similar to those found in industry, research and medicine, there are some uses that may be unique to the military or employ significantly larger activities than those found in comparable non-military devices. The use of radio-thermal generators (RGTs) is an important example which will be one focus of the Tripartite Initiative of the USA, the Russian Federation and the IAEA. RGTs could typically incorporate of the order of a PTBq of ^{90}Sr. A number have been found in the public domain. For example, following the discovery of radiation injuries to two members of the public in Georgia, two RGTs were located and recovered in early 2002.
— Sites of conflict, almost by definition, bring the potential for some form of breakdown in the chain of control of the security of radioactive sources. Collateral damage caused by shells, bombs and other munitions may involve damage to the radiation sources themselves or the facilities in which they are housed. This can result in the abandonment of the facilities or sources, leaving them available for people to gain access to them or scavenge.

- Almost half of the Croatian territory was affected by war from July 1991 to September 1995. The collateral damage was significant. A range of industrial sources of GBq levels of activity were affected: 18 were recovered in a clean-up programme but 24 remained unaccounted for. Some 60 ‘lightning preventers’, each containing GBq quantities of ^{226}Ra were also recovered from the rubble of demolished buildings.
- In 1992, an IAEA Mission to Beirut, Lebanon discovered, in a conflict ravaged derelict hospital, two radiotherapy sources similar to those in the Goiânia, Brazil accident (~50 TBq ^{137}Cs).

Once an assessment is complete, an action plan can be drawn up to address the threats. For example, the assessment may have identified that a significant number of sources are disused but have not been disposed of. Here, a targeted national plan to safely and securely dispose of the sources would remove both the potential for some to become orphan sources and for them to be targets for malicious intent. The assessment may also have identified a significant threat of illicit cross border trafficking or inadvertent importation of orphan sources. In this case, it may be appropriate to assess the value of installing portal monitors at nodal points, such as ports, railway marshalling yards and metals recycling facilities. Clearly, if monitoring systems are installed, there is an expectation that sources will be detected and, therefore, there is a need for contingency plans to deal with such finds. These plans must be well documented, members of staff must be appropriately trained and the plans exercised.

7. CONCLUSIONS

It was clear even before the terrorist attack of 11 September 2001 that there was a significant orphan source issue arising from poor safety and security of radioactive materials around the world. The IAEA's Action Plan to address this had made progress, but it is clear that there is a long way to go, particularly in improving the development of regulatory control in many countries.

Even where there are mature regulatory systems, the enforcement of source security has, until recently, been focused on preventing unintended access to sources. There is, therefore, a need to revisit the benchmarks for practical source security to take into account malicious intent. In doing this, the benefits to be derived from the use of radioactive sources must not be lost from sight. Good judgement will be required to balance the value of ease of use of radioactive sources against the threat from malicious intent.

A significant percentage (of the order of 20–30%) of all radioactive sources are disused sources that should be disposed of to safe and secure disposal facilities. However, the availability of such facilities and, where they are available, the disposal costs to owners are inhibitors to disposal. As a result, there is a reservoir of radioactive sources providing a potential target for terrorist acquisition and a stream of orphan sources in the public domain. This issue requires addressing through coherent national and international plans.

Finally, the issue of orphan sources and the potential for malicious acts involving radioactive material is likely to remain for some time. From the examples given in this paper, it is clear that these situations reinforce the need for appropriate emergency preparedness arrangements both nationally and internationally.

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Keynote Address

RADIATION SAFETY AND MEDICINE
Infrastructure requirements and lessons from the past

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Abstract

A national radiation infrastructure must include two major components or mechanisms to deal with radiation exposure during the course of medical practice and radiation injuries, should they arise. Implementation includes stakeholder involvement, necessary resources, inspection, and education and training. Review of recent radiation accidents shows the importance of each of the factors. Since radiation injuries are quite rare, local or national specific medical expertise may be limited. In these circumstances, the international community has often been able to provide assistance, particularly through the IAEA and the WHO.

1. INTRODUCTION

The radiation safety aspects involving medicine include regulation and inspection of standard medical practices in diagnostic radiology, nuclear medicine and radiation therapy. Such infrastructure is important as medical exposures account for over 90% of human-made radiation and controllable exposure. In addition, there must be a framework to provide co-ordination and assistance in cases of unplanned exposures and accidents.

2. LOCAL AND NATIONAL REQUIREMENTS

The national infrastructure for radiation safety during the usual course of medical practices involves specification of allowable equipment, calibration of the equipment initially and periodically, review of the doses (perhaps with reference levels as defined by the ICRP), and inspections. Regulations are best developed with stakeholder involvement. There may be specific licensing or certification requirements for physicists, technologists and physicians. It is clear that lack of education alone has led to many adverse outcomes, for example, interventional diagnostic procedures.

The national framework also needs to have policies on how to deal with unplanned exposures from accidents. This would involve investigative aspects not only from a physics viewpoint but also in terms of patient treatment.

3. INTERNATIONAL ASSISTANCE

International assistance is often necessary when there are medical considerations of radiation safety. These extend to protection of the patient during planned medical procedures as well as to accidents with injuries. The IAEA has recently formulated an International Action Plan for Protection of the Patient in Medicine. This was done in co-operation with the WHO, PAHO and multiple international professional organizations. The aim is to protect patients in a variety of ways, including preparation of materials, seminars, distance learning, etc.

International assistance is also available in terms of medical physics assistance after accidents involving injuries. This is primarily provided through the IAEA as well as the WHO and PAHO. The two main mechanisms are to dispatch expert teams to the location of the accident and to provide consultation or co-ordinating care in foreign countries for selected patients.

4. LESSONS FROM RECENT ACCIDENTS

4.1. Costa Rica accident

The accident in Costa Rica [2] was due to initial miscalibration of a newly installed cobalt radiotherapy source. The accident had a number of contributing causes, including poor training and education, lack of regulations concerning certification of physicists, no secondary calculations, lack of communications between technologists, physicists and physicians, and short cuts taken as a result of inadequate machines and staff for the workload.

4.2. Panama accident

The accident in Panama [3] was due to inappropriate use of a radiation therapy computer treatment planning system. Contributing factors also involved a failure to follow the operating manual, lack of secondary calculations, lack of treatment records at the hospital where the physicians were seeing the patients, and the physicians seeing patients too infrequently during therapy.

4.3. Peru accident

The accident in Peru [4] involved an industrial radiography source that was placed in a worker's pocket and taken home. Actions taken after the source was found to be missing involved a long and complex medical course. The proximate cause of the accident was a possible attempt to steal the source.

4.4. Poland accident

The accident in Poland involved a radiation therapy machine that apparently had a continuing degradation following a power outage, resulting in a very marked increase in dose rate.

All of these accidents show not only the need for a regulatory infrastructure but also a medical 'safety culture' within the medical community. There is also a critical need for international medical support and assistance.

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Rapporteur's Summary

OBSERVATIONS FROM THE POSTER SESSION AND SUMMARY OF REPORTS SUBMITTED FOR TOPICAL SESSION 9

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1. INTRODUCTION

The report on Topical Session 9 summarizes issues raised in papers submitted for the session dealing with source security and emergency preparedness issues. The report is an attempt to summarize observations on two topics mentioned, in the form of general observations, basic observations and specific observations for each topic. It is proposed that some specific observations should be discussed during Round Table 4.

2. GENERAL OBSERVATIONS

Over the last few years, there has been a strong increase in the concerns related to the security of sources and the potential use of sources for malicious acts. These concerns have been analysed in several IAEA conferences, and conclusions from them give a clear message: unless thoroughly controlled and protected at the national and facility level, the sources may be vulnerable to theft with the intention to use such sources for 'dirty bombs' or RDD. In addition, facilities where sources are located are vulnerable to sabotage or terrorism attacks (see Keynote Address and CN-107/91 — Brazil, in the CD-ROM);

— IAEA Member States and other international organizations have become increasingly aware of the dangers that illegal activities involving high radioactivity sources may cause in terms of radiation and health effects, and damage to property and to the environment (see CN-107/63 — Ghana, in the CD-ROM). Thus, source security is an important factor in emergency preparedness, as is the sustainability of an entire radiation safety infrastructure;

— Incidents involving radiation sources reported during the last decades have prompted a range of both national and international measures which are designed to prevent the loss of control over the sources and to recover them if such losses occur, integration of activities to cope with radiation incidents into large-scale emergency preparedness plans (see Keynote Address).

2.1. Basic observations from reports and posters

A large number of reports have been submitted to this conference and some of them cover issues related to source security and emergency preparedness, some reports have been presented in this session and several papers have been discussed during the last two poster sessions;

A sustainable radiation safety infrastructure shall ensure protection of people and the environment by ensuring the safety and security of radioactive sources (see CN-107/14— Yemen, in the CD-ROM);

Any safety relevant source and practice shall be authorized (licensed). It is impossible to do so without a competent regulatory authority: an effective control system is a must;

The IAEA already provided and is providing assistance to establish and to enhance safety infrastructure, but more efforts are needed from the IAEA and the Member States, including trilateral and multilateral activities to ensure a global safety regime (see CN-107/27 — Republic of Moldova, in the CD-ROM; and CN-107/63 — Ghana, in the CD-ROM);

In recent years, emergency preparedness plans also include preparedness and responses to threats of thefts or sabotage (see CN-107/15 — Morocco, in the CD-ROM);

In some regions, there are concerns about the situation in neighbouring countries because the safety situation is not known and no exchange of information or collaboration exists which increases potential threat to others (see CN-107/63 — Ghana);

Some reports directly or indirectly mention the following international undertakings which are relevant to this topical session:

— Convention on the Physical Protection of Nuclear Material;
— Convention on Early Notification of a Nuclear Accident;
— Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;
— Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management;
— Code of Conduct on the Safety and Security of Radioactive Sources.

2.2. Specific observations

Initiatives to strengthen the physical protection regime (nationally and internationally) are strongly supported.

While steps have already been taken to improve the physical security of radiation sources, continued efforts are required at both the national and international levels.

3. SAFETY AND SECURITY

3.1. Observations

The risks of theft and sabotage of nuclear material and other radioactive substances, and the risk of sabotage of nuclear and radiation facilities should be considered as part of a comprehensive approach to safety and security;

An effective national nuclear security system is possible only where there is good collaboration between the national regulatory authority, the security agencies, customs and law enforcement agencies (see CN-107/63 — Ghana, in the CD-ROM);

The apparatus containing radiation sources must be designed to allow the controlled use of radiation but to ensure protection of personnel and to prevent the loss of sources (see CN-107/51 — Spain, in the CD-ROM);

The regulatory authorities should prepare regulatory requirements and guidance documents for safe and secure uses of sources (see CN-107/52 — Spain, in the CD-ROM), but it is recognized that even safety regulations do not always exist and security regulations are rather rare (see CN-107/63 — Ghana, in the CD-ROM);

Possibilities for the disposal of radiation sources or the possibility of returning disused sources to the supplier need to be established (see CN-107/63 — Ghana, in the CD-ROM);

The International Organization for Standardization (ISO) has published the security requirements for certain types of equipment which must be considered in the construction of the latter in order to reduce the operational incidents (see CN-107/51 — Spain, in the CD-ROM);

During the preparation of requirements, the optimization of radiation protection and source security shall be considered because loss of control over sources has potential radiological risks (see CN-107/52 — Spain, in the CD-ROM). Terrorist activities could also incite panic, contaminate property and even cause injury or death among the civilian population (see CN-107/63 — Ghana, in the CD-ROM).

3.2. Specific observations

It is recognized that the IAEA has developed a nuclear security action plan (see CN-107/63 — Ghana, in the CD-ROM), which covers:

— Physical protection of nuclear materials and nuclear facilities;
— Detection of malicious activities involving nuclear and other radioactive materials;
— State system for the accounting and control of nuclear material;
— Security of radioactive material other than nuclear materials;
— Assessment of safety and security related vulnerability of nuclear facilities;
— Response to malicious acts, or threats thereof;
— Adherence to and implementation of international agreements, guidelines and recommendations;
— Nuclear security co-ordination and information management.

National authorities and international institutions have already started several initiatives in line with the security action plan dicussed previously (see Keynote Address and CN-107/63 — Ghana, in the CD-ROM);

Some more international activities are needed to improve source security already into the design stage of sources and of equipment/apparatus for these sources.

4. EMERGENCY PREPAREDNESS

4.1. Observations

It is widely recognized that an emergency plan should be established at all facilities and activities where a competent authority recognizes safety concerns, including the need for physical protection (see CN-107/15 — Morocco, in the CD-ROM);

Emergency plans shall consider all steps to be taken in all phases, i.e. urgent, intermediate and recovery, including the medical follow-up of the exposed populations, the rehabilitation of the grounds, the compensation for damages and, more generally, the return to conditions considered to be normal (see CN-107/15 — Morocco, in the CD-ROM);

Education, training and exercises are absolutely necessary and lessons learned from any incident or accident should be considered in the adjustments of emergency plans and in training materials (see CN-107/15 — Morocco, in the CD-ROM);

Two specific plans and training programmes should be developed: for responders and for all relevant authorities to cope with large-scale incidents and accidents (see CN-107/91 — Brazil, in the CD-ROM);

There is a need to strengthen the national capability to deal with radiological emergencies arising from accidents and incidents, and those due to the malevolent use of nuclear materials and other radioactive sources (see CN-107/63 — Ghana, in the CD-ROM).

4.2. Specific observations

While steps have already been taken to improve emergency preparedness, continued efforts are required at both the national and international levels.

Round Table 4

SAFETY AND SECURITY OF SOURCES: LESSONS LEARNED

DISCUSSION

Chairperson

J. BARCELÓ VERNET
Spain

ROUND TABLE 4

J.-P. GAYRAL (France): In recent years, many countries have taken action designed to reduce the risk of the occurrence of accidents with radiation sources. Generally, they have started by appointing a national radiation safety authority and then adopted regulations; only after that has a start been made with emergency preparedness and response planning. In my view, such planning should start earlier in the process of establishing a radiation safety infrastructure — and obviously, it should start earlier also if that infrastructure is going to have to respond to security concerns.

In this connection, it is important to remember that the IAEA can assist countries with their emergency preparedness and response planning.

The IAEA can also assist countries when radiological emergencies arise. A few years ago, for example, it assisted Georgia, where there had arisen a radiological emergency due to the presence there of orphan sources. In doing so, it called upon other countries to help, and France, Germany, India, the Russian Federation, Turkey and the USA responded by, for example, providing the capabilities necessary for an orphan source search campaign using airborne, 'car-borne' and hand-held radiation detectors.

An aspect of radioactive source security which is causing me some concern is the fact that there are now many reports on the subject with very detailed information which could easily be accessed by anyone wishing to use radioactive sources for malevolent purposes. We need to think more not only about the security of radioactive sources but also about the security of sensitive information on them, which must not be allowed to fall into the wrong hands either.

A.P. PANFILOV (Russian Federation): Radioactive sources exist both within and outside nuclear facilities. Generally, those within such facilities are safer and more secure because, for example, the personnel handling them are very well qualified for the job. Owing to 'radiophobia', however, most people are very concerned about nuclear facilities, despite the fact that the safety and security risks associated with the radioactive sources there are relatively low. At the same time, they underestimate the risks associated with the radioactive sources outside nuclear facilities.

In my view, this is due to the fact that the public is not properly informed about the risks associated with radioactive sources not under regulatory control, and even less about the possibility of terrorist acts being perpetrated with radioactive materials. The issue is a psychological one, and the information provided to the mass media by the competent organizations is very important in this connection.

In a number of countries it is necessary to improve the national systems for radioactive source accounting and control. The Russian Federation, which possesses a great deal of relevant experience, stands ready to assist the countries in question through, for example, the provision of training.

A. HASAN (USA): I should like to draw attention to a programme under way in the USA which, in my view, could be important for the safety and security of radioactive sources. It is the Radiation Protection without Borders Programme being run by the American Health Physics Society.

S.B. ELEGBA (Nigeria): In my view, not enough emphasis is being placed on the role of countries which export radioactive source in helping to ensure the safety and security of the radioactive sources which they export. In my view, those countries should not simply manufacture and sell radioactive sources; they should also bear some of the responsibility for 'cradle to grave' management.

J. BARCELÓ VERNET (Spain): This is not simply an issue of radioactive source exports and imports, or of developed versus developing countries. Often, companies that manufacture and/or supply radioactive sources have gone out of business by the time the sources manufactured and/or supplied by them are no longer wanted by the users. Dealing with the sources is then a problem for the regulatory body.

O. MAKAROVSKA (Ukraine): We have received the IAEA technical document entitled Security of Radioactive Sources (IAEA-TECDOC-1355), and we welcome the fact that the IAEA plans to produce a safety guide on the basis of that document.

The Ukraine is very vulnerable as regards its State borders, and we would therefore like to see the IAEA developing standard procedures for the exchange of information during the export and import of radioactive sources.

M.S. ABDULLAH (Yemen): A dirty bomb that spreads 1 Ci of radioactivity could cause as much disruption as one that spreads 1000 Ci of radioactivity. Consequently, all radioactive sources — however weak — must be kept secure.

P. JIMÉNEZ (PAHO): Following the International Conference on Security of Radioactive Sources held in Vienna in March 2003, PAHO and the IAEA have initiated a joint programme for the location, securing and conditioning of orphan sources in a first trial exercise will take place next month, in Barbados, and we hope that most of the orphan sources in the region will have been located and secured by the end of this year.

Within the framework of the programme just mentioned by A. Hasan, the IAEA and PAHO are assisting a number of countries in the area of radioactive source safety — starting with Colombia, Ecuador, Jamaica and Panama.

R. CZARWINSKI (Germany): A clear distinction should be made between information which must be widely available for safety reasons and information which must be restricted for security reasons, and the restriction of security sensitive information should not be allowed to reduce the competence of persons responsible for safety.

In that connection, I would mention an IAEA database on different radioactive source types which is very useful for helping to identify orphan sources. However, the database has not been made widely available, although the information in it can be found through the Internet or in manufacturers' advertisements.

A.L. RODNA (Romania): I think the time has come to revisit the concepts of 'justification' and 'optimization' in the light of security concerns.

In this connection, I would mention that we are planning to import a blood irradiator and considering whether it should be one with a cobalt source or one with a caesium source. A cobalt source poses a greater security risk because cobalt has a longer half-life; a caesium source poses a greater security risk because the caesium is in powder form and therefore very suitable for use in a dirty bomb.

I.A. GUSEV (Russian Federation): Given the increase in concern about the security of radioactive sources, I should like the IAEA to look into the possible radioactive contamination of groundwater and other environmental components through the malevolent use of radioactive sources and into the psychological impact of their malevolent use. These two issues were not considered during the preparation of the IAEA's Categorization of Radioactive Sources (IAEA-TECDOC-1344).

M.L. PERRIN (ISO): Regarding the question of radioactive source security, I would mention that ISO is preparing a standard entitled 'Monitoring for inadvertent movement and illicit trafficking of radioactive material'. It is hoped that the standard will be published early in 2004.

K. MRABIT (IAEA): I would mention that the American Health Physics Society, to which reference has just been made, approached the IAEA some time ago with a request for information about what was being done within the framework of the Model Projects. We provided the requested information, and the IAEA and the Society are now co-ordinating activities in order to avoid duplication of effort.

E.M. VALDEZCO (Philippines): With IAEA assistance, a number of countries, including the Philippines, have collected the disused radium sources within their territories and conditioned them. In my view, the next step should be to dispose of the conditioned sources in a regional repository, rather than in several national repositories. Alternatively, perhaps the USA could accept the sources, as they have been properly conditioned.

J. BARCELÓ VERNET (Spain): That is an interesting — but somewhat controversial — idea.

M.Y. OSMAN (Sudan): Radioactive sources in use are probably safer than disused radioactive sources that are being kept at the workplace. Hence, the logical thing to do is to put disused radioactive sources into storage at a remote location in some relatively unpopulated part of the country. However, such locations — probably unattended for long periods — may well be insecure. The problem of the long term storage of disused radioactive sources must be solved in a manner that is both safe and secure.

A.O. KOTENG (Kenya): Our regulatory authority knows about the radioactive sources currently in use in Kenya, which are safe and could be made more secure through additional security measures. What we are mainly concerned about is illicit trafficking in radioactive materials, for example, uranium from mines in Angola and the Democratic Republic of the Congo. Perhaps more could be done to prevent radioactive materials being removed illegally from places like uranium mines. Also, greater access to information gained through intelligence gathering would help in combating illicit trafficking.

E.C.S. AMARAL (Brazil): The Goiânia accident gave some indication of the possible impact of a malevolent act perpetrated with a dirty bomb, even one based on only a very weak radioactive source. People who were not involved in the aftermath of the accident cannot imagine how difficult it was to deal with the accident's consequences — particularly with what one might call the 'psychological contamination' of the population.

Despite the controls on the importation of radioactive sources into Brazil introduced following the Goiânia accident, there are industrial gauges containing very small amounts of radioactive substances and not explicitly stated to be radioactive whose importation does not have to be authorized by us, and they could pose a problem if they fell into the wrong hands.

I. GISCA (Republic of Moldova): We are co-operating with the United States Department of Energy in efforts to increase the security of radioactive sources in our country. These efforts are being supported by the IAEA, which has organized a number of expert missions as a result of which we have improved our relevant technical documentation.

A. JANSSENS (European Commission): R. Czarwinski made a valid point about access to information. As regards emergency response to a malevolent act involving a dirty bomb, however, I think the most important thing is immediate good communication with the public so that societal disruption may be minimized. Apart from information obtained through intelligence gathering, the only real tool we have for dealing with a malevolent act involving a dirty bomb is the ability to immediately inform the public about what has happened, what the likely consequences will be and what countermeasures should be taken.

R. PACI (Albania): Since 2001, anyone in Albania wishing to be licensed to use a radioactive source must have a contract with the manufacturer for the return of the source when it is no longer needed or a contract with a radioactive waste management organization for the transfer of the disused source to that organization.

Also, we now have import notification requirements such that we know when the source will be entering the country and whether it is being carried by road vehicle, aircraft or ship. There are similar notification requirements for the export of disused sources.

S.B. ELEGBA (Nigeria): The countries participating in the Model Projects provide the IAEA with information about the radioactive sources within their territories. Perhaps the appropriate authorities in the countries which export radioactive sources could provide the IAEA with information about the sources being exported to other countries, including details regarding the consignees and/or the users. Such information might be useful if, say, a radioactive source manufacturer went out of business.

J.A.W. MAINA (Kenya): When designing radiation facilities, we have in the past been concerned about accidents involving radioactive sources and about people stealing such sources for profit — not about people gaining access to them for malevolent purposes. I believe that we must now assess the design of radiation facilities also in the light of security concerns and that the legislation relating to the design of such facilities must be revised.

P.M.C. BARRETTO (IAEA): Further to what E.M. Valdezco said, I do not think that countries with very small numbers of disused radioactive sources are going to seek national solutions to the problem of disposing of them. The idea of regional repositories is therefore an attractive one. We have discussed the idea with Member States within the framework of AFRA, ARCAL and RCA, and the IAEA has looked into it, but I have the impression that the interest in it has declined. Perhaps this conference could help to revive that interest.

Round Table 5

FEATURES OF INFRASTRUCTURE REQUIREMENTS

DISCUSSION

Chairperson

S. NIU
ILO

ROUND TABLE 5

W. KRAUS (Germany): In many countries with nuclear power plants and nuclear fuel cycle facilities, the main emphasis in the field of radiation protection is placed on public exposure control, mainly because of the public perception of radiation risks, and expensive environmental and discharge monitoring programmes covering both routine and accident conditions have been set up. Their example should not be followed by countries without nuclear power plants and nuclear fuel cycle facilities, for example, most of the countries participating in the Model Projects. There are other ways of controlling public exposure, and I shall here briefly give my personal views regarding the associated priorities.

Higher priority should be assigned to the safety and security of radioactive sources. The necessary protection measures should be implemented together with occupational exposure control measures and emergency preparedness and response arrangements. Occupational exposure control implies the establishment of operational radiation protection and safety programmes which should cover, inter alia, the shielding of radioactive sources and control of the access to such sources.

In the countries participating in the Model Projects, the most important aspect of ensuring the safety and security of radioactive sources is the management of disused sources. The best management option is the return of disused sources to the manufacturers or suppliers; an alternative is conditioning and long term safe storage.

A prerequisite for all those public exposure control activities is a functioning regulatory infrastructure.

The conditioning and storage of low level radioactive waste are public exposure control measures of second priority. In some countries there are near-surface disposal facilities, and if possible they should be used also by other countries.

Preferably, radioactive waste should be disposed of as ordinary waste — after the establishment of relevant clearance levels. In the countries participating in the Model Projects, where radioactive effluents are being discharged by nuclear medicine departments, the necessary monitoring equipment is usually available. In nuclear medicine, problems of public exposure control should be tackled in the context of the implementation of medical exposure control measures.

Environmental monitoring and food monitoring are public exposure control measures of third priority, sometimes justified only in order to meet public concerns. The same priority should be assigned to the control of the importation of consumer products, which are usually exempt from regulatory control. The regulatory body should rely on the results of prototype testing and on the approvals given by the authorities in the manufacturers' countries.

Radioactive residues, radioactively contaminated sites, and the distribution and use of radioactively contaminated commodities — especially from NORM industries — may result in significant radiation exposures, but hardly in deterministic effects. The international discussion about the applicable radiological criteria is still going on, and the IAEA is an important participant. As long as no internationally agreed recommendations have been made, the relevant measures of public exposure control should be assigned only fourth priority in the countries participating in the Model Projects.

G.A.M. WEBB (IRPA): In my view, the most important element of a radiation safety infrastructure is the people. I shall explain why I think that.

After obtaining a basic degree in physics, chemical engineering, radiobiology or whatever, and taking a course like the post-graduate educational courses organized within the IAEA framework, you start to work. If you are intelligent, however, you soon realize how little you know about how to do your job.

If you are lucky, at that point, you receive some job related training — perhaps, again, through courses organized within the IAEA framework or through fellowships provided by IAEA Member States.

After the training, you return to your place of work (your laboratory or whatever), where you in due course encounter a problem not covered by the training. That is when networking with other people becomes important.

In a country — or an organization — with many people working in radiation protection and related fields, networking develops from within. You are usually working in a team together with people who have been doing the job in question for some time and can help you with your problem. Nevertheless, you would be wise to join an association of radiation protection professionals like — in the United Kingdom — the Society for Radiological Protection. Such associations organize meetings on various topics (how to interpret the new regulations, how to designate classified areas, whether to apply internal or external dosimetry in particular work situations, and so on), where you can participate in the discussions and learn. The most important thing about such meetings, however, is that you get to know people well enough to telephone or e-mail them with your problems.

In that connection, I would mention that the Society for Radiological Protection has established an Internet based question-and-answer system through which its members can obtain answers to questions as mundane as, "Where can I buy lead-lined gloves?" I think such a system would be useful in other countries as well.

In countries where little use has been made so far of ionizing radiation and radioactive substances, networking is more difficult simply because there are very few people with the relevant expertise and experience. I would remind people from such countries, however, that training courses can give rise to networks — after you have spent a few weeks on a training course with a number of other people, you should be able to refer problems to them, provided that you yourself are prepared to help solve any problems they may have.

IRPA is a non-governmental organization which has no financial resources but whose members together possess a great deal of expertise and experience. Organizations like the IAEA, the ILO and the WHO have financial resources, and I would like to see the IRPA working more closely together with such organizations.

In Round Table 3, I spoke about the establishment of regional radiation protection societies in regions where there is a widely spoken common language. I think regional, language based networks would also be useful, and I would like to hear from any participants in this conference who are interested in the establishment of such networks.

A. HASAN (USA): I should like to speak briefly about three infrastructure elements that, in my view, are essential for sustainability.

One is people: what G.A.M. Webb just called "the most important element of a radiation safety infrastructure". The people operating such an infrastructure need not only certain technical knowledge, but also management and communication skills. Selecting the right people is not easy, and I think the IAEA might be able to help by providing guidance on selection criteria.

The second element I would mention is the ability to enforce regulations. Here, I think the IAEA might be able to help by providing guidance on enforcement performance assessment and on involving national decision makers in the monitoring of enforcement.

The third element I would mention is a disposal path for disused radioactive sources, for in many countries such sources are being stored incorrectly and represent human health and environmental hazards.

While I have the floor, I would like to touch on the question of the fees which some regulatory bodies charge for taking over disused sources. Such takeover fees are important for some regulatory bodies, which do not receive much in the way of financial resources, but the regulatory bodies are uncertain about what takeover fees to charge. Perhaps the IAEA could provide guidance in this matter also.

J. VAN DER STEEN (Netherlands): I agree with what W. Kraus said about radioactive residues, radioactively contaminated sites, and the distribution and use of radioactively contaminated commodities, except that I am not so sure that the relevant measures of public exposure control should be assigned only fourth priority in the countries participating in the Model Projects.

Those who decide on such measures may find safety reports being produced by the IAEA on, for example, the oil and gas industry and the phosphate industry helpful.

A.L. BIAGGIO (Argentina): The priorities in a country that is at an early stage of development as regards radiation protection will differ from those in a country that is at an advanced stage.

W. Kraus seemed to make a distinction between public exposure control and occupational exposure control. For me, the important thing is to focus on radioactive sources that can give rise to significant overdoses if something goes wrong, regardless of whether the victims are members of the public or radiation workers — or patients undergoing radiotherapy.

W. KRAUS (Germany): I agree with A.L. Biaggio to the extent that one can solve many public exposure control problems by solving occupational exposure control problems.

I. SOUFI (Morocco): Radioactive sources are widely used in Morocco, mainly in medicine and industry. Also, Morocco will soon have its first research reactor, so it is currently upgrading its radiation safety infrastructure.

The main difficulty that it is encountering is a shortage of qualified people. Without a critical mass of expertise, it is impossible to meet the BSS requirements.

When upgrading a radiation safety infrastructure, one should ensure that the legal framework clearly defines the lines of responsibility and prevents overlapping, and that the regulatory body is capable of achieving safety objectives and is not simply an administrative entity.

Also, one should look into what assistance can be obtained from other countries, the IAEA and professional societies, with on-the-job training and later with networking.

A high priority is a national policy on radioactive waste management, for example, should radioactive waste management be centralized? Similarly, one should consider whether to establish a national centre for the provision of dosimetry, calibration and other services. In this connection, I would mention that I do not think such services should be provided by the regulatory body; a regulatory body providing services may stop focusing on its primary tasks, and it may even find itself confronted with conflicts of interest.

It is important to build a relationship between the regulatory body and users that is based on consultation and mutual understanding and respect. Such a relationship can lead to greater confidence within the general public and the media.

I.A. GUSEV (Russian Federation): I think the most important considerations when one is setting priorities are radiation dose and available resources. One should allocate the available resources in such a way as to achieve the greatest dose reduction for one's money.

S. NIU (ILO): It would be interesting to hear about infrastructure requirements and priority setting in countries that are not IAEA Member States.

K.L. SHRESTHA (Nepal): In my country, radiation and radioactive substances are being used mainly in the health sector, where we are using, for example, imaging devices, cobalt-60 radiotherapy devices and linear accelerators, and the number of uses is increasing.

The Cabinet recently established a committee — chaired by the Minister of Science and Technology — to look into radiation safety issues. The committee has set up three sub-committees — one on policy matters, one on radiation applications and one on background radiation.

Our first priority is the establishment of a regulatory body and the promulgation of regulations. Our next priority will be the radiation protection of people working in medical services where radiation and radioactive substances are being used and in associated laboratories.

In addition, we are concerned about the exposure of the general public to background radiation and about the security of radioactive sources.

E.L. WALKER (Bahamas): In my country, where radiation and radioactive substances are also being used mainly in the health sector, we have rudimentary radiation safety standards that are being applied at individual institutions but no national radiation safety regulations.

We need assistance with the drafting of such regulations and also with the establishment of a regulatory body capable of carrying out inspections and enforcing the regulations.

A.O. KOTENG (Kenya): Further to what I said in Round Table 4, where I spoke about illicit trafficking in radioactive materials that enter Kenya clandestinely from other countries, I would mention that such materials are often sold to people who know little or nothing about ionizing radiation and therefore seek advice from experts. That is when the Radiation Protection Board usually gets to hear about the matter. By that time, however, many individuals may have been overexposed.

In order to combat illicit trafficking, besides information gained through intelligence gathering, there is a need for police, customs and other officials to be equipped with suitable radiation detectors and also to be trained in radiation protection, so that they know what first steps to take if they discover radioactive materials.

B.-K. KIM (IAEA): I should like to address myself to those in the audience who are from countries participating in the Model Projects.

A great deal has clearly been achieved through the Model Projects, most participating countries having attained Milestones 1 and 2, and now the IAEA's Office of Internal Oversight Services and outside experts are making a systematic evaluation of the situation as the focus switches to Milestones 3–5. By the time the evaluation has been completed, in November 2004, further participating countries will also have attained Milestones 1 and 2.

As many of you have told me, each participating country has its own particular priorities as it contemplates Milestones 3–5. We urge each participating country to let us know what its priorities are when it submits its technical co-operation project requests.

Some of you have indicated that, when sets of project requests are being prepared for submission to the IAEA through official channels, the initial assignment of priorities is sometimes modified in a manner which they do not greatly appreciate. In response to that, I would say that our regional managers and country officers are well able to 'read between the lines'.

Of course, a more systematic approach to priority setting is the formulation of a Country Programme Framework (CPF). Once a Member State has reached agreement on its CPF with the IAEA, priority setting becomes a non-issue whoever the responsible minister is. I would, therefore, urge those participating countries which do not yet have a CPF to embark on or complete the CPF formulation process as soon as possible and those which have a CPF to update it regularly.

I also have a message for the countries represented here which are not IAEA Member States: the IAEA stands ready to assist you if the necessary extrabudgetary resources are made available, but your chances of receiving IAEA assistance will be much greater if you join the IAEA.

D. HERNÁNDEZ (Argentina): I agree with G.A.M. Webb that the most important element of a radiation safety infrastructure is the people.

Argentina's National Atomic Energy Commission has certainly been of that view since its establishment some 50 years ago, and it has therefore attached very high priority to education and training.

In that connection, I would mention the post-graduate educational course which Argentina — with IAEA support — has been offering each year for over 20 years. The course has so far been attended by some 700 post-graduates, about half of them from Argentina and the rest mainly from the Latin American countries.

G.A.M. WEBB (IRPA): I should like to take this opportunity to announce that the 11th IRPA World Congress will take place in May 2004 in Madrid. It will cover all aspects of radiation protection, including the security aspects, and it will be open not just to IRPA members.

FINDINGS AND RECOMMENDATIONS

(Closing Session)

Chairperson

H. BOUTALEB
Morocco

Summary of Topical Session 1

STAKEHOLDER INVOLVEMENT IN BUILDING AND MAINTAINING NATIONAL RADIATION SAFETY INFRASTRUCTURES

Chairperson

C.J. HUYSKENS
Netherlands

Rapporteur

C. LEFAURE
France

1. MAIN FINDINGS FROM THE SESSION

For a clear understanding of issues, the following primary definitions were reiterated:

— A ‘stakeholder’ is a body (i.e. a person or an organization) entrusted with stakes (such as interests or shares, etc.) of a problem (an issue, business, culture, etc.). The term refers to interest groups having a common identifying interest that often provides a basis for action and involvement.
— ‘Involvement’ is the readiness to be concerned with or moved by something; it is synonymous with engagement and commitment, and the opposite of apathy, indifference, unconcern.

Therefore, involving stakeholders means that an organization is responsible to more than its shareholders; it is also responsible and accountable before other interest groups, its employees and public parties. Stakeholder involvement requires a sound methodological approach as how to organize the various aspects of information, communication as a part of the processes of policy and decision making, and their accounting.

It was broadly reflected during the session that contemporary society has become increasingly interested in participating in public decision making on health, safety and environmental protection issues. In this context, it is important that several international workshops and working groups have reported that their experiences with stakeholder involvement have demonstrated the following positive results:

— Ensuring the adhesion of parties to the decisions;
— Promoting transparency of processes and improving the trust between involved parties;
— Building confidence in the technical and management solutions that have been adopted;
— Fostering the readiness for mutual accountability between parties.

The keynote addresses as well as the Posters Session showed that experience is growing; examples and experiences already exist of stakeholder involvement, and some case studies from Australia, Canada, France, Kenya, Latvia, the USA and Zambia were presented during the session. They pointed out their results, the challenges and the difficulties to be faced.

As for the results, most examples showed that any national radiation protection infrastructure benefits from co-operation with stakeholders, in particular, with public involvement in the regulatory decision making. It was also clear from all presentations that each country has to find the approach that best suits is needs, its culture and its legal framework. Nevertheless, feedback from other countries appears to be a major input when tailoring a specific national approach.

Several challenges have been emphasized, such as the development of a pluralistic expertise or finding ways of balancing the interests of different parties, and of providing them with equitable involvement when they have fewer resources, less power and a lower level of education and information compared with the other parties.

Difficulties were raised corresponding to different social, cultural and economic situations. In developing countries, constraints on human resources and funding imply the need for a tailor made approach to stakeholder involvement in order to enhance the performance of the regulatory body:

— In these countries, there is a need to commit stakeholders, such as licensees and professionals, to take care of radiological protection even when other stakes appear to be priorities;
— Pools of qualified and skilled individuals might be set up with the help of all stakeholders in the country and international organizations;

- Innovative approaches might be developed to find new partners with technical, human or financial resources;
- Networks should be set up to benefit from ‘mutual’ resources at regional and international levels.

The presentation of networking through the examples of the European ALARA Networks (EAN) and CEEAN demonstrated that it is an efficient modern concept and a very good way to facilitate regulation and infrastructure improvements, taking care of the stakeholders’ needs and wishes. Useful lessons can be learned from this experience and make it avoidable to re-invent the wheel.

2. CONCLUSIONS ABOUT THE FOLLOW-UP AND THE ROLE OF INTERNATIONAL ORGANIZATIONS

The following issues were identified for follow-up by international organizations:

- Analyse stakeholder involvement case studies and disseminate to all countries the lessons learned from these case studies in pointing out what is generic and what is country related.
- Provide guidance on how to implement the existing techniques and tools in specific local and regional situations.
- Stimulate bottom-up approaches in complement to top-down procedures.
- Support, materially and technically, the fostering of regional network structures.
- Support further methodological development of stakeholder involvement theory in general and the practical applications in the radiological safety domain.

Summary of Topical Session 2

OVERVIEW OF IAEA MODEL PROJECTS

Chairperson

W. STERN
United States of America

The IAEA Model Project for Upgrading Radiation Protection Infrastructure was launched in 1994 and is now an unprecedented international technical co-operation effort. Through these projects, the IAEA has a proactive and integrated approach to identify and meet Member States' needs in accordance with the safety and security requirements of the BSS. The adequacy of health and safety measures established by a Member State for handling and storing materials and for operating facilities is a prerequisite for approval by the Board of Governors of the IAEA of any assistance project that involves sources of ionizing radiation. Consequently, the Model Project is essential to allow the peaceful uses of ionizing radiation materials in some countries. Currently, over 85 Member States are participating in the Model Projects.

In this session, there was general agreement that the Model Project and its approach has succeeded in assisting many countries in establishing appropriate laws, regulations and regulatory authorities empowered to authorize and control practices involving radioactive sources, but much more work needs to be done. The Model Project has promoted a common understanding of necessary radiation safety frameworks and strong regulatory authorities. It has also helped to minimize the illicit trafficking of radioactive materials. The key challenges identified in the conference are the lack of resources within recipient countries, delays in promulgating necessary laws in recipient countries, and institutional instability. Speakers indicated that, as the Model Project moves forward, there should be greater concentration on the maintenance of radiation source inventories and the need for continued capacity building in recipient countries, as well as a greater political will to implement radiation protection requirements in some recipient countries.

Speakers agreed that the Model Project and its approach should be strengthened and expanded, where justified. There was agreement that the safety and security of sources are overlapping concepts and that the Model

Project has paved the way for better security. The IAEA and Member States should examine how the issue of radiation source security can be explicitly integrated into the Model Project. Some urged that the IAEA should examine whether the Model Project should more specifically address the life-cycle management of sources. Others pointed out that part of the life-cycle management issue is covered under Milestone 4 and under a different technical co-operation project.

Several speakers urged that all Member States, including those working toward fulfilling the requirements of Milestone 1 of the Model Project for Upgrading Radiation Protection Infrastructure, should work towards implementing the guidelines of the revised Code of Conduct on the Safety and Security of Radioactive Sources. The IAEA's efforts in developing sustainable national radiation safety infrastructures, and in particular the regional Model Project approach, is a cornerstone for enabling Member States to implement the Code of Conduct.

Summary of Topical Session 3

IMPLEMENTATION EXPERIENCE WITH MODEL PROJECTS

Chairperson

M. MARKKANEN
Finland

Rapporteur

C. MASON
Australia

1. OBJECTIVE AND CONTENTS OF THE SESSION

The objective of the Session was to identify experiences (positive and negative) of countries participating in the Model Project and of peer reviewers. The session comprised two keynote addresses: the first, presented by C. Schandorf from Ghana, dealt with the experience of peer review assessment missions; the second, presented by A. Mastauskas, described the implementation experience of the radiation protection infrastructure in Lithuania. A total of 35 contributing papers were submitted to this session and findings from these papers were reviewed by the Rapporteur. The presentations were followed by a discussion.

2. OBSERVATIONS AND FINDINGS

The meeting recognized the achievements of the Model Project in all aspects of establishing and/or upgrading radiation safety infrastructure in regulatory framework and occupational radiation programmes. The participants expressed the view that the Model Project offered a very effective way of addressing the Member States' needs in meeting the principal requirements of the international BSS. The meeting recognized, however, that there were still significant outstanding elements of the infrastructure that need to be established and/or developed with the assistance of the IAEA. This concerns particularly medical and public exposure control programmes as well as developing a capacity for emergency planning and response.

The success of the Model Project has attracted the participation of all developing countries, including new Member States of the IAEA. In view of the radiation safety requirements as a prerequisite to all technical co-operation projects involving radiation sources, the success of the Model Project achieved so far, and the increasing number of the participating countries, the IAEA is commended for the introduction of this extremely effective regional modality for addressing countries' needs.

Several specific areas were pointed out requiring further attention. Somewhat little attention seems to be paid to arrangements at workplaces, such as classification of areas, use of local rules or the establishment of investigation levels, i.e. to overall optimization of the protection of workers. Provided that there is a system of inspection in place — which is the case in most participating countries — significant progress could perhaps be made relatively easily by emphasizing these matters in the inspection programme.

Medical exposure control still remains a major challenge for many participating countries. In this area, overall doses and also risks for accidental overexposures can likely be reduced significantly. Practical implementation of the measures needed rely highly on the commitment of the medical profession and, therefore, its involvement in all phases of developing controls — starting from drafting related regulations — is essential.

Acknowledging that, at the moment, exposures to natural radiation sources might not be a first priority issue when setting up a national infrastructure for radiation protection, it was noted that some activities involving naturally occurring radioactive materials (NORM) may result in such significant exposures to workers and to members of the public that they should not be totally disregarded. In some countries, NORM industries or exposure to radon in workplaces is actually the most significant source of occupational exposure.

The importance of networking was stressed. This includes networks for exchanging experiences among regulators and among radiation protection professionals. Costs could perhaps be shared by creating some technical services on a regional basis. Among these could be, for example, internal dosimetry and analytical services, but a desire for finding regional solutions for managing disused sources was also expressed. The IAEA should seek possibilities to promote various types of networking.

A continuing challenge in several countries is the low priority assigned by the government to radiation safety issues. This was shown by a lack of resources leading to, for example, difficulties in recruiting competent staff, and in delays in law promulgation. This is perhaps one of the major reasons for having to conclude today that the Model Project action plans were originally too ambitious.

Some countries also reported on increasing concerns about the security of sources.

As a whole, the Model Project has been very highly appreciated by the participating countries. For example, the training provided by the IAEA has been highly valued. Also, the peer review missions have turned out to be useful assistance to regulators setting up or upgrading national infrastructures. However, it was noted that some participating countries have not yet had the possibility to profit from these missions.

There was some discussion on the multilateral approach of the Model Project, resulting in slightly differing opinions, but the vast majority was in favour of continuing the Model Project. However, the objectives of the Model Project should perhaps be more clearly defined for each step.

Summary of Topical Session 4

RESOURCES AND SERVICES, QUALITY ASSURANCE, INTERNATIONAL SUPPORT OF SERVICES

Chairperson

K. COY
Germany

Rapporteur

R. CZARWINSKI
Germany

1. IDENTIFYING ISSUES

From 14 papers submitted, the Rapporteur's experience and the keynote address, the following issues were identified with regard to the priorities emphasized in the papers as well as in the discussion:

— Dosimetry is the capital service needed for all radioactive practices. If not provided by the regulatory body, it must be carried out by an approved institution and prove available for immediate action. Since dose record keeping must warrant operation for life, and take account of the mobility of persons monitored, it shall be provided centrally on behalf of the government.
— Requirements for internal dosimetry laboratories were not described in detail.
— The role of technical advisory services was emphasized, although not for using such expertise for the planning or construction of sophisticated installations.
— Calibration services, including intercomparison analyses, were among the few international services being provided and acknowledged.

- Quality assurance and management systems — particularly for medical appliances — were found indispensable, but on some occasions difficult to impose. The assisting role of the IAEA was clarified for that issue.
- The question of provision of emergency equipment was raised; lack of maintenance services was reported.
- Waste management was not highlighted in the papers or in the discussion.
- Outsourcing and the level of decentralization were considered, depending on the type of service.
- Environmental monitoring was mentioned in a few papers.
- Critical opinions were highlighted, referring to the independence of inspectors (with the option of contracted inspectors) and of authorities in general.
- For the distribution of services between regulatory bodies and private companies, there was agreement that authorities should concentrate on the provision of essential radiation protection services and engage or encourage external institutions for accompanying services.

2. FINDINGS

The following findings arose from the presentations and from the ensuing discussions:

- The full range of services potentially being rendered from ‘outside’ appears not to be recognized yet.
- International co-operation can be propagated in a better way.
- Generic governmental and merely technical services need to be identified.
- Cost effectiveness of services is to be considered.

Summary of Topical Sessions 5 and 6 and Round Table 2

SUSTAINABLE EDUCATION AND TRAINING: DEVELOPING SKILLS

(Topical Session 5)

Chairperson

P.N. LIRSAC
France

NEEDS FOR INTERNATIONAL EDUCATION AND TRAINING

(Topical Session 6)

Chairperson

A. ALONSO
Spain

STRATEGY FOR DEVELOPING AND SUSTAINING KNOWLEDGE AND COMPETENCE

(Round Table 2)

Chairperson

M. REPACHOLI
WHO

1. EDUCATION AND TRAINING

The IAEA has defined a Strategic Approach to Education and Training in Radiation and Waste Safety (Strategy on Education and Training) aimed at establishing, by 2010, sustainable education and training programmes in Member States. This Strategy was endorsed by General Conference Resolution GC(45)/RES/10C that, inter alia, urged the Secretariat to implement the Strategy on Education and Training. This strategy is based on:

— The establishment in Member States of national, regional and collaborating training centres to conduct such education and training activities in relevant official languages of the IAEA.
— The ‘train the trainers’ concept is aimed at increasing the number of skilled people in each country, promoting the safety and radiation protection culture and the sustainability of the infrastructure.
— The networking of such training centres.

2. FINDINGS AND STATEMENTS

During Topical Sessions 5 and 6 and the related Round Table 2, it was stated that:

— The implementation of the strategy is in progress.
— Many countries already have a well established national infrastructure and regulatory requirements for education and training activities. Two opposite approaches are adopted: a very prescriptive one where the legislation incorporates detailed requirements (for authorization, content of training courses, accredited training centres , trainers, etc.) and a more flexible one involving general goal setting legislation.
— Evolution of training is as different in each country as the regulatory requirements (due to history, culture, radiation applications, particular situations, influence of individuals, etc.), however, there are some more general factors:

- Training is the motor to improve radiation safety in a country.
- National co-operation is an important element (training should involve all concerned governmental, academic and research organizations and professional associations).
- International co-operation is a significant factor, particularly concerning the training of qualified experts.
- Training should not be limited to those directly involved in the handling of radiation sources or radioactive substances (it should include radiation protection modules in university curricula, provide awareness training for groups potentially involved, such as staff members from hospitals, members of security forces linked to physical protection activities or emergency preparedness, personnel at airports in charge of transport and/or storage of radioactive substances, police, fire workers, etc. and it should inform medical doctors, teachers, journalists, etc.).

— It is not known if the training infrastructure set up by Member States is effective or not. A specific appraisal tool and procedures are necessary for such assessment.
— Six training centres are providing PGEC courses and specialized training courses at regional level in Arabic, English, French, Russian and Spanish. This has resulted in the training of 150–180 qualified experts per year.
— The primary categories of persons to be trained are operators, radiation protection officers (RPOs), qualified experts (QE), regulators and inspectors. However, the definition of a QE is different in the IAEA BSS compared with the EURATOM BSS. There is also a need for clarification and harmonization of roles and duties of RPOs.
— Education and training activities should take into account the very large spectrum of radiation applications, of radiation sources and of activities of the trainees through a diversity of specific and appropriate educational tools.
— To achieve the sustainability of training programmes in Member States, it is essential to develop at the same time trainers' skills and capabilities, as well as technical competencies. The 'train the trainers' courses that are currently being piloted should be organized on a larger scale.
— Government commitment is a key for sustainability. In parallel, for regional training centres, a long term agreement with the IAEA is essential for hosting PGEC at a regional level.

3. RECOMMENDATIONS

3.1. General policy

— The IAEA should continue implementing its Strategic Approach to Education and Training in Radiation and Waste Safety (Strategy on Education and Training) aimed at establishing, by 2010, sustainable education and training programmes in Member States and to continue to strengthen, subject to available resources, its current effort in this area, and in particular to assist Member States, national, regional and collaborating centres, in conducting such education and training activities in all the official languages of the IAEA.
— The IAEA strategy should be developed in collaboration with other appropriate international organizations, such as the WHO, OECD/NEA, ILO and PAHO.
— The IAEA, in accordance with its Strategy on Education and Training, should continue to help Member States to provide post-graduate

education courses leading to a diploma in radiation protection; to develop and disseminate standardized, specialized and public education curricula and training modules for radiation safety and security, and to deliver training courses where needed when possible in local languages.
— The PGEC helps to create a core of qualified experts (QEs) in Member States, but to amplify the dissemination of radiation protection and safety culture, it is essential that these new QEs are involved as quickly as possible in training the RPOs. This is clearly not the role of the IAEA but of the Member States. Nevertheless, in order to reach sustainability as soon as possible, when implementing the Strategic Plan, the IAEA should prepare training packages specifically addressed to RPOs in medical and industrial areas.
— The concept of 'train the trainers' should be continued to increase the number of skilled trainers in each country, and thus to promote sustainability of the infrastructure.
— The IAEA should update and enlarge its glossary in 'nuclear, radiation, waste and transport safety' terminology, and have it translated into the official languages of the United Nations, as it should be considered a substantial part of the training packages.
— The definition of QE should be clarified with other international organizations in order to meet the need for mutual recognition.
— Appraisals and/or self-appraisals by the IAEA and/or by the Member States of the development of the provisions for education and training in radiation safety should be conducted in a consistent manner to ensure the quality of programmes and the compliance with IAEA Safety Standards.

3.2. Establishing education and training infrastructures

— Member States should take advantage of the information contained in pertinent IAEA publications, such as Training in Radiation Protection and the Safe Use of Radiation Sources (IAEA Safety Reports Series No. 20, 2001) and the Safety Guide Building Competence in Radiation Protection and the Safe Use of Radiation Sources (RS-G-1.4).
— Adequate training of workers, operators, RPOs and QEs in radiation safety should be a prerequisite for granting a licence/authorizing a practice.
— Because of the broad spectrum of radiation applications (e.g. energy, medicine, industry, agriculture, petroleum, mining and biological research) of radiation sources (i.e. reactors, accelerators, radioactive sources) and of the future activities of the trainees (including equipment maintenance, radioactive source user, radiologist, radiobiologist,

radiation protection officer, radiation expert, regulators, etc.), adequate education and training programmes should be developed and maintained to meet the many varieties of needs in a given Member State.

- Member States should ensure proper education and training of occupationally exposed workers (such as medical, irradiator facility staff and regulators), as well as potentially exposed workers (such as source distributors, police, fire fighters, scrap dealers, customs officers and border guards).
- In addition, appropriate information and communication should be provided by Member States to news media personnel and the general public about radiological hazards, radiation protection, waste safety and emergency response.
- Training subjects should be enlarged when necessary to include a basic understanding of other safety issues relating to chemical, biological and physical hazards in the workplace.
- Links between training (which is the driving force of radiation protection), research, operational radiation protection, communication (stakeholder involvement), development and implementation of radiation protection standards and establishment of specific regulatory requirements should be identified and used to improve the radiation protection infrastructure in a country.

3.3. Organizing training

- Training curricula as well as the IAEA Standard Syllabus have to be updated continuously to meet modern needs (for example, to include more specialized computer training and new technologies); training material, standardized and translated into the languages of the region, has to be updated regularly.
- National or regional courses have to be held in the main language of the country or region; countries with a different language than the main one in their region should send their trainees to regional courses in a region speaking their languages.

3.4. Networking

- A discussion platform on training issues should be established at an international level (an initiative of the European Union).
- A network of collaborating training centres should be established (an initiative of the IAEA).

Summary of Topical Session 7

AUTHORIZATION, INSPECTION AND ENFORCEMENT, AND INDEPENDENCE OF REGULATORY AUTHORITIES

Chairperson

HUA LIU
China

Rapporteur

A. OLIVEIRA
Argentina

In this session, the participants of the conference discussed issues including the effectiveness and efficiency of the activities of the regulatory bodies involved in authorization, inspection and enforcement. Also discussed was the independence of regulatory bodies with promotion departments. Topics covered by this session were a comprehensive programme and practical implementation, including a graded approach to regulatory requirements; licensing of cross border situations; quality assurance issues for regulators; correct balance between enforcement and co-operation; and source inventory.

Hua Liu from China chaired the session. S.B. Elegba from Nigeria introduced the Nigerian experience of arrangement for authorization, inspection and enforcement. A. Janssens from the European Commission introduced the experience of the European framework for authorization, inspection and enforcement for radiation safety, and clarified that a 'competent authority' in European radiation safety regulations should be understood to be a 'regulatory authority', as defined in the IAEA BSS. The experiences from the two speakers were useful and informative. There were 23 contributed papers from 20 countries in Topical Session 7. A. Oliveira from Argentina, as Rapporteur, summarized all the contributed papers during the conference.

The participants of the conference were satisfied with the progress achieved by the Member States under the full support of the IAEA Model Project on radiation safety infrastructure, and hoped for the continuity of the

Model Project, in order to further improve the effectiveness and efficiency of the regulatory bodies involved in authorization, inspection, enforcement — and their independence with promotion departments for nuclear technique. The following is a list of findings and recommendations:

- The Member States should ensure that their regulatory bodies have effective independence and that they have the authority, competence as well as sufficient resources to sustain effective operations for regulatory activities.
- The IAEA should encourage Member States to incorporate quality assurance into their regulatory infrastructure and provide some requirements or guidance on quality management. The Member States should conduct peer reviews of their infrastructure performance, using the newly established performance indicators by the IAEA.
- The IAEA should help Member States to strengthen their infrastructure for border monitoring and the detection of illicit trafficking, including guidelines, training, exercises and improved detection technologies. Regulatory authorities should develop good collaboration with law enforcement authorities for border monitoring and detection of illicit trafficking. A standardized format for the authorization of radioactive sources and harmonized procedures for importing and exporting radioactive sources should be developed. Every Member State involved in the import or export of radioactive sources should take appropriate steps to ensure that transfers are undertaken in a manner consistent with the provisions of the Code of Conduct on the Safety and Security of Radioactive Sources and that transfers of radioactive sources in Categories 1 and 2 should take place only with prior notification by the exporting State and, as appropriate, consent by the importing State in accordance with their respective laws and regulations.
- The national radiation safety and security infrastructure should ensure control of high risk radioactive sources from manufacture to disposal. Regulatory and other relevant authorities should ensure manufacturers, suppliers and users maintain continuity of control of high risk radioactive sources. Provisions should be required by the regulatory authorities for radioactive source disposal or long term storage of disused sources.
- Each Member State should establish a national registry of radioactive sources with adequate information on source inventory. This register should, as a minimum, include Category 1 and 2 radioactive sources. The IAEA should make available a standardized format for the national registries, using an upgraded version of the existing Regulatory Authority

Information System (RAIS). The IAEA should also provide assistance for RAIS in network version and in different languages.

— Easy to understand systems of identifying or labelling radioactive sources in Category 1 and 2 should be developed, where practicable, and used as a guide worldwide. The IAEA should help Member States to establish practicable methods for this kind of identification system for the existing high risk sources.

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Topical Session 7	HUA LIU	China
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