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NOTE

The International Atomic Energy Agency (IAEA), in co-operation with the World Health Organization (WHO), the International Labour Office (ILO), the European Commission (EC), and the OECD Nuclear Energy Agency (NEA), organized the *International Conference on National Infrastructures for Radiation Safety: Towards Effective and Sustainable Systems*. The Government of Morocco through the University Mohammed V, Agdal is hosting the conference in Rabat, Morocco, 1-5 September 2003.

This book contains contributed papers submitted on pertinent issues, including stakeholder involvement, IAEA Model Projects on Upgrading Radiation Protection Infrastructure, Quality Assurance, education and training, regulatory activities, performance evaluation, source security, and emergency preparedness. The papers were accepted following guidelines established by the Programme Committee. The material in this book has not been edited by the IAEA. However, certain modifications were made: a unified format was adopted for all papers, abstracts and conclusions were added when missing, and a few corrections were made in the text. Some papers were presented as posters only, and for them only an abstract appears in this book. After the Conference these contributed papers will be published on a CD ROM as part of the Proceedings of the Conference, along with the invited papers and discussions. Authors wishing to make slight modifications to their papers may contact the Conference Secretariat.

The papers are grouped by topical session, but there is some overlap between topics, and a given paper could pertain to more than one session.

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STAKEHOLDER INVOLVEMENT IN BUILDING AND MAINTAINING NATIONAL RADIATION SAFETY INFRASTRUCTURE (NATIONAL AND INTERNATIONAL)

Historical experience and practice of the Ministry of Health of Bulgaria with regard to protection of professionals and population from ionizing radiation

D.N. Hristoskova, R. Georgieva, G. Vasilev

National Center of Radiobiology and Radiation Protection
Sofia, Bulgaria

Abstract. The use of ionizing radiation (IR) in Bulgaria (x-ray diagnostics) dates back to the early XX century. Its application to medicine, industry, science, education, etc. has been gradually extending. Since 1974 a Nuclear Power Plant with 6 reactors and total electric power of 3,76 GW in Bulgaria has been operating. At the beginning of the 21st century about 14000 persons are occupationally exposed to IR, the total amount of the population being about 8 millions. The health aspects of radiation protection are realized by special structures of the Ministry of Health, which are one National Center of Radiobiology and Radiation Protection and centers in five of the biggest regional in the country. In the sphere of radiation protection Bulgaria maintains close contacts with all international institutions: IAEA, WHO, EURATOM, ICRP, UNSCEAR, ICRU, etc.
In Bulgaria Basic Standards for Radiation Protection were published in 1936, 1958, 1965, 1972, 1992 and 2000. They all strictly comply with the international publication of ICRP (№ 6, 9, 26, 60), the IAEA Safety Standards (1963, 1967, 1982, 1996) and EC (DIR 96/29).
In the time of pre-accession in the European Union in Bulgaria there is an intensive harmonization of legislative acts and regulations in the sphere of the radiation protection with the EU acquis.

Co-operation in Development of Radiation Protection: The case of the Central Eastern European ALARA Network

G. Morkunas[a], M. Gustafsson[b], C. Lefaure[c]

[a]Radiation Protection Centre
Lithuania
[b]International Atomic Energy Agency
Vienna, Austria
[c]CEPN
Fontenay aux Roses, France
France

Abstract. The experience gained in the creation of the Central Eastern European Network (CEEAN) is discussed with emphasis on its co-operation with the International Atomic energy Agency, IAEA, and the European ALARA Network. Despite the problems encountered at its creation, and limited resources, the CEEAN has already proved to be an effective tool in information exchange on the practical implementation of the principle of optimization of radiation protection.

1. Introduction

One of the basic radiation protection principles, namely, the principle of optimization, is relatively well understood by the radiation protection community. However, the implementation of this principle is accompanied by problems, most of which are connected with practical (operational) radiation protection. Adequate radiation protection infrastructure is a basic prerequisite in the creation of the radiation protection system, a system which effectively protects all members of society, takes into account the existing national resources, does not impose any unnecessary restrictions on obtaining benefits from ionizing radiation, and is trusted widely. However, use of radiation creates practical problems, which cannot always be easily resolved by just one country, one regulatory authority or one radiation protection institute. In these cases the exchange of information, the assessment of situations and collective attempts to find a solution are needed more and more.

Different countries in Europe have achieved different levels in radiation protection. Material resources, availability of national experts, development of services, even traditions and history are factors having an influence on operational radiation protection in different countries. On the other hand, several countries are encountering similar problems, have similar history, achievements, etc.

The International Atomic Energy Agency, IAEA, is, in its programme on radiation safety, supporting its Member States in their implementation of the optimization principle, for example, through the publication of a Safety Report on Optimization of Radiation Protection in the Control of Occupational Exposure [1]. It is also co-sponsoring the Information System on Occupational Exposure (ISOE), a worldwide system for information exchange on occupational exposure in nuclear power plants [2]. Support for radiation protection programmes is also provided through the IAEA Technical Co-operation programme, mainly through the Model Projects on Upgrading Radiation Protection Infrastructure (hereafter called the Model Projects) [3].

To initiate the fostering of information exchange on methodologies for occupational dose reduction in industries and practices other than nuclear power plants and on dosimetric information in these practices, the IAEA contacted the European ALARA Network (EAN) created in 1996. A meeting, with participation from the EAN, to Review the Existing Information Exchange on Methodologies and Techniques for Occupational Dose Reduction in Different Industries, excluding Nuclear Power Plants, and to Plan for Future Activities was held at the IAEA on 17-20 April 2001. The purpose of the meeting was to draw from the experience gained by the EAN and review how this could be applied in other IAEA regions. Representatives from all IAEA regions took part in the meeting, which concluded that regional ALARA Networks would be feasible and might significantly enhance the feedback, exchange and dissemination of information on practical radiation protection issues. The strategy of creation of such Networks was discussed, possible areas of activities of Networks delineated and the most appropriate means identified.

2. Creation of the Central Eastern European ALARA Network (CEEAN)

During meetings of radiation protection experts from Central and Eastern European countries common points of interest and problems were identified long ago. These problems are successfully solved through the IAEA Model Projects, but radiation protection is developing so quickly that new problems are continuously arising.

The meeting organized by the IAEA in 2001 was the starting point for the creation of the CEEAN. Information on the possibility to have such a Network between countries and participants of the Model Projects has been disseminated. This information emphasized the intricacy of radiation protection, stressed presence of common problems, suggested co-operation as one possible way of solving the problem, and asked for opinions rather than commitment of any kind.

Approximately ten countries, i.e., their radiation protection regulatory authorities, responded with expression of interest, support and willingness to join an ALARA Network. Almost everybody stated that support by the IAEA was very important for creation of the Network.

A meeting was held in Vilnius, Lithuania, on 8-10 April 2002, with the support of the IAEA, to establish a regional ALARA Network aimed at enhancing optimization of protection and reducing occupational exposure. Experts from five countries, the IAEA and the EAN took part in the meeting.

The CEEAN and its Steering Committee were established. In addition the basis for its operation and an action plan were agreed during this meeting. Constitution of the CEEAN was drafted and adopted and the plan elaborated. The meeting emphasized a need to include medical and public exposure within the scope of its activities, because these areas are also very important in the countries to be represented in the Network.

The creation of the CEEAN, was based on: existing Networks of exchange of information, the need to find common solutions to similar problems encountered by potential members of the Network, necessity to further develop the national radiation protection infrastructures already created with the help of the IAEA, initiative of the IAEA in creation of such Networks, and common hopes for the future.

3. The basic principles of the CEEAN

The objectives of the CEEAN were defined on the basis of the existing situation, common problems and real possibilities. They include building the programme of work and Network of contacts developed during the Model Projects, promotion of the application of the ALARA principle in occupational radiation protection, medical exposure and public exposure, provision of the means for feedback experience to the users and dissemination of good practices in these areas, provision of feedback to the IAEA programmes and to proposals of prioritized needs in this region.

The Network is based on voluntary participation and voluntary termination of membership, openness for new members, equal rights and responsibilities of all the members, responsibility of members for inputs, active participation of all the members, objectivity and impartiality of outputs.

The following activities are foreseen: information exchange on operational radiation protection, case studies, publication of an annual newsletter, creation of ad-hoc working groups devoted to important problems, annual meetings, seminars and training courses.

The possible contents of the newsletter were defined. The list includes an editorial, information on particular issues by persons especially experienced in these fields, information from the EAN and the IAEA, cases and their analyses, incidents and accidents and lessons learnt, announcements about forthcoming events of interest to members of the Network, a list of the national contact points. Seminars and workshops (duration 3-5 days) would be devoted to particular problems of optimization.

The end users are radiation protection regulatory authorities, licensees, supporting organizations and, if appropriate, emergency response organizations, radiation protection experts, radiation workers, radiation protection regulators, radiation protection officers, i.e., all the interested parties. The wide audience also creates the issue of the accessibility of the material of the Network. Material in English cannot be widely used in some countries under consideration. It was decided that that the common language of operation of the Network will be English and national contact points would be responsible for translation if they consider it necessary.

The activities of the CEEAN are co-ordinated by the Steering Committee which consists of the national contact points. National contact points collect the necessary data and present it to the Network, disseminate data in their countries in the appropriate language, make preparations for meetings, workshops and training courses in their country.

The CEEAN members are states, at present represented by their radiation protection regulatory authorities. The main fact which should be taken into account is the efficacy of Network activities – any national institution with enough authority and competence might be a representative in the Network. It is highly desirable that each member state is represented by one institution, but more than one institution with well defined responsibilities might also represent any member country. The opinion of the IAEA on authority and competence of a particular institution is welcome, respected and taken into account by the Steering Committee. The new members are accepted by the Steering Committee after receiving the official request.

It is clear that the CEEAN is a democratic informal and effective organization open for new members. It is very important that the main priority of the Network is radiation protection, the main value – professionalism, the main task – effective use of existing resources for effective protection against ionizing radiation for members of public, workers and patients.

4. Role of the IAEA in development of the CEEAN

The CEEAN was created on the initiative and with the support of the IAEA. Also, the CEEAN in its activities follows the recommendations of the IAEA so, in fact, the task of the CEEAN is the effective implementation of the best practices elaborated by the IAEA.

In its note "Findings and Recommendations of the International Conference on Occupational Radiation Protection: Protecting Workers against Exposure to Ionizing Radiation", held in Geneva, Switzerland, in August 2002, the Secretariat of the IAEA states: "…the continued use and expansion of international mechanisms for facilitating application of the fundamental principle of optimization of occupational radiation protection (i.e. that such protection should be the best under the prevailing circumstances) – for example ALARA Networks – should be created".

There is no doubt that Networks like the CEEAN will need support, at least in the beginning of their activities, which might be methodological (establishment of principles of operation of the Network, organization of meetings, seminars and training courses, giving advice, and even encouragement) and material (support of participants and outside experts for attending different events, presentation of training material). The role of the IAEA in such activities might in due course change because one of the Networks should become self-sufficient and self-sustainable but close connections of these Networks with the IAEA will ever remain important.

The role of the IAEA in the development of the CEEAN is still increasing despite the fact that the Network already exists. It is positively taken by all the participants. On the other hand, the experience gained in this particular case will be also helpful for the IAEA in development of similar structures in future.

5. Co-operation of the CEEAN with the EAN

The EAN long ago proved that the existing formal system of exchange of information between different countries might be very helpful both for these countries and the international community. It is enough to mention the items dealt with during the EAN workshops: ALARA and decommissioning, good radiation practices in industry and research, managing internal exposure, management of occupational radiological and non-radiological risks: lessons to be learned, industrial radiography: improvements in radiation protection, occupational exposure optimization in the medical and radiopharmaceutical sectors. The experience of the EAN was extensively used in the creation of the CEEAN.

These Networks are in close co-operation. Despite the differences in scope of both Networks (medical exposure is out of the scope of the EAN), differing amounts of available resources and availability of expertise in member states of the Networks, an operational co-operation on radiation protection is possible and effective. A representative of the EAN participates in the Steering Committee of the CEEAN, and vice versa, the CEEAN co-ordinator is invited to the EAN Steering Group. All material issued by each network is immediately made available to the other. The EAN organizes workshops where the CEEAN members are invited and it is envisaged that when the CEEAN will organize such workshops, the topics will be chosen in order to have a complimentary approach. Co-operation is facilitated by the fact that some members of the CEEAN are transposing and introducing the EU radiation protection directives into national legislation.

The development of the key elements of a radiation protection infrastructure which might be facilitated by an effective operation of the CEEAN will further strengthen a future close co-operation between these Networks.

6. Present activities of the CEEAN and problems encountered

The first newsletter of the CEEAN was published in its Webpage www.rsc.lt/alara. Contacts among national contact points are kept, different radiation protection issues are discussed. It is indicative that these issues usually are characteristic for all the members of the CEEAN. In addition to occupational radiation protection, items such as shielding of accelerators used for cargo control on the borders, control of radioactivity in mail, and the minimum size of x-ray rooms were discussed.

It is important to emphasize that all the activities of the CEEAN after its creation are performed with minimum resources, using electronic means of communication. It shows that the results might be achieved even with restricted resources, which is rather common in the countries which are present and potential members of the CEEAN.

However, the problem of commitment still remains. National contact points of the CEEAN need to be more active and more end users should be included in the activities of the Network. The attitude is changing and it indicates that such Networks might be a good tool in development of self-confidence and self-sufficiency. It is particularly important taking into account the fact that the knowledge and experience already gained in previous projects shall be used as effectively as possible. In this respect the close co-operation between CEEAN, EAN and IAEA is very important.

7. Conclusion

The main result of the CEEAN is the fact that the Network already exists. Its necessity is seen by all the members of the Network. In future it might be a very operative and effective tool in resolving the different problems both at the national and international level.

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Development of Technical Capabilities for Sustainable Radiation and Waste Safety (RAF/9/029)
Status of resources and services in Kenya: A stakeholder's view

[a]**D. M. Maina**,
[b]**J. A. W. Maina,**
[a]Institute of Nuclear Science, University of Nairobi, Kenya
[b]Radiation Protection Board, Nairobi, Kenya

Abstract.. Provision of radiation services and acquisition of radiation detection and measurement equipment in the country has been generally lacking dating as far back as 1995. During the period 1995 to present, Kenya's Regulatory Authority, the Radiation Protection Board (RPB) undertook to provide personal monitoring, quality assurance, radioanalysis among others. Over the years these services have stalled due to outdated equipment most of which have broken down. A maintenance and calibration service for nuclear equipment is an expensive issue. Staff retention has been declining over the years. However, the trend is reversing and stakeholders are taking increasingly active roles in sustainable national and regional resource and service development programmes.

1. Introduction

Nuclear applications in Kenya are on the increase in all major fields of socio-economic development. Provision of regulatory services, guidance and enforcement procedures, has also grown over the last fifteen years. However, staff retention is a critical issue where job opportunities, with relatively high incentives, are high either inside or outside the country. Human and equipment resource development has not kept pace and this has hampered effective and efficient provision of services. The poor status of the economy has had its impact on delivery of quality service.

2. Regulatory Authority

The Radiation Protection Board is the Regulatory Authority in Kenya. It is established by an Act (law) of Parliament promulgated in 1982. The Act was revised in 1985 [1] shortly before becoming operational in 1986. There was subsequent subsidiary legislation (Legal Notices No. 54 and 55 of 1986), which set procedures and standards mainly in the medical sector [2,3].

The Regulatory Authority is attached to the Ministry of Health. This parent Ministry runs the bulk of medical radiation facilities with the highest number of radiation workers. It is therefore expected that the Regulatory Authority face difficulties of a regulatory and enforcement nature in ensuring compliance with regulations and standards by the Ministry's radiation facilities.

The Authority has also published a revised draft of the Act which ensures autonomy, wider coverage of radiation practices and empowerment. Stakeholders have been involved in this process from the onset. The draft also addresses the principal requirements of the International Basic Standards (BSS)[4].

Legislation of regulations (legally binding guidelines) under the main Act, targeting specific practices should be a priority. Apart from the 1986 subsidiary legal notices, no other regulations have been gazetted.

3. Personal Monitoring

There are about 2,500 radiation workers in the country. Most of the workers work in well-established radiation facilities. However, there has been a general lack in provision of essential radiation safety services within such radiation establishments that have been licensed by the Regulatory Authority. Such services are personal monitoring, routine safety surveys, contamination and leak tests, among others.

There is a general belief that the Regulatory Authority has the obligation and responsibility of providing such services. The Radiation Protection Act provides that such services are the moral and legal responsibility of the licensee. Proper dissemination and enforcement procedures on provision of safety services should be established, published and executed by the Regulatory Authority.

Currently the Regulatory Authority, through its National Radiation Protection Laboratory (NRPL), provides Personal Monitoring services for about 300 medical radiation workers. The Ministry of Health has put in place film badge monitoring services for all government radiation workers while those in the private practice are either monitored (about 200) by private organizations or go without the service.

The Regulatory Authority has set up a central record keeping system for external and internal radiation dose. Stakeholders have come up in support of this move. Personal Monitoring and central record keeping are aimed to be self-sustaining services.

4. Equipment Calibration and Maintenance

Technical equipment (for radiation detection and measurement) have been provided through support from the International Atomic Energy Agency (IAEA).

Most radiation facilities do not have monitoring equipment. It is not enough for a Radiation Safety Officer (RSO) in a radiation facility to have a radiation monitor, whose readings cannot be independently verified. It is essential that such equipment be calibrated on a regular basis.

Calibration and maintenance of radiation detection and measurement equipment is coordinated by the Regulatory Authority. The services are sourced from the Secondary Standards Dosimety Laboratory (SSDL) at Arusha, Republlic of Tanzania. The Regulatory Authority also handled equipment maintenance services. However, with the advent of more modern equipment based on ‘intelligent grains of sand’ the service could not be sustained, as human resource development did not keep pace.

Cost of calibration and maintenance of equipment abroad may not be acceptable to decision makers of radiation facilities. Even government funding for the calibration exercise is delayed by ‘red tape’. In addition long overland travel, as is the case in Kenya while submitting equipment to the SSDL in Arusha, through uneven roads and terrain, may not auger well for electronic equipment. Risk of loss or damage is high.

Such technical services should be provided by stakeholders, Non Governmental Organizations (NGOs) and International Organizations through accreditation. Incentives have to be provided and enforcement actions taken to ensure compliance.

5. Radioanalysis

A Multi-channel (3”x3” NaI(Tl) Crystal) gamma spectroscopy system belonging to the Regulatory Authority has been beyond repair for several years now. The Institute of Nuclear Science, University of Nairobi, is currently offering Radioanalytical services with the understanding of the Regulatory Authority. The Institute uses a Hyperpure Germanium Detector system.

Other private organizations like the SGS (K) Ltd. supplement radioanalytical services. More equipment are therefore needed especially for regulatory and intercomparison purposes as well as decentralization of the services.

6. Human Resources and the 'brain drain'

Kenya has placed the issue of human resource development high on her development agenda. Human resource development is a recurrent need for capacity building. In Kenya, as in most other member countries, the 'brain-drain' has been high and is clearly visible in the current number of Regulatory Authority's technical staff – eight (8) only – with a higher number having left.

To address this issue government support has been provided to expand technical staffing of the Regulatory Authority with an initial recruitment of seven (7) technical staff. Other factors that impact on provision on competitive incentives, and staff retention, are being appropriately addressed. Concrete steps have to be taken to ensure staff retention.

Continuous emergence of nuclear applications, expansion and decentralization prorammes, offer new job opportunities that require additional qualified and skilled staff. A pool of such qualified and skilled staff should therefore be established from which the government, the private sector and the international community can tap from. Of course the stakeholders would be obliged to provide support for such a pool. The IAEA has provided immense support in personnel training through training courses, workshops, scientific visits and international conferences.

7. Emergency Response

Most radiation facilities have, in principle, radiological emergency procedures in place. However, the Regulatory Authoriy, stakeholders and other government organs have not established a common national response procedure. A systematic approach to a national response plan is desirable. To this end, the Regulatory Authority should take the lead and enhance co-operation and co-ordination with stakeholders and other government agencies for capacity building in this area.

The Regulatory Authority also needs to have an inventory of available resources and be able to mobilize such resources to execute a National Response Plan.

8. Way Forward

That the Regulatory Authority needs to be independent cannot be overemphasized.

Regulatory responsibilities of a Regulatory Authority should be de-linked from provision of services and resources to licensees.

9. Conclusion

It is evidently clear that in order for effective and efficient provision of regulatory services, current legislation on composition, legal empowerment, and independence of the Regulatory Authority should be revised, as an immediate need, so as to keep pace with the current trends in human resource development, provision of services, as well as enforcement activities, within the region and throughout the world.

In the provision of services and training of manpower resources, stakeholders – both national and international – should be fully involved to compliment efforts by the regulatory authority in building and maintaining an effective and efficient national infrastructure. To this end the regulatory authority should play the crucial liaison role to enhance cooperation and coordination in capacity building.

The regulatory authority should also make concerted efforts, involving stakeholders, in prioritizing service areas where technical equipment can be collectively acquired and shared at national, or even regional, level.

Binding action plans for development of sustainable resources and services should form the bond between the regulator and the stakeholder.

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Role of Partnership in Enhancing the Performance of Radiation Regulatory Authority in Zambia

S. C. Banda

Research and Development Coordination User Liaison Section
National Institute for Scientific and Industrial Research
Lusaka, Zambia

Abstract. The National Radiation Infrastructure includes legislation, human resource, technical capacity to execute responsibilities of the regulatory (1). In cases of developing countries like Zambia, special challenges arise in view of the constraints both in terms of human resource and funding. This paper will highlight same measures that may be undertaken to improve the operations of nation radiation protection infrastructure. The measures include collaboration with Science and Technology organisations that have technical capacity, delegation of responsible to key institutions that may have competence and generation of funds through training and provision of reliable quality service. (2). In Zambia, some achievements in this line have been registered by Radiation Protection Board working with the University of Zambia and National Institute for Scientific and Industrial Research (3). Some measures of generation of funds have been done though utilization of the generated remains to be the limiting factor to exploit fully benefits that may arise from the use of the monies generated from services. Partnerships with private sector may be used as regulatory authorities for support to its programme in particular the public awareness campaign. Sponsorship by a Private Cellar Phone Company (Telecel Zambia) and Rotary Club of Lusaka for Radiation Week to Radiation Protection Service under Theme "***Safe Radiation Use***" is one such an example. The other opportunity is the technical cooperation with regional and international organisations such as SADC, IAEA, WHO, Interpol, EU and WCO for technical capacity building, human resource development and information access.

1. National Radiation Infrastructure

The National Regulatory Authority in Zambia is the National Radiation Protection Board. The Board functions within the framework of the Ionizing Radiation Act of 1972, Chapter 331 of the Laws of Zambia. The Board has membership that include University, Mining industry, Agriculture and Nuclear. The Board has the Radiation Specialist Protection Service that implement the programmes as determined by the Radiation Protection Board. (1)

Their major roles are regulatory through issuance of licence, monitoring through visits and documentation.

The Board has recently initiated the Regulatory Authority Information System (RAIS) for the control and management of radioactive sources.

2. Nuclear Science and Technology Peaceful Application.

The Peaceful Nuclear Applications in Zambia include medical institutions that have facilities for X-ray, nuclear medicine and radioisotopes relating to human health applications, industry use of various equipment in particular the process gauge control, Non-destructive facilities and road testing equipment. The cobalt-60 irradiator and the cesium-137 source are used for research and demonstration by the National Institute for Scientific and Industrial Research. The mining industry remains one of the major users of nuclear instrumentation in process control.

Partners to Enhance Performance of Regulatory Authority

The National Regulatory Authority has to take innovative approaches to enhance the performance in view of the constraints in terms of skilled human resource and funding.

Radioactive waste management poses a challenge to Zambia in the sense, that a government funded supported agency needs to take up the control of spent or disused and/or orphum radioactive source in view of the funding involved. This Agency can be set-up after the Radiation Protection Board recommends for institutions such as NISIR to take up the responsibility.

The Radiation Regulatory Authority through fees from licence, workshops/seminars and services has generated some funds. These funds can enhance the performance of the RPS of they can be utilized to improve technical capacity (purchase of equipment) and meet operation costs that relating to licencing, monitoring and control of radiation users. However, to fully exploit this avenue, there is need for reform to the Government regulations of the having the decisions relating approval being made of the use of funds generated by the Ministry responsible for health instead of the Radiation Board. (2)

The Radiation Protection Service has used the National Institute for Scientific and Industrial Research in conditioning of the spent or disused radiation source on the Copperbelt. This arrangement allows the regulatory authority use the technical expertise at NISIR to address one critical national need of the radioactive waste management. The expertise at the Physics Department of the University of Zambia have been involved in research relating to radon levels in the underground mines on the Copperbelt. (3)

In Zambia, partnership with private sector may be used as regulatory authority to mobilise support for the Public Awareness Campaigns. There is a documented case of the Rotary Club having collaborated with Radiological Society of Zambia and Telecel (Cellular Phone Company) in Public Awareness Acting on Radiation Week. The Cellular Phone Company sponsored T-shirts and public promotion materials in terms of posters.

This type of partnership can be use in the promotion of radiation safety and role of radiation protection by the private sector sponsoring leaflet to targeted particular audiences.

Partnership can also be exploited where the industry finances training of their safety officers to enable them acquire information on the roles in enhancing safe use of radiation and new development relating to the peaceful nuclear science and technology application.

The other opportunity is the technical cooperation with regional and international organisations such as SADC, IAEA, WHO, Interpol, EU and World Custom Organisation (WTO) that can be used to enhance the National Radiation Infrastructure in terms of technical capacity building, human resource development and access to relevant technical information.

The International Atomic Energy Agency (IAEA) will remain a key player in the human resource development in the areas of radiation safety. In order to amplify this situation, it may be appropriate to cite a situation that the Government of Zambia has with the OPEC Loan worth US$5.6 million to establish a Cancer Disease Diagnostic Hospital that include Radiotherapy Unit. Under this arrangement, IAEA will train medical technical personnel that include the radiation protection service. It should also be realised that the other training that involve nuclear techniques has the aspect of radiation protection as key to safe operation of equipment and use of nuclear techniques.

The nuclear science cadre may also consider ways to dialogue the Civil Environmental Protection Unit Societies as way to use such avenue to augment the requirements of an operational and effective technically competent radiation regulation authority.

3. Conclusion

This paper has outlined several cases that involve national radiation regulatory authority collaborating and partnering with other organisations with the focus on enhancing its performance that are aiming at ensuring that quality service of the radiation regulatory authority is provided to its clientele and the stakeholders.

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Stakeholder Involvement in Building and Maintaining Radiation Safety Infrastructure in Latvia
The case studies

A. Eglajs[a], **A. Salmins**[b]

[a] Ministry of Environment
Riga, Latvia

[b] Radiation Safety Centre
Riga, Latvia

Abstract. This paper comprises the assessment of interests for central and local governments, different authorities, public and commercial companies, political parties and non-governmental organizations, organised and ad-hock groups of public, which could contribute to development and maintenance of infrastructure for radiation safety, general environmental protection, as well as for public health among other similar fields. Understanding of these interests allows to be prepared for eventual demonstrations or publications against decisions about significant modifications of infrastructure and provides ideas how to explain needs of financial and human resources for maintaining of supervisory system and management of major facilities, which are vital for safety infrastructure. Two case studies are presented in this report related to modification of the framework law and the preparation of radioactive waste management strategy.

1. Introduction

Latvia has limited uses of radiation sources; there are neither nuclear power plants nor nuclear fuel cycle facilities in the country. The majority of applications are related to medicine and the use of radiation gauges in industry. In this rather limited radiation safety framework, it is probably easier to recognise major stakeholders than in the countries, which have much broader scope of application of radiation. Significant changes in supervisory system and in legislative framework took place recently in the country. A number of ongoing activities are related to waste management, the most important of them being decommissioning of the research reactor and, therefore also the expansion of radioactive waste disposal site.

Based on this background, the recently established new radiation and nuclear safety regulatory body together with Ministry of Environment is trying to assess already managed achievements as well as those difficulties, which we have met in the recent past, in order to mitigate them in nearest future. All of these questions are related to involvement of stakeholders on different levels and to various extent. Latvia follows international trends in this field, as it is always possible to find certain good examples, which a comparatively small country can consider and chose the best available option based on international experience from other countries. I would also like to refer, in this regard to one of the last international meetings on such issues, such as The International Stakeholders' Conference on Approaches to the Management of Environmental Radioactivity, which took place in Luxembourg on 2 and 3 December 2002.

2. Description of Case Studies

2.1. New framework law and stakeholders

2.1.1. Background for modernisation of legal framework

Latvia had *Radiation safety and nuclear safety act* in force already in 1994 [1] (a reminder: Latvia re-established its independence in 1991 and international experiences were limited in early 90ties). First Act was prepared by Ministry of Environmental Protection and Regional Development[1], taking into account the experiences of Sweden and Finland. Based on that framework law several regulations were in force, e.g. national basic safety standard, radioactive waste management regulations, safe transport regulations etc. It was recognised within country and also outside that some improvements were needed, but Act reflected (in general) all major recommendations in this field and also introduced necessary requirements to ensure safe practices with radiation sources.

Main difficulties and deficiencies of that system were related to situation of several regulatory authorities and there were some problems related to *independence of the regulator* because medical radiology applications were controlled by institutions from the Ministry of Welfare.

2.1.2. Major modifications in new framework law

Without detailed analysis of all juridical modifications in new Act, one could rise a question what was achieved to improve supervisory infrastructure and to clarify interaction between regulatory body and other relevant state institutions. The main achievements by Act from 2000 on Radiation Safety and Nuclear Safety [2] is the establishment of a single regulatory body – Radiation Safety Centre and to empower it for cooperation with all relevant institutions to ensure safety of sources and practices with radiation sources.

2.1.3. Stakeholders and their opinions regarding Act

From the legal point of view any physical or legal person within a country is a stakeholder because requirements imposed by the law have to be fulfilled and there are no formal excuses for non-compliances due to lack of knowledge or resources. More over certain provisions of law influence international activities and therefore international organisations, regulatory authorities in other countries and many other legal and physical persons need to be included within the list of stakeholders.

As in any state, Latvia also has established certain legal requirements how to collect opinions from major stakeholders and how to further proceed in cases where it is impossible to find solutions acceptable for all relevant parties. Definitely, always will be differences in opinions and wishes, but compromises must not compromise the safety otherwise we cannot ensure adequate safety level and fulfilment of international obligations.

The main stakeholders involved in modernisation of radiation safety framework law were as follows (starting from higher legal level, but obviously, that in negotiations among drafters of the act and stakeholders, usually discussions started from the bottom to provide chance for political leaders to validate already assessed proposals and not spending time for discussions about technical issues or consequences, which they cannot fully understand due to specifics and the need for special knowledge on certain topics):

— Saeima (Parliament) – to take into account opinions from political parties composing parliament and inhabitants who voted for those parties;

[1] Since February 1, 2003- Ministry of the Environment

— Cabinet of Ministers – to make proposal (draft act) for Parliament and to provide political and/or technical and financial decisions in case if some ministries cannot reach agreement on specific items; The Government acts at relatively late stage, therefore draft document must have already reached rather acceptable form and may only contain some options otherwise discussions at meeting of the Cabinet would be unsuccessful and could also imply negative consequences for unsuccessful drafters of the act.

— Ministries (in general and also certain number of them in particular – those who had or/and will have some competence to validate requirements and to ensure their fulfilment); That negotiation process could start at different stages (e.g. during the early drafting of Act, if their representatives are directly involved in that process or after the draft had been finished by limited number of expert's group leaded by one ministry or authority). There isn't the best option, one could remind a joke about management – if you have a lot of time or you would like to stop the process, then the best option is to establish a large working group officially, in this case you will be always busy and nobody would claim that all opinions are not discussed, but definitely, in such manner it is hard to believe that there will be outcome in limited time period. Certainly, many things depend from national traditions and circumstances, but as we had limited time (related to implementation of IAEA recommendations and planed accession to the EU) and wish to make successful second attempt (fist was in early 90^{th} and resulted with an Act in 1994) to establish good regulatory infrastructure few experts from the Ministry of Environmental Protection and Regional Development took initiative to develop new version of framework law. Involvement of representatives from other ministries in early stages were limited and mainly oriented to the experts who know the issue and also experts from leading institutions and facilities. As consequences of such procedure – we managed our job within reasonable time, however there were complaints, that changes had been proposed to meet our own interests (e.g. job, positions, influence to users etc.);

— Money keepers (Ministry of Finance) – official discussions about need for public funds were raised and negotiated at the end of drafting (after announcement of new act in weekly meeting of State secretaries), because operational expenses for regulatory infrastructure could be assessed only at a stage, when is clear what exactly will be established and what will be the tasks and scope of activities for regulators. Regarding public funds (budget and extra-budgetary resources) there were two questions:

  - first, investments for establishment of new system, for which we got strong support from our ministry (grant from Latvian Environment Fund), also from neighbouring countries (Sweden and Denmark) and the IAEA;

  - second, operational expenses (regular budget for new institution) – that question is usually one of the hardest because any ministry for finance does not like significant changes from year to year (very often if annual budget is not to be prepared as "zero budget" (when all assessments for expenses have to be calculated as they never been known before and for any financial position shall be prepared full explanation) everything is based on situation in previous fiscal year and increase should be within limits of increase in state income and with respect to changes in distribution of available resources among state institutions) for new regulatory authority legal establishment was in middle of the year as result in 2001 the increase of needed resources was less visible and easier acceptable.

— Owners of facilities etc. – it is not that easy to explain how interests of owners were taken into account, because they were involved under auspices of all possible groups of stakeholders and could be identified only in some specific groups e.g. dentists and companies who provide veterinary services – these groups were legally treated differently in previous, therefore their opinion was assessed in very early stages.

— Non-governmental organisations – this group of representatives from general public always stands outside of fully formal procedures. Latvia, as many other countries, decided to involve NGOs in formal procedures. But who can instead of NGOs decide which from these organisations should be consulted? Ministry of Environment maintain long traditions to keep continuous communication with the Environmental Protection Club (Latvian abbreviation VAK – green NGO, which was established in late 80^{ties}). There is also a Centre of NGOs (Latvian abbreviation NVOC), but as non governmental organisations they do not, and probably will not, formalise their activities. As a result, the Ministry should approach all members of Centre to ask their opinion, but it is technically not possible and there still is no guarantee that all NGOs would be approached. Therefore it has become a common practice to send documents for comments to the VAK and NVOC, in addition draft documents are published on the internet home page of the Ministry.

— Professional associations and interest groups (official organisations) – for radiation safety framework law the most important was the Association of Radiologists and Rentgenologists (professional medical doctors), but also several smaller groups delegated their experts already in early stages for drafting of the new law.

An outcome from consultations was reasonable validated version of new act, which also contains provisions for stakeholders' involvement in implementation of the safety system. Parliament approved establishment of the *Radiation Safety Board* (consulting organisation to the Government and also to the regulatory authority) and some tasks for the regulator – to maintain information flow to general public and local municipalities and consultations with them.

2.2. First radioactive waste management strategy

2.2.1. Background for strategy

Latvia has a national near surface radioactive waste repository, where since early 90^{ties} radioactive waste is stored in removable waste containers. According to the conditions of license for the operator (fully owned state company RAPA, which shall be reorganised as state radioactive waste management agency) the oldest part, which was used from 1962 till 1992, is licensed as a permanent disposal site, but the last vault – as a long term storage. A decision will have to be made on disposal of waste suitable for near surface repository and the rest of waste will have to be stored in interim storage until deep geological disposal option becomes available (either within country) or outside, should regional approach be accepted among countries.

Based on the decision of Government we are in early stages of decommissioning and dismantling of nuclear research reactor and therefore Latvia has a need to expand disposal capacity. Few years ago the disposal site in Baldone was assessed by consortium of EU radioactive waste management agencies (CASSIOPEE) [3]. The study was done within EU funded project and between recommendations for Latvia there are two suggestions related the new strategy:

— To build dedicated long term storage for spent sealed sources and long-lived waste,

— To modify disposal vault's design to meet current best available practices in other countries.

2.2.2. Scope of strategy

The Radiation Safety Centre together with the Ministry of Environment and company RAPA drafted strategy, which already was published, opinions are collected and assessed, but strategy is not yet approved. The main items prepared for considerations of the Cabinet of Ministers are:

— Methods for financial support (called also as compensation for risk, but authors of this document do not share such opinion) to local municipalities, which are in close vicinity of disposal site. Question, which shall be considered is either any direct compensation could be acceptable for potential risk (all of us are living under certain technological risks) or could there be an option of fixed payments from central government to these local municipalities to maintain acceptance of public for tasks which are vital for country as whole, but make additional burden to some municipalities.

— When and to what extent the waste disposal site shall be expanded – as public acceptance for waste management is very hardly manageable issue, the Ministry suggested to build two vaults at once, when all legal issues are solved and environmental impact assessment study is finished. In such way there is a chance to minimise financial resources and to ensure needs for decommissioning and capabilities to maintain reserve for radiological accidents.

— When to start feasibility study for deep geological disposal option in country – that is a moral obligation because from economical point of view the total amount of long lived waste is so small, that there are no reasons for such disposal if no nuclear power option is envisaged.

2.2.3. Main stakeholders for waste management strategy

The main stakeholders are:

— Central Government, but difficulties related to politically dangerous situation – any proposals related to waste management in general and radioactive waste in particular in practically all countries are not welcomed by general public. To a certain extent, the following two abbreviations explain the situation: *NIMBY* (Not In My Back-Yard) and BANANA (build anything, anywhere, anytime). This may result in an intention to postpone such decisions (maybe, but not in time of my office).

— Local municipalities, which in majority of cases are against, because the benefits from uses of radioactive materials are at the State level, but problems are at different place and there could be also some economical losses (not received profit, less investments etc. due to proximity of radioactive waste disposal) due to the fact of vicinity of such facilities.

— NGOs (mainly different “greens”), which due to different reasons are often against any nuclear activity.

— Operators of facilities, which generate radioactive waste – they depend on solution. If no solution on waste disposal is achieved, there is a risk of long delays in decommissioning, need for extra storage space (on site) for spent sealed sources and long lived waste. In future a situation may occur that there is no more space available for disposal of waste.

Outcomes of this case are not fully clear up to now. Hopefully, we will reach compromise and will find solution acceptable for stakeholders. There are so many negative examples in the world, that we could assume that the central government, having fully assessed situation, will be ready for certain compromises. On the other hand – there is a need for some involvement of international society, because “no-decision” situations or large excuse (high level of direct compensations for “risk”) in one country could make a precedent, which will strongly influence situation in many other countries.

3. Conclusions

There is no right or wrong answer about scope of stakeholders. Any particular case should be studied and discussed among all relevant parties, if possible, however some specified procedures must be defined and some kind of short list of stakeholders to be consulted is a must.

Questions related to stakeholder involvement are discussed and should be more discussed in different forums. There is a need to ensure that the approach to protection of the public, radiation workers and the environment against radioactivity and ionising radiation continues to develop and adequately responds to societal concerns and international obligations.

Radiation safety field is not specific with respect to stakeholders, but only some questions have much longer impact and also pre-defined (not always motivated) negative opinion from certain groups.

Understanding of particular interests allows to be prepared for eventual demonstrations or publications against decisions about significant modifications of infrastructure and provides ideas how to explain needs of financial and human resources for maintaining of supervisory system and major facilities, which are vital for safety infrastructure.

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Networking as a Tool to Promote Stakeholder Involvement: Example of the European ALARA Network

C. Lefaure[a], **J. Croft**[b]

[a]Centre d'études pour l'Evaluation de la Protection dans le domaine Nucléaire (CEPN), France

[b]National Radiological Protection Board (NRPB), United Kingdom

Abstract. The European ALARA Network (EAN), set up in 1996 by the European Commission, has helped reveal stakeholders needs regarding feedback on good radiation protection practice and helped towards stakeholders' satisfaction through their direct involvement into the network's life. Good examples of that involvement are the EAN workshops. The stakeholders are involved during the preparation phase, the workshops themselves, the development of recommendations and finally within the follow up actions. More and more categories of stakeholders are interested in topics covered within the EAN, and other similar networks are being set up in other regions.]

1. Background to the European ALARA Network (EAN)

On the 1 January 1996 the European Commission established the European ALARA Network (EAN). In 2001, the European Commission positively reaffirmed its interest in the EAN, by supporting it financially for another three years', set within its fifth Framework program "Nuclear Energy Program".

The main objective of the Network is to carry on promoting the efficient and effective application of the ALARA principle through European co-operation and hence ensuring better protection of workers from ionising radiation throughout the Member States and applicant countries. **The** Network is co-ordinated by the CEPN and managed by a Steering Committee. The number of countries participating to the Steering Committee has regularly increased and now stands at 14 countries.

EAN is responsible for initiating and organising annual scientific European ALARA Workshops. These are forum to:

— exchange feedback experience;

— identify problems that need further research or development, aid the implementation of ALARA in practice, as well as to provide the different stakeholders, and particularly the Commission, with recommendations concerning regulatory, managerial, research and development issues. Between 60 and 80 experts attend each workshop.

EAN publishes twice a year the ALARA Newsletter to provide a link between all those concerned with ALARA. It is distributed through various channels, including national contacts, national radiation protection societies and the EC. The Newsletter reaches several thousand individuals or institutions, mainly in Europe.

Access to the Network is also possible through the EAN Internet site (http://www.cepn.asso.fr/EAN.html). All the issues of the Newsletter, most of the presentations from the Workshops as well as the conclusions and recommendations from these Workshops are available on the Web site.

Since 1996 EAN has:
— set up sub-networks on research reactors and industrial radiography;
— provided the impetus for setting national and international systems to track the lessons learned from radiological incidents (RELIR, EURAIDE),
— given rise to new European research projects (SMOPIE) [1].

2. EAN as a Tool to Promote Stakeholders Involvement

From its very beginning EAN has comprised a mix of different types of stakeholders. Three categories are dominating so far: regulatory bodies,; research teams on radiological protection and risk management and nuclear utilities. However, many other stakeholders (unions, professional societies, utilities outside the nuclear area, manufacturers of devices…) have taken one or several opportunities to participate to EAN actions. All these members have decided to participate to the Network on a voluntary basis; they have neither been designated by the EC nor by a government. This has led to a very flexible, pragmatic and adaptable management of the Network allowing a very positive stakeholder involvement. EAN workshops are very good examples of that involvement.

2.1. Involvement of stakeholders during the preparation phase of the workshops.

The selection of the topics has always been the result of a negotiation between the countries, and different types of stakeholders. Therefore their contents cover a wide variety of area of concern. The following table 1 shows the results of these negotiations for the successive workshops and the relative influence in the selection process of regulatory bodies, utilities and research teams in radiological protection and risk management.

Table I. Stakeholders most influencing the selection of the topics for the EAN Workshops.

Contents of the EAN Workshops	Regulatory bodies	Utilities	Research teams
ALARA and decommissioning (1997)		**X**	
Good radiological practices in the non nuclear industry and research (1998)	**X**		
Managing internal exposure (1999)			**X**
Management of radiological and non radiological risks (2000)		**X**	
Industrial radiography improvements in radiological protection (2001)	**X**		**X**
Occupational exposure optimisation in the medical field (2002)	**X**		
ALARA and decommissioning II (2003)		**X**	
Control, inspection, audit, assessment of occupational exposure (2004)	**X**		

One rule that has developed from the first workshop is that the program of any workshop must aim at covering the points of views of all the different stakeholders concerned by the topic. For example, a principle conclusion from the second workshop (Good radiological practices in the non nuclear industry and research (1998)) was that industrial radiography remains a domain with the potential for significant improvement in terms of occupational radiological protection. However, during that second workshop there was neither a representative of a non-destructive testing company, nor any industrial radiographer. Therefore, when three years later it was decided that another workshop should be specifically devoted to industrial radiography, all concerned stakeholders were invited: they included not only representatives of non-destructive testing companies and radiographers, but also trainers in radiological protection, producers of industrial radiography devices, developers of dosimeters and detectors, international organisations etc

In preparing the programme for the Workshops contacts are often made with (or by) other groups or networks. For example during the preparation of the sixth EAN Workshop on "Occupational Exposure in the Medical Sector", the "European Society of (medical) Radiographers" contacted the EAN in order to be involved in the organisation. Similarly during the preparation of the fifth EAN Workshop on industrial radiography contacts were made with the "International Society of Non Destructive Testing". In both cases several of their representatives participated to the workshop. In addition the views of international agencies such as IAEA, ILO and, of course, EC are solicited.

One very positive aspect is the fact that no administrative or diplomatic rule constrains or forces the EAN to make any contact. Involving stakeholders at the European Commission level should have necessitated the coordination between several different Directorates and would have taken much more time and energy. The workshop program committee simply makes the decision and asks for the participation of any stakeholder. It has also the possibility to financially support a few potential participants if needed without referring to the EC or following a long procedure.

However one important limitation is the difficulty in involving both industrial workers and representatives of small firms in these workshops. It is not easy, even with the offer of financial support, to convince a manager to allow a worker to spend about one week of his work time in a workshop. Similarly it is not easy to convince the manager of a small firm to participate himself to such event. Therefore, no small firm manager has ever participated to the EAN workshops and the few trade union representatives who have participated were supported by big industries. The ability to provide a training certificate at the end of the Workshop is a good help to facilitate participation of workers. This was particularly the case for medical radiographers during the sixth workshop as many of them are part of a Continuous Professional Development (CPD) scheme, and the Certificate was part of their CPD evidence.

2.2. Involvement of the stakeholders during the workshops

The EAN workshops are not a big congress or symposium, they are actual workshops, where all participants are expected to provide their input. In order to pursue that objective, from the first workshop, the number of participants has therefore been restricted to less than 100. The program committee makes a selection from those applying to attend, taking into account the background and experience of applicants.

Since the fourth Workshop, work in small groups has been introduced into the programme to improve the involvement of all participants. One third of the time is now devoted to that type of work. The program committee proposes the topics for each group to consider but the group may decide to include other contents in its scope. The Programme Committee selects all topics as subjects where problems are still to be solved. During the work in groups, the collective experiences allow clearer definition of the practical needs and more focused potential solutions. The objective for the group work is to make recommendations in order to improve the situation, each recommendation being targeted to a specific organisation or grouping (EC, regulatory body, vendors…). These recommendations are proposed by each group's rapporteur during the final plenary session and discussed by the audience. The organisers then make a synthesis of the recommendations. The main conclusions and recommendations are considered and endorsed by the EAN Steering Committee, published in the Newsletter, put on the web site and sent to the interested parties. To provide an example of the output from a Workshop, the recommendations from the 6th Workshop are given in Appendix 1. **[Christian to add]**

2.3. Involvement of the stakeholders during the follow up of the Workshops

Following recommendations from the workshops many actions have been implemented by different stakeholders; for example:

— The French Society for Radiation protection (SFRP) has set up a national system to track the lessons learned from radiological incidents in France (RELIR);
— The Directorate General Research from the European Commission has decided to support a research programme on Strategies and Method for Optimisation of Internal Exposure of Workers from Industrial Natural Sources (SMOPIE);
— A group has been set up in co-operation with the European Non Destructive Testing Society in order to develop Codes of practices targeted at NDT companies and clients;
— A web page is under construction with the help of the participants to the sixth workshop, in order to provide all partners from the medical area with information on all existing guidance documents on radiological protection for the workers and the patient.

3. Conclusion

The work programme of the EAN has provided mechanisms to reveal stakeholders needs in pursuing ALARA and has helped stakeholders meet these needs through their direct involvement into the network's life. This has been done through many different means, the number of which is increasing:

— large diffusion of feedback experiences using the newsletters, the workshops and the website;
— new European research programs and operational systems;
— new sub-networks in different areas.

Whilst the formal recommendations of the Workshops provide a high profile output from the Network; there is also much activity at the grass roots individual level. It is a true 'network' with people being able to develop contacts that can be helpful in addressing specific radiation protection issues. More and more stakeholders coming from new domains and sectors are involved and participate in the work of the Network, giving rise to new recommendations and actions at local, national and international levels.

One of these actions has been recently implemented by the International Atomic Energy Agency of the United Nations. Looking at the format and results of the EAN, the Agency has started a process to set up similar networks in other regions in the world, the first being the CEEAN (Central and Eastern European ALARA Network) [2].

The objective, in the near future is to extend the Network and to open it as widely as possible to all the stakeholders (trade unions, stakeholders from the medical area, other professional bodies…) that are interested but still underrepresented in the Network.

Topical Session 3

IMPLEMENTATION EXPERIENCE WITH THE MODEL PROJECTS (VIEWS FROM THE COUNTRIES, POSITIVE AND NEGATIVE EXPERIENCES)

Implementation Experience of the Radiation Protection Infrastructure in Lithuania

A. Mastauskas

Radiation Protection Centre
Vilnius, Lithuania

Abstract. A national radiation protection infrastructure has been created in Lithuania in order to ensure radiation protection 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 public and personnel 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 the establishing national radiation infrastructure in Lithuania are presented and their solution is discussed.

1. Introduction

Lithuania is one of the three Baltic States. It is a small country located in the Northeastern part of Europe, on the coast of the Baltic Sea. The population of Lithuania is 3.5 million, the area of the country is more than 65,000 km^2.

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, on-site dry spent nuclear fuel interim storage facility at Ignalina NPP. However, when considering the problems of radiation protection and safety of sources it should be emphasized that more than 890 users that use more than 40000 of radioactive sources of different activities are available in Lithuania.

The state infrastructure of radiation protection is still being created after Lithuania regained its independence and in connection with recommendations laid out in the ICRP-60 publication and IAEA recommendations [1-5] and requirements of legislation of European Community. That includes adequate laws and regulations, an efficient regulatory system, supporting services. Taking into account that the establishing an appropriate infrastructure is an evolutionary process we took as a priorities to enact legislation which provides for, among others things, the establishment of a national radiation safety infrastructure, and to prepare basic regulations, guides which provide a regulatory structure for radiation protection and safety, to establish Regulatory Authority provided with necessary inspection and enforcement power, to provide adequate staff resources for Regulatory Authority and ensure their proper training, to initiate arrangements for the establishment of technical services and emergency provisions, to establish a system for the authorization, licensing and inspection.

Lithuania joined the IAEA in 1993 and it was already in 1994 when the program LIT/9/*002 "Radiation Protection and Waste Management Services Upgrading*" commenced. We are grateful to the IAEA for our inclusion in 1996 together with other countries into new program INT/9/143 "*Upgrading Radiation and Waste Safety Infrastructure"* and later to the Regional Project RER/9/056 Model Project for *Upgrading Radiation Protection and Waste Safety Infrastructure* and RER/9/065 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 cooperation project *Enhancing Occupational Radiation Protection in Nuclear Power Plants*. The projects and implementing national plans have had a great impact towards establishing and developing an effective and sustainable national radiation protection infrastructure based on international requirements.

Together with the help which we have received from the IAEA we have received the support from the Government of the Sweden and from the Swedish Radiation Protection Authority. During the last two years we are implementing MATRA project *Improvement of Capacity of Services essential for Radiation Protection in Medicine* with support from the Government of the Nyderlands. The European Commission in 2001 approved the PHARE program with Twinning and Supply components. The objective of this programs is strengthening the Radiation Protection Centre, reviewing legislation on radiation protection, developing aquality assurance system comprising all areas of responsibilities of the Radiation Protection Centre, preparing for accreditation of laboratories, upgrading the systems of radiation protection training, emergency preparedness and public information, improving the system of radiation protection in radioactive waste management.

In order to achieve the objective of the Europe Regional Project RER/9/056 and RER/9/065, five milestones were identified. The establishment of a regulatory framework, from our point of view, is the main Milestone in the process upgrading radiation protection infrastructure in the country.

1.1. Milestone 1. Establishment of a system of notification, registration, inspection, licensing, and enforcement, including an inventory of radiation sources.

For this purpose an effective regulatory framework should be set up, including the establishment of a national regulatory authority with clearly defined role. Regulations, guides regarding radiation protection, transport, radioactive waste and licensing procedures need to be established.

1.2. Laws and regulations

Since the re-establishment of the independence of the Republic of Lithuania the Lithuanian authorities have invested a lot of work in setting of national legislation in all aspects of the public relations, including the specific regulations in the field of the use of ionising radiation and the protection of occupationally exposed workers.

A number of laws, Government Resolutions, regulatory documents (Hygiene Regulations) and orders by the Ministers of different ministries and by the Director of the Radiation Protection Centre are the legal basis for radiation protection, safety and registry of sources in Lithuania. 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 general provisions for the protection of people and environment against the hazards of ionising radiation are set in the Law on Radiation Protection.

The Government of Lithuania issued the Resolutions: “General provisions on Dosimetric Control in case of Radiation Accident” (1998), “Regulations of Licensing the Practices with Ionizing Radiation Sources” (1999), “Establishment of the State Register of the Ionizing Radiation and Exposure of Workers”(1999).

The Hygienic Norms (Regulations) are official documents approved by the Minister of Health, and they are binding for the persons and institutions concerned in the Norms. The basic requirements on radiation protection including dose limits are described in Hygiene Regulations HN 73:1997(2001) “Basic Standards of Radiation Protection” which have been prepared by the Radiation Protection Centre for 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 requirements of these Hygiene Regulations[1] [2], [5], more then 15 Hygiene Regulations were prepared and adopted.

The drafts of the new legal acts in the area of radiation protection are prepared by the Radiation Protection Centre in co-operation with other institutions concerned in the regulations. It is very important that according to the Radiation Protection Law the Radiation Protection Centre as a Regulatory Authority has a right to issue the regulations. The Radiation Protection Centre has issued the several regulations which concern different technical and practical aspects of the implementation of the Radiation Protection Law.

1.3. Regulatory Authority

Law on Radiation Protection stipulates the competencies and responsibilities in the field of radiation protection of the Government, the Ministries and the Radiation Protection Centre. According to this 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. Centre is responsible for preparation of laws and legal documents, preparation and presentation to the Government of principles of state strategy in radiation protection, registry and regulatory control of safety of sources of ionizing radiation, licensing of users and organisation of control of compliance with radiation protection requirements, organisation of supervision and control of workplaces where sources of ionizing radiation are used. It is also responsible for control of medical exposure, monitoring of radioactive contamination of foodstuff, its raw materials, drinking water and building materials, control of indoor radon concentrations, personal dosimetry control and emergency preparedness.

The Radiation Protection Centre has additional tasks stipulated in other laws and legal acts like the Law of Nuclear Energy, the Law on Radioactive Waste Management, the Law on the Import, Export and Transport of Goods and technology, the Law on the Management of Ignalina NPP, etc. In this field the Radiation Protection Centre co-operates with the Nuclear Power Safety Inspectorate, Ministry of Environment, Ministry of Social Security and Labour, Ministry of Economy in matters concerning the safety of personnel at work, and with other institutions.

The staff of the Radiation Protection Centre, including its four regional departments, includes 47 employees (engineers-radiologists, medical doctors of radiation hygiene, radiochemists, technicians-radiologists).

The establishment of a regulatory framework requires many efforts 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.

1.4. System of Notification, Authorization, Inspection and Enforcement

According to the IAEA recommendations [1], [2] and requirements of the Lithuanian Law on Radiation Protection and the Government Resolution “On Establishment of the State Register of the Sources of Ionizing Radiation and Exposure of Workers”, the Radiation Protection Centre is a body responsible for the keeping State Register of the Sources of Ionizing Radiation and Exposure of Workers. All users performing their activities with sources of ionizing radiation shall present all necessary data to the Radiation Protection Centre after annual inventory of the sources, after installation, decommissioning or after disposal of the disused sources, after finishing the activities with the generators of ionizing radiation. The information are presented every week from the Customs Department to the Radiation Protection Centre about all sources imported to or exported from Lithuania. The State Register of the Sources of Ionizing Radiation and Exposure of Workers in Lithuania is created and managed in local software. The RAIS (Regulatory Authority Information System) versions have been examined. Together with experts from the IAEA attempts in developing the existing RAIS system and its adaptation to our needs are made.

According to the requirements of the Law on Radiation Protection and the Governmental Resolution "On Regulations of Licensing the Practices with Ionising Radiation Sources", it is prohibited to produce, operate, market, store, assemble, maintain, repair, recycle, and transport sources of ionising radiation and handle (collect, sort, treat, keep, recycle, transport, store and decontaminate) radioactive waste without a license issued by the Radiation Protection Centre. The Radiation Protection Centre has the right to suspend or repeal the license, when the licensee does not follow the licensing conditions until these conditions will be re-established.

The officers of Radiation Protection Centre and its local 4 departments execute state supervision and control of radiation protection of users of the sources. There are 16 state inspectors who are performing inspections in enterprises on prescribed periods depending on the type of practice. On the basis of results of performed inspection the inspection protocol is filled in and time period for eliminating violations of the requirements of radiation protection and source safety is determined. If it is not done within prescribed time, the Radiation Protection Centre has the right to suspend or repeal the license and impose a fine.

Other milestones as establishment of a national system of control occupationally exposed personnel, control of medical exposure, control of public exposure, establishment of a system of emergency preparedness have been implemented.

According to the Report of the IAEA Peer Review Mission to Lithuania (October 2000) which reflects the assessment of the implementation of Model Project RER/9/056 – Upgrading Radiation Protection Infrastructure, the Lithuania has effectively implemented milstones 1 and 2 of the Model Project. This means that Lithuania has established:

- an effective Regulatory Framework, and
- necessary Technical services for the control of occupational exposure, including an effective personal dosimetry for external radiation.

Further assistance of the Agency would be necessary in developing nacional radiation protection infrastructure: training of staff, improving a system for the occupational exposure control, particularly during the decommissioning of the nuclear power plant, improving level of preparedness and response to a radiological emergency, creating the system of public information and education.

Radiation Protection Centre expresses the sincere appreciation to the IAEA for the support in creation of national radiation protection infrastructure. Recently steps are taken in creation of quality system of regulatory authority. Self sustainability of the radiation protection infrastructure will be ensured also by the Central Eastern European ALARA Network which was created with the help of the IAEA and is intended to be used for information exchange among countries facing similar problems in radiation protection.

For implementation of the radiation protection infrastructure in Lithuania, performing our duties it is very important for Lithuania to receive the necessary help and expertise from the IAEA, other international organisations and countries in the framework of co-operation.

Steps are taken in creation of radiation protection education and training system. Radiation Protection Centre expresses its sincere appreciation to the IAEA for positive attitude to the new national project *Strengthening of regulatory capabilities of State Nuclear Power Safety Inspectorate and upgrading of training in nuclear and radiation safety* which will provide Lithuania with needful assistance in establishing of national radiation protection training centre. The establishment of the training centre is facilitated by the fact that the Radiation Protection Centre will receive funds for its strenghtening including preparation of premises of the training centre, training trainers, making available of technical facilities including equipment for practical exercises, accreditation of the centre, evaluation of experence and preparation of recommendations.

2. Conclusions

1. 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, experience exchanged. It allows us to presume that the necessary level of radiation protection is to be achieved in Lithuania as in other European countries.

2. In the framework of the Technical Co-operation and on the basis of the assessment of the current status in Lithuania it would be expedient to continue technical co-operation programme include the following objects:

- Training of radiation protection professionals, radiation protection officers, radiation workers and all the other persons which are 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, improving level of preparedness and response to a radiological emergency, creating the system of public information and education,
- Establishing or substantial 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 that IAEA supports the creation of the Central and Eastern European ALARA Network. This network, keeping in mind the common problems and similar situations for the many Member States, would be very helpful in solving many problems of operational radiation protection.

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Regulatory Control of Ionizing Radiation Sources in Armenia
Achievements, challenges

A. Martirosyan, A. Mnatsakanyan

Armenian Nuclear Regulatory Authority (ANRA)
Yerevan, Republic of Armenia

Abstract. In 2001 the Government of the Republic of Armenia adopted decree on transfer of the responsibility for regulation of protection against ionizing radiation and safety of ionizing sources in Armenia from the Ministry for Health of the RA to the ANRA. As far as the national legislation and infrastructure was not in line with the modern radiation protection requirements the ANRA has developed plan of measures intended to improve the infrastructure on protection against ionizing radiation and safety of ionizing sources. It includes also the activities to be implemented under the IAEA RER/9/062 regional project, which was initiated in 1996 as Model Project INT/9/143.

1. Introduction

According to the existing information there are approximately 1700 ionizing radiation sources in Armenia, which are used in all industrial fields. Most of the ionizing radiation sources (70%) are used for medical purposes. The Armenian Nuclear Power Plants (ANPP) and the dry spent fuel facility, located on the territory of the ANPP, are also important in terms of radiation protection.

The problems with strengthening of regulatory control over ionizing radiation sources in Armenia are as follows:The national legislation and infrastructure is not in line with the modern radiation protection requirements;Variety of unsolved problems accumulated over the years (weak regulatory control, physical ageing and obsolescence of vast majority of equipment, absence of qualifies specialists and so on);

— Financial problems peculiar to all independent states after the USSR collapse.

The process of strengthening of regulatory control over ionizing radiation sources moves in the right direction.

2. Laws The following laws governing the radiation protection and safety of ionizing radiation act in Armenia:

— The Law on Safe Utilization of Atomic Energy for peaceful Purposes (enforced on 1 March 1999);
— The law on Population Protection in case on Emergency Situations (enforced on 15 March 1999);
— The Law on Licensing (enforced on 8 August 2001).

At present the Law on Safe Utilization of Atomic Energy for peaceful Purposes is in the process of revision. The new edition of the law will incorporate in more generalized manner the issues related to regulation of radiation protection, radioactive waste safe management, emergency preparedness and licensing.

3. Regulatory Authority

Till 2001 the responsibility for supervision on protection against ionizing radiation and safety of ionizing sources rested with the Hygienic and Sanitary Supervision Department of the Ministry of Health of the Republic of Armenia. On 24 May 2001 the Government of the Republic of Armenia adopted decree № 452 (at the recommendation of the IAEA and with respect to the independence of the ANRA from the users implementing activities in the atomic energy utilization field), on transfer of the responsibility for regulation of protection against ionizing radiation and safety of ionizing sources in Armenia to the ANRA. The Radiation Protection and Emergency Response Regulation and Control Department of the ANRA is responsible for the issues related to protection against ionizing radiation and safety of ionizing sources. At present the department consists of 7 specialists, 5 of them are involved in the issues related to protection against ionizing radiation and safety of ionizing sources.

The following regulations of Russian Federation and former USSR related to protection against ionizing radiation and safety of ionizing sources act in the Republic of Armenia:

- Radiation protection norms NRB-76/87;
- Basic sanitary rules of radiation protection OSP-72/87;
- Sanitary rules for NPP design and operation- SP-AS-88/93;
- NPP radiation protection rules - PRB-AS-89;
- Sanitary rules for radioisotopes equipment operation-Sanitary- hygienic norms and requirements for consulting rooms of X-ray therapy, -X-ray and radioisotope diagnostics, physiotherapy.

The Government of the Republic of Armenia has approved:

- Procedure for registration of ionizing radiation sources (Government decree №765 as of 16 August 2001);
- Special rules for transportation of nuclear and radioactive materials (Government decree № 1263 as of 24 December 2001);Basic requirements on planning and implementation of response actions in case of nuclear and radiation emergencies (Protocol № 51 as of 13 December 2001).

New statute of the ANRA was developed and submitted to the prime minister of the RA for approval.

The following documents are on the sage of approval:

- Norms on protection against ionizing radiation and safety of ionizing sources;
- Basic rules on protection against ionizing radiation and safety of ionizing sources. It is planned to develop new safety requirements to different ionizing radiation sources (manuals, guides etc.).

4. System of Notification, Authorization, Inspection and Enforcement

The ANRA is responsible for re-registration of ionizing radiation sources rests with. From October 2001 the ANRA initiated activities on inventorization of ionizing radiation sources in Armenia, which is planned to complete till the end of 2003. For registration of ionizing radiation sources the ANRA used a special software developed by Armenian and USA specialists. In accordance with the requirements of the procedure for registration of ionizing radiation sources, the objects applying ionizing radiation sources must declare about ionizing radiation sources applied in their facilities. The mentioned document contains the list of information required for declaration and registration.

The ANRA has registered 743 ionizing radiation sources of 124 objects of 4 regions of the Republic of Armenia, 543 out of 743 are located in Yerevan.

The numbers of the registered sources by type are as follows:

- X-ray devices (medical, industrial, scientific and other) - 394 items;
- Radioisotope devices - 32 items;
- Radioisotopes - 236 items, 3 out of which are unsealed radiation sources;
- Electronic accelerators - 8 items;
- Industrial gauges - 57 items;
- Electronic microscopes -16 items.

In the registration process the ANRA detected 67 ionizing radiation sources, which were not registered by the Hygienic and Sanitary Administration of the Ministry for Health of the RA. These are:

- X-ray devices - 9 items;
- Radioisotope device - 1 item;
- Radioisotope sealed source - 57 items.

57 radioisotope sources are mainly low radioactivity sources used for education purposes.

At present in the Republic of Armenia act old authorization procedure for activities with ionizing radiation sources in the form of sanitary passport which, in accordance with acting regulations, is issued once in three years. The information related to issuance of the sanitary passport was kept in the Hygienic and Sanitary Administration of the Ministry of Health of the RA. This information as well as the register of sources was transferred to the ANRA. But the information is rather old. The ANRA initiated activities on inventorization of ionizing radiation sources, after which it is planned to conduct licensing of activities with sources. In the ANRA there are 4 inspectors for radiation protection who at the meantime are involved in the activities with inventory of sources. The ANRA develops the inspection regulations. The new approaches, in particular the requirements of the IAEA TECDOC-1113, will be taken into account in developing the documents on authorization of practices.

5. Occupational Exposure Control

The requirements to occupational exposure control are established in detail in the safety regulations. In particular, the basic radiation protection rules specify that the controlled and supervised areas should be indicated at the objects using ionizing radiation sources and the list of activities necessary to ensure the protection within these areas should be defined. Basing on the requirements of the basic radiation protection regulations, the administration of the organizations should organize development of local rules, which necessarily should contain the requirements to individual protection and the list of protective measures for different types of activities.

In accordance with the regulations, a facility applying ionizing radiation sources should organize occupational exposure control, including work place control within its facility. In Armenia the occupational exposure control is organized in the Armenian NPP. Film and TLD dosimeters are used for control of the ANPP personnel external radiation and, if necessary, individual electronic dosimeters are used as well. At the ANPP about 800 persons are under exposure control and the control is performed by the relevant service of the ANPP. The same service also performs calibration of dosimeters and registration and analysis of doses.

The relevant service of the ANPP is included also in the IAEA ISOE system through which receives and transfers the occupational exposure related data and examples of "good practices" in this area. At the same time the Armenian NPP performs measurement of individual dosimeters collected from other ionizing radiation sources and registers data for transfer to the relevant organizations.

The organization and conduction of occupational exposure control of the 842 personnel dealing with other ionizing radiation sources is not in line with the modern practice and requires reconsideration and improvement.

The ANPP Internal Contamination Measurement device (SICH) through which lungs of personnel are mainly examined makes the systematic internal occupational dose measurements for the specialists. The workplaces monitoring and data recording are performed in an organized manner and in accordance with the special programs. The internal occupational dose measurements for the personnel dealing with other ionizing sources are not made. The monitoring conduction also requires reconsideration and improvement.

6. Medical Exposure Control

The Regulations mentioned in the point 3 specify the safety requirements at radiotherapy and brachyteherapy procedures. The mentioned regulations specify also the requirements to safety of personnel in emergency situation as well as the requirements to safety of patients. About 15 medical physicists work in the mentioned field.

This field is considered the big one in Armenia and has a number of problems the solution of which is connected with re-consideration and improvement of infrastructure. The regulations acting in this field also specify the safety requirements. Among them are those Guidance levels, which are used for diagnostic purposes. The patients' exposure dose optimization is not performed on the basis of the guidance levels. Physical ageing and obsolescence of the X-ray devices explain it. Nuclear medicine is mainly used for diagnostic purposes with application of unsealed ionizing radiation sources (^{99m}Tc and ^{135}I). The regulations specify the requirements to the quality assurance and quality control, dose calibration and monitoring of the procedures.

7. Public Exposure Control

In Armenia the following organizations are responsible for the environmental monitoring:The ANPP responsible for the environmental monitoring within the supervised area. The monitoring is performed according to the developed programs and methods. While monitoring man-made radionuclides content in different objects of environment is examined, i.e. atmospheric air, soil, fall-outs, water, food as well gamma dose rate on the territories. The Armenian Hydrometeorological Administration is responsible for gamma dose rate measurements in different parts of Armenia. The measurements of radioactive isotopes contents in constructions are performed by Standardization administration during certification construction materials.In accordance with the requirements of acting regulations [See Point3], the facilities where unsealed ionizing radiation sources are used, have approved limits for discharges and releases. In Armenia the discharges and releases from the facilities are on the more less than the permissible limits.

8. Radioactive Waste Safety

There are storage facilities for the used ionizing radiation sources at the ANPP and Oncological Scientific Center. The storage facility for old high radioactive ionizing radiation sources is located at the Armenian NPP controlled area. Intermediate and low radioactive ionizing radiation sources are disposed in the RADON type near surface radioactive waste repository located close to the ANPP. According to the new approaches introduced in Armenia it is planned to develop the national program for radioactive waste safe management. The program will be developed introduced by the state authority for radioactive waste management. It is planned to establish a special fund for financing the activities with radioactive waste management.

9. Emergency Preparedness and Response

The issues on emergency preparedness and emergency response coordination are governed by a number of Laws of the Republic of Armenia and "Basic requirements to organization and implementation of response actions in case of nuclear and radiation emergencies" regulation approved by the Government of the RA in December 2001. The ANRA's responsibilities in the issues related to emergency response are as follows:

- Development of regulatory documents for emergency response;
- Control the emergency preparedness of atomic energy utilization objects and organizations of the national emergency response system;
- Establishment of the decision making criteria for emergency response and protective actions;
- Coordination of radiation monitoring in case of radiation emergency;
- Prognosis on situation change and recommendations on necessary protective actions the basis of data characterizing the damaged object and adjacent to it territories;
- International notification about an emergency.

10. Metrology, Standardization and Calibration

Standardization administration is responsible for calibration of radiometric and dosimetric equipment. The administration has the relevant services and necessary laboratory. The mentioned service at present undergoes international accreditation under the IAEA RER/2/004 regional project.

11. Training and Personnel

In the regional and Sub-regional training courses and seminars organized within the IAEA projects participated approximately 30 Armenian specialists. All specialists continue working in this field.

In our opinion such Regional and Sub-regional training courses and seminars are useful for general training of specialists (familiarization with new international approaches, experience of other countries) and their number is sufficient. Fellowships and scientific visits are important as they give opportunity to discuss directly with colleagues and specialists all-important issues and familiarize on the spot with the existing experience.

Under the IAEA RER/9/062 regional project in 2002 was organized one scientific visit and 5 scientific visits are planned for 2003. Future (2003-2004) Fellowships and scientific visits will be decided on the basis of results of ionizing radiation sources registration.

12. Conclusion

The following tasks were performed under the Model Project:

- There was established one state regulatory authority on protection against ionizing radiation and safety of ionizing sources;
- In the framework of the project on the basis of results of expert meetings and scientific visits of the legal framework on radiation protection was clarified (legal pyramid);
- HARSHAW 4500 was put into operation for individual dose measurements;
- There were received a number of measurement devices necessary for regulation of radiation protection, including neutron radiation measurement device which is very important for control of spent fuel of the ANPP and ANPP storage facility.

For implementation of the tasks planned under the IAEA RER/9/062 regional project work plan the main problems were connected with:

- The legal basis and infrastructure of protection against ionizing radiation and safety of ionizing sources;Professional qualification of the personnel dealing with ionizing radiation sources;
- Occupational exposure control;
- Physical ageing and obsolescence of ionizing radiation sources.

Financing. The ANRA has developed plan of measures intended to improve the infrastructure on protection against ionizing radiation and safety of ionizing sources. The plan will be implemented during 2003-2005. The plan includes also the activities implemented under the IAEA RER/9/062 regional project andthose activities included in the plan, which require external assistance.

To Strengthen Radiation Safety in China

Hua LIU

National Nuclear Safety Administration,
SEPA,Beijing, China

Abstract: The Chinese government has paid attention to nuclear safety and radiation safety. The licensing systems for nuclear installations and radiation sources are established. To strengthen regulatory control on radiation sources, China published basic safety standards for radiation protection and radiation sources, and Chinese Congress is reviewing the new law on Radiological Pollution Control. The paper introduces the infrastructure system for regulation and control of radiation sources and the safety activities done by the regulatory body within this few years.

1. Introduction

The application of radiation sources in industry, agriculture, medicine and scientific research are going to be more and more widespread in China. Up to the end of 2002, there are about 63721 radioactive sources used in industry, agriculture, medical and science research areas.

The Chinese Government has paid great attention to radiation safety. To control and regulate the activities related to nuclear energy and nuclear technique, the licensing system for civilian nuclear installations and the licensing system for radiation sources have been established. The two licensing systems have played very important role in China.

2. The Regulatory Infrastructure for Safety of Radioactive Sources in China

2.1.Current regulatory infrastructure

The Chinese government established a licensing system for civilian nuclear installations based on Regulations on Surveillance and Control of Civilian Nuclear Installations – 1986, a government order. According to this regulation, National Nuclear Safety Administration/SEPA (NNSA/SEPA) is responsible for the regulation and control of nuclear safety for civilian nuclear installations. Regarding the regulation of radioactive sources, the licensing system is established based on the Regulations on Radiation Protection for Radioisotope and Irradiation Apparatus – 1989 [2], a government order. According to this regulation, the responsibilities for the safety of radioactive sources are authorized to three government agencies, that are Ministry of Public Health (MOPH), Ministry of Public Security (MOPS) and NNSA/SEPA.

The NNSA/SEPA is the regulatory body for nuclear safety and radiation safety. The functions and duties for the safety of radioactive sources are:

— to enact policies, department rules, standards and guides and to conduct inspection;

— to approve environment impact reports (forms) and to implement environment monitoring;

— to license nuclear installations, radioactive waste management facilities;

— to regulate spent and disused sources and to deal with accidents of radioactive sources.

The MOPH regulates manufacture, sale and use of sources and irradiation apparatus. The function and duties are:

— to issue license to sources in stages of manufacture, use and sale of the radiation sources;

— to investigate incidents or accidents of the sources with MOPS and NNSA/SEPA.

The MOPS is responsible for the security of the sources. The function and duties are:

— to be responsible for registration and security of the radiation sources;

— to be responsible for investigation and search for lost sources.

2.2.Development on strengthening regulatory control for radioactive sources

Above regulatory infrastructure has some problems, such as overlap and unclear of the responsibilities for different governmental agencies. On the highlight of Safety Series No. 115 [1] and the international experience, the Chinese government is making efforts to strengthen regulatory control on radiation sources and has made great progresses in legislation and infrastructure.

2.3.The Chinese Basic Safety Standard for Radiation Protection

The Chinese Basic Safety Standard for Radiation Protection and Safety of Radiation Sources (CBSS) was issued in October 2002 and valid from April 1 2003. It is a mandatory national standard and should be followed by all related government agencies and operating organizations in nuclear industry and application of radiation sources.

The CBSS are based on IAEA BSS. According to CBSS, China adopts three principles of radiation protection, e.g. justification of practice, optimization of radiation protection and dose limits. The basic dose limit for occupational radiation workers and the public is exactly same as IAEA BSS. And the regulatory body also asks utilities to use ALARA principle to make assessment to the radiation workers and public.

There are lots of technical standards and safety guides on nuclear safety and radiation protection in China. These guides and technical standards describe the detailed technical requirements and methods on nuclear safety and radiation safety in siting, construction, operation and decommissioning of the nuclear installations, radiation sources and radioactive waste management. These documents are being reviewed by related institutions for revise based on the CBSS.

2.4.The Radiological Pollution Control Act (Draft)

The Radiological Pollution Control Act is the basic law in China that is applicable to all the regulatory control activities related the nuclear installations, radiation sources, uranium mining, radioactive minera1 resources application and radioactive waste management. It was drafted and discussed in various government agencies for past few years. The Chinese government approved it and provided to the Congress for review in November 2002. The Congress finished the second review in April 2003 and is planing to conduct final review and approval process within this year.

The purpose of the draft Act is to prevent and control radiological pollution and to take strict regulation so that to ensure nuclear safety and radiation safety. The Act will authorize NNSA/SEPA and its provincial environmental protection agencies to be responsible for unified inspection and regulation on radioactivity pollution control including the safety of radiation sources and to provide NNSA/SEPA more resources.

The Act will establish licensing system for construction, first fuel loading, operation and decommissioning of nuclear installations and establish licensing system for production, sale, use, transportation, safety storage and disposal of radiation sources. Environment impact assessment system is also established.

2.5.Other related laws

The Congress issued Act on Environment Impact Assessment, Clean Production Act and Occupational Disease Control Act in 2002. The Act on Environment Impact Assessment establishes the environment assessment system in China. Before approval of any construction project, SEPA or its agencies at province level will review the environment impact assessment report (Form) submitted by the applicant. The design, construction and acceptance of environment protection facilities in approved project should be completed with the main facilities in the project simultaneously. Regarding the radioactive effluent release to the environment, the utilities have to get an effluent release permit from SEPA or provincial environment protection agencies.

The Clean Production Act is related to environment protection and industry safety of all ores in China. The Occupational Disease Control Act is related to control of occupational disease including radiological occupational disease.

3. Activities to strengthen the safety control of the radioactive sources

3.1.To conduct joint examination and enforcement on sources safety

The NNSA/SEPA, MOPH and MOPS jointly conducted a special examination and enforcement on safety of significant radiation sources in China in 2002. We checked the registration status, confirmed the inventory of the sources, examined the safety use of the sources, and collected spent sources. The central government and provincial governments have input a lot of resources on this activity including manpower and financial support, such as the government collected about 1000 spent sources or disused sources without charges from the organizations that have financial problems.

By the joint examination and enforcement, we confirm the sources inventory, require the users of the sources to complete registration process and to take some safety measures for security of the sources, and we collect some spent sources. According to the data from the joint examination in 2002, there are 8312 users and the inventory is 63,721 sources. We found that there are about 13,800 disused or spent sources in the inventory, among them 2750 sources are belong to the owners that have financial problems. During the joint examination, 270 orphan sources are found. As the expert’s estimation, there are total around 2000 orphan sources in China. We also found that some illegal users of the sources that did not register in MOPH, MOPS and NNSA/SEPA. The number of illegal users in some provinces accounts for 30% of the inventory in those provinces.

The NNSA/SEPA, MOPH and MOPS are planing to organize a special activity in nation wide to collect all spent sources to ensure the safety of the sources. The government will provide some financial support to those organizations that have financial difficulties.

In addition, on the support of IAEA project in past few years, the China National Nuclear Corporation collected about 800 spent radium sources used for nuclear industry from its sub companies. These spent radium sources has been conditioned. The CNNC has built a new storage facility in Northwest Low Radwaste Site in Gansu Province in China. The CNNC will store about 10,000 spent sources including 800 conditioned spent radium sources in this site from 2003.

3.2.To implement education and training on radiation safety

The education and training for specific management staff and users of radiation sources is very important. We have completed Training Program on Radiation Protection and compiled a radiation protection teaching material to meet the need of training to the technical staff in the field of radiation protection and radioactive waste management. Some training courses have been arranged. The IAEA model project has provided training courses to our staff in radiation protection.

China will implement a qualifications management system for specialist staff in nuclear safety and radiation safety and organizations in radioactive monitoring. Without the qualification, any person can not work in the critical position for the safety of nuclear installations or radiation sources.

3.3.To monitor the occupational exposure by radiation sources

The total number of radiation workers in medical and industrial uses of radiation is 190,000 in 2001. The number of trainee is 69000. The rate of trainee accounts for 36 % of all radiation workers.

Regarding the individual dose monitoring, the number of radiation workers who should be monitored is up to 160,000 persons by the end of 2001. And actually the monitored number is 96,000 persons. The monitoring rate has got up to 62%. The annual average effective dose of monitored workers is 1.3 mSv and the average annual collective effective dose is 126 man Sv.

3.4.To control the public exposure

The provincial environment protection departments have implemented environmental monitoring and provided information to Radiological Environment Monitoring Center (REMC) of SEPA. Every year, the REMC will publish the report on radiological environment monitoring.

To strengthen the environment monitoring capabilities, the SEPA began to establish a national radiological monitoring system in China from last year. The function of the system is to implement supervision monitoring to radiological effluent of significant nuclear installations and to monitor radiation level in the environment. The total investment of the project is RMB105 million. The project is expected to complement by 2004.

To prevent illegal trade of radiation sources from the other country without authorization, the SEPA pushed the Chinese Customs to be equipped with radiation monitoring instruments in order to measure the radiation level before the goods passing through the Customs. By the radiation monitoring in Customs, we found a spent source mixed into used steel that would be exported to China from other country. We also found some radiological contaminated used steel in Customs.

3.5.To establish emergency response system for radiological accidents and incidents

The NNSA/SEPA has made emergency plan for dealing with nuclear accidents and radiological accidents. And each provincial environment protection agencies has also made its own emergency plan based on the NNSA/SEPA emergency plan with local conditions in every province. The NNSA/SEPA requires the nuclear installations to make emergency plan and submit it for approval.

Once a radiological accident happened, three provincial departments, e.g. departments of environment protection, public health and public security should be reported. They will send experts equipped with monitoring instruments to the accidental site to deal with the accident. If necessary, the central government will send expert team to assist the emergency response on site. The SEPA Emergency Center for Nuclear and Radiological Accidents has the capability to collect on line the safety parameters of the nuclear installations and information on radiological accidents. The center will assess the reactor conditions based on the input of safety parameters and will assess the radiological consequence for nuclear accidents or radiological accidents. The MPH establishes Medical Emergency Center for Radiological Accidents.

After September 11, the Chinese government has paid more attention to anti terrorist related with radiological accidents, such as dirty bomb. Some measures have been taken on the safety and security of radiation sources. The contents on anti terrorist related radiological accidents have been added into the emergency plan in central government and provincial government levels. Some emergency exercises or drills have been conducted timely.

4. Conclusion

There is quite large amount of radiation sources in China. To strengthen radiation safety and prevent the radiological accidents, the Chinese government has decided to unify the regulation and control for radiation sources. The responsibilities and measures for strict control on radiation sources will be given by Act of Radiological Pollution Control and government order in near future. The new regulation system will fully satisfy the requirements of Code of Conduct on Safety and Security for Radiation Sources made by IAEA.

Within recent years, the NNSA/SEPA has pushed to established new regulation system and organize joint examination and enforcement for radiation sources and to establish the emergency response system for any nuclear or radiological accidents.

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The Regulatory Infrastructure for Radiation Protection the Safety of Radiation Sources and Security of Radioactive Materials in Ethiopia

G. Gebeyehu Wolde

General Manager (NRPA)
National Radiation Protection Authority
Federal Democratic Republic of Ethiopia

Abstract. The application of Nuclear Techniques in Ethiopia started in the early sixties in the medical field and through time has gradually expanded to other areas. Following this growth the practice of Radiation Protection in Ethiopia dates back over 15 years. Radiation Protection Legislation 79/1993 was promulgated in December 1993, which has established an Autonomous Regulatory Authority to control and supervise the introduction and conduct of any practice involving ionizing radiation. Since 1998 the National Radiation Protection Authority has made a remarkable progress in terms of building a National Radiation Protection Infrastructure and is in a full swing transformation process towards a dynamic credible and competent regulatory Authority. The regulatory activities are designed in line with the main regulatory instruments, Notification, Authorization, Inspection and Enforcement. NRPA has a national inventory system and fully implemented the Regulatory Authority Information System (RAIS), which provides a systemic integration and will be instrumental to enhance the effectiveness of the regulatory system. A substantial progress has been made in the development and provision of support and technical services in the areas of Metrology and Calibration Services, Instrument Maintenance Service, Individual Monitoring of Personnel, Environmental and Food Monitoring and Interim Storage Facility for spent sources. Development of a national system for emergency preparedness and response is the current top agenda of NRPA. Towards ensuring an effective radiation protection and regulatory programme, NRPA is also making a proactive involvement in, expanding its outreach, information dissemination, awareness promotion and development of key human resources. In the last four years Ethiopia has been actively co-operating with IAEA in the framework of the Regional Model Projects RAF/9/024, RAF/9/028 and RAF/9/029. The inputs received through the project framework coupled with the demonstrated local commitment have immensely contributed to the transformation process and the current status of achievement in building a sound and credible National Infrastructure for Radiation Safety.

1. The National Regulatory Infrastructure

The main legislation governing the practice of ionizing radiation called “The Radiation Protection Proclamation No. 79/1993” issued by the House of Representatives, Government of Ethiopia, on 22nd December 1993 has established and empowered the National Radiation Protection Authority (NRPA) to, authorize and inspect regulated activities, issue guidelines and standards and enforce the legislation and regulations.

The NRPA is organized as an autonomous public authority and now strengthened and developed to a level of competence for effectively fulfilling its legislative mandate under the enabling provisions of the legislation. Its functions are also emerging and developing to cover all aspects of the regulatory control.

The main legislation contains some detailed provisions, which have the nature of Performance Regulations, and these provisions were instrumentally used to bridge the gap until the issuance of detailed regulations. However, drafting the detailed set of regulations and reviewing based on the BSS 115 and including the adoption of IAEA regulations for safe transport of radioactive materials also completed. The detailed regulations will be shortly submitted to the government for approval and promulgation.

As an essential part of the national infrastructure, NRPA has achieved the necessary empowerment to enforce the law and developed the national credibility and recognition as the top safety authority. NRPA is having all the required physical, financial, organizational and human resources to effectively implement its regulatory programme. The organigram and the staffing plan of NRPA is currently being updated and revised in order to address the emergent needs. See Annex 1 for details. In line with the ongoing changes and the status of organizational development the level of staffing in NRPA has substantially changed. At present the total staff head count is over 54 that constitutes over 40% technical staff members.

2. The National Regulatory System

The regulatory activities are designed in line with the main regulatory instruments, Notification, Authorization, Inspection and Enforcement. In its effort to develop a systematic regulatory regime in a professional transparent and sustainable manner, NRPA has developed and tested in practice pertinent guidelines and procedural manuals.

After deliberate enrichment based on test feedback, the manuals are issued as a permanent systemic instruments.

2.1. Notification

The system of notification for effectively identifying and locating radiation sources subject to regulatory control is very well in place. Users of radiation sources and machines notify the NRPA through application for import and authorization for practice. Arrangement is made with the Ethiopian Customs Authority and Investment Authority of Ethiopia, so that any importation of radiation sources and equipment is subject to the clearance and approval of the NRPA.

The NRPA has an organized inventory of sources and equipment and periodically update the source/ equipment user and inventory status.

2.2. Authorization

NRPA has developed a system of authorizing practices by registration or license. A final set of procedural guide documents, which incorporates the Radiation protection requirements, safety assessment protocols, as well as application forms, and practice specific guides are designed and currently put in practice.

2.3. Inspection

In the 2002/2003-budget year NRPA has established and activated inspection plan and priority listing, based on the degree of hazard associated with the practices and past inspection history.

Now all practice centers and sources are routinely inspected once in a year and the frequency can be increased based on the degree of hazards associated with practices. Inspections are carried out following appropriate procedural and technical guidance documents and a system of monitoring are in place to ensure that inspection findings are communicated to the users in a timely and clear manner.

2.4. Enforcement

The issue if enforcement is a bit complex in an environment where, a limited alternative for health service provision exists with a retrospective regulatory exercise. However NRPA has developed a coherent set of strategies to progress enforcement actions in a step-by-step incremental manner and by starting from the front end (most recent) practices.

A new cooperative framework arrangement is made with Ministry of Health, Addis Ababa Regional Government Health Bureau and other Regional Governments to coordinate actions for the enforcement of the radiation protection proclamation. An enforcement guide is now in use to maintain consistency and objectivity. Regularly improving the enforcement guide document is also a follow-up task for NRPA to ensure continual systemic improvement.

3. National Inventory of Radiation Sources and Radioctive Materials

Registration of radiation sources and radioactive materials has started in 1996 by distributing questioners to different institutions and departments in the country and simultaneously issuing calls by public media. Since then the inventory has been regularly updated and currently the inventory of about 96% of Radiation Sources and Radioactive materials in the country is accounted.

The NRPA has now fully implemented the Regulatory Authority Information System (RAIS), which provides a systemic integration and will be instrumental to enhance the effectiveness of the regulatory system.

The total number of registered Equipment (X-ray) currently stands at 458 and the Radioactive Sources inventory stands at 50 with the following breakdown. There are also different unsealed sources mainly used for nuclear medicine and research in 7 institutions.

Inventory of Radiation Generating Equipmer			Inventory of Radioactive Sources	
It. No	Radiation Generators	Quantity	Radiation Sources	Quantity
1	Plain Radiographic	342	Nuclear Gauges	31
2	Dental X-Ray	87	NDT	2
3	CT Scanners	3	Research & Educ. (Sealed Sources)	7
4	NDT	9	Medical application (Sealed)	6
5	Others	17	Others	4
	Total	458	Total	50

4. Provision of Radiation Protection Services

A substantial progress has been made in the development and provision of support and technical services in the following areas:

a) Individual Monitoring of Personnel

The Radiation Protection Proclamation has established registration and certification of radiation workers, designation of a radiation protection officer in every practice center and ensuring a timely and continued provision of personal monitoring service be principal requirements to be met for authorization and practicing any activity involving radiation.

Personal Monitoring of radiation workers involved in radiological and other activities is being provided by NRPA with Thermo Luminescence Dosimetry technique. The current estimate of total number of radiation workers need to be monitored is about 1200 and a total of 694 workers were so far getting this service every month. With an augmented capacity NRPA plans to expand the coverage of personal monitoring service to achieve full coverage by the end of year 2003. In the year 2002 NRPA has successfully implemented the cost recovery scheme for the provision of personal monitoring services.

Any overexposure observed in the monthly monitoring reports will be promptly communicated to the practice centers and simultaneously the Regulatory Department of NRPA will be notified for investigation and regulatory intervention.

b) Metrology and Calibration Services

NRPA has established a Secondary Standard Dosimetry Laboratory, obtained calibration factors from IAEA Seibersdorf Laboratory and embarked at a level of rendering a regular calibration services to the domestic users. This will enhance the quality and reliability of the Radiation Protection Programme in place.

Arrangement is underway with the Ethiopian Authority for Quality and Standards to get an official accreditation to the SSDL laboratory.

c) Instrument maintenance service

The instrument maintenance workshop for maintaining radiation-monitoring equipment is reorganized in the new office/lab complex. The unit is staffed with a fulltime instrument maintenance engineer and provides maintenance services on a regular basis.

5. Medical Exposure Control

Management of Quality Assurance system in medical practices is one of the key systemic elements for ensuring effective medical exposure protection and control. Besides exercising direct regulatory control, for advancing the medical exposure control programme in a sustaining manner NRPA has placed emphasis on the establishment of a national capacity for quality control in medical practices. The strategy followed is to build the core capacity with collaborative approach in three premier medical institutions and gradually expand to all medical practice centers in the country.

To this effect NRPA has launched a comprehensive project for the establishment of pilot Regional Quality Assurance Centers within the departments of specialized Referral Hospitals through the material support of IAEA and other sponsors. The key goal of this intervention is to progressively influence knowledge, Attitude and Practice for the improvement of radiological safety conditions in the departments and achieving a good quality of service and enhancement in the Safety Culture with a multiplier effect and gradual expansion to all other practice centers in the country.

6. Public Exposure Control

NRPA ensures adherence of the regulatory requirements to control any public exposure delivered by a practice or source. Through the regulatory programme ensures the establishment, implementation and maintenance of protection and safety policies, procedures and technical and organizational arrangements in relation to public exposures.

NRPA extends its regulatory control in the transport of radioactive materials in line with the IAEA transport regulations [ST-1, 1996 revised version]. The technical capacities for ensuring public exposure control are also developing in the area of waste management, environment and food monitoring and consumer goods control.

a) Environmental and Food Monitoring

A high-resolution gamma spectrometry system is used to analyze food and environmental samples. Certificate of radioactivity content is provided to customers for export food-stuffs. NRPA is planning to expand this activity in the area of import food control in the near future.

Ambient level radiation measurement is currently carried out at 15 synoptic meteorological stations within and outside Addis Ababa. The TLD technique is employed and crystals will be collected and read in a quarterly basis.

b) National Provision for Management of Disused Source

The safe management aspect of spent radioactive sources scattered in different practice centers and kept in a sub standard condition has been the source of grave concern for a long time. There is a felt need for organizing a central interim storage repository facility in Ethiopia. With the support of the IAEA a national waste management strategy has been developed. In this process the problems and constraints were analyzed from a realistic perspective and remedial actions and priorities including the establishment of a temporary radioactive waste storage facility were identified.

Based on the identified strategic direction NRPA has established a temporary storage facility and spent radioactive sources from various practice centers and industries in the country were collected, conditioned and safely stored as an interim measure. NRPA has also prepared a project profile for the establishment of a permanent facility. With the technical support of IAEA preparatory work for developing detailed project document is underway.

7. Emergency Preparedness and Response

With the number of sources, which are in use at present and the possible increase in the future, the likely-hood of some emergency cannot be ruled out. An organized structure for emergency response does not exist. However, the Ethiopian Science and Technology Commission is the contact point in the event of such emergencies. To close this gap NRPA is planning to design a National Radiological Emergency Preparedness and Response Plan and elaborate the mechanism for subsequent approval by the appropriate bodies in the near future.

8. Training at National Level

For ensuring the effectiveness of Radiation Protection Programme fostering knowledge and awareness by way of training in the areas of protection and safety among radiation workers will have a profound impact. NRPA is paying serious attention to this aspect and organizes two regular training programmes and other tailored special trainings for radiation workers every year. Such programmes are expanding in content and outreach as the capacity limitation is being alleviated.

Through these programmes so far over 276 radiologists, regulatory inspectors, radiographers, officers in charge of radiology departments, and Ethiopian Customs Authority participated at various occasions. A regular awareness promotion programme transmitted by public media in various events also supports the NRPAs public outreach programme and this will continue in quarterly manner.

9. Information Dissimination

As an important supplement to the Radiation Protection and regulatory programme, NRPA has given due emphasis to develop and implement a mechanism for the periodic dissemination of information to relevant users and stakeholder groups about protection, safety and related findings.

The system has two basic components characterized by the type of information conveyed i.e., regulatory or awareness promoting. On the regulatory aspect, Inspection findings are promptly communicated to the users and partners in due time. In the case of any irregularity and abnormal situation NRPA also aware the relevant party about such occurrences and this system is continually upgraded for effectiveness.

For promoting public awareness NRPA is pursuing to publish an exclusive disclosure of the Radiological Safety condition of the facilities and practice centers in the country together with the Annual Reports. NRPA has also established a full-fledged information and documentation center, which will expand its public information outreach.

10. External Relations and Cooperation

In this area a commendable activities has been carried out in order to promote the objectives and regulatory mandates of NRPA and the Radiation Protection Proclamation.

A number of consultative meetings have been organized and useful discussions carried out with several public and government bodies and key stakeholders mainly on issues related with the implementation of the Radiation Protection Proclamation, Radiation Protection Programme and forming partnership and cooperation to that effect.

11. Major Obstacles

There are numerous challenges faced and tackled in the course of NRPA's development.

The major ones, which reflect on its long-term performance, could be cited as follows.

— Challenges and Complexity associated with the retrospective licensing;

— Sources imported long ago without proper documentation and remain without appropriate storage;

— Lack of centralized repository facility;

— The challenges of stretching the activities while developing the basic capacity

12. The Way Forward

The National Radiation Protection Authority has implemented with success activities pertaining to the formative/organizational and development / Implementation phases of the national regulatory programme. The assistance received from the IAEA through the frameworks of the Regional Model Projects RAF/9/024, RAF/9/028 and RAF/9/029 were highly instrumental and enabling to realize the swift transformation.

Through this transformation process NRPA has developed the key strategic assets and appropriate institutionalized capabilities bolstering the establishment of a credible and appropriate radiation protection infrastructure.

The lessons learned through the organizational development exercise are also significant for shaping our future strategies.

The challenges of today and the near future are the challenges of:

— Consolidating the current achievements and ensuring sustained operational effectiveness;

— Continually ensuring an appropriate performance monitoring, measurement and evaluation system;

— Maintaining continuous performance improvement programme;

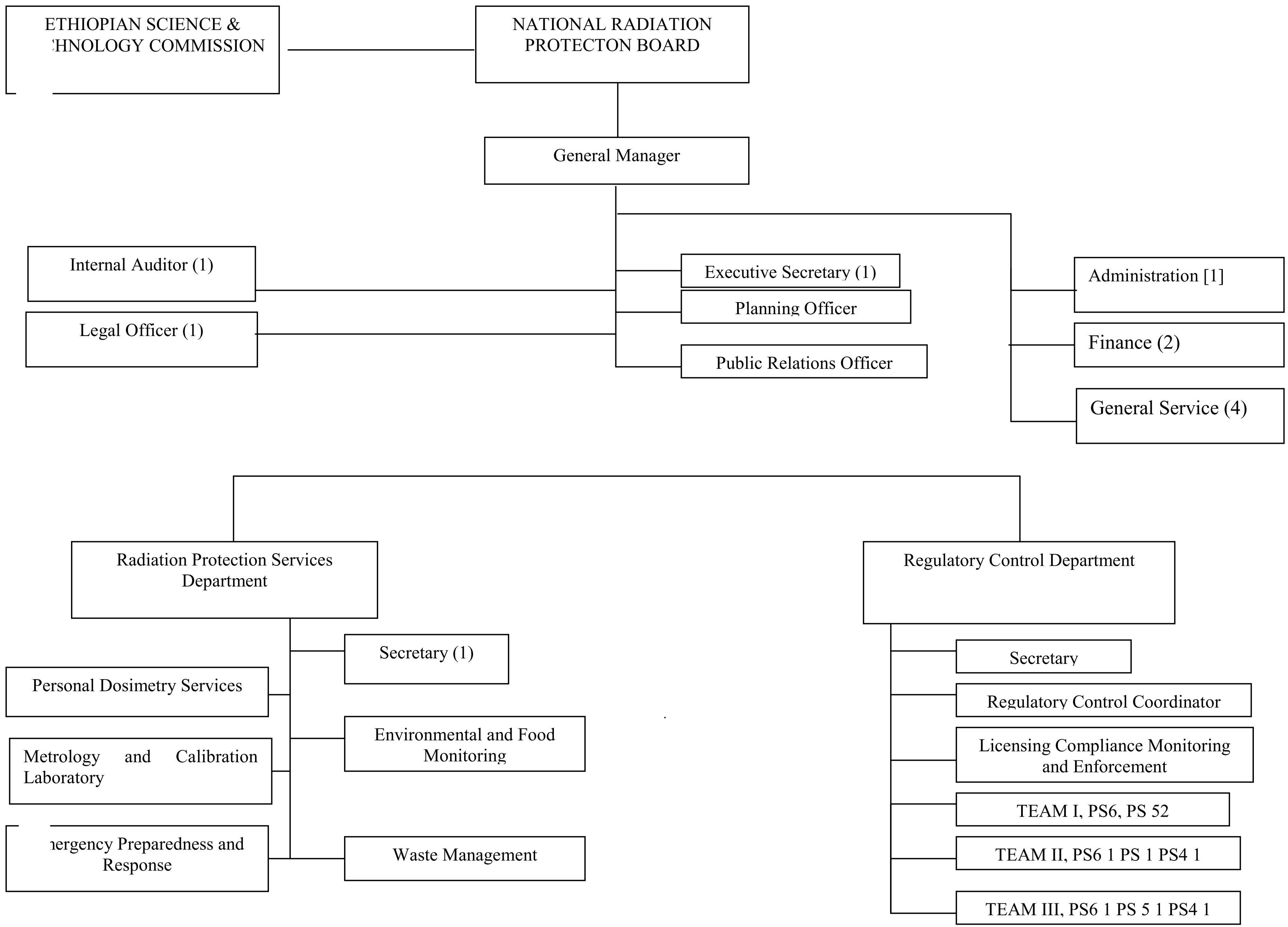
— Building the required flexibility in order to achieve an appropriate fit with the dynamically changing transition environment in Ethiopia.

To this end among the available strategic routes NRPA will pursue the following to achieve sustained effectiveness and efficiency.

— Building a collaborative framework for strategic partnership and maximizing the degree of support provided by its key stakeholders.
— Continually augmenting technical competence and building the credibility and confidence that the different publics will have on NRPA.
— Building the ability of NRPA to recruit, develop and maintain people with the required core competencies.
— Ensuring adequate budgetary provision to support a sustained operational effectiveness.
— Maintaining the dynamism and the ability to anticipate and respond to the emerging needs of the public.
— Pursuing excellence in management and promoting professionalism.

Finally for NRPA at its current position, optimism about its future towards the attainment of effective and sustainable Radiation Protection Programme is well founded.

ANNEX I: The Organizational Structure of NRPA [MAY 2003]



Radiation Protection Infrastructure in the Republic of Yemen
Country Report

M. S. Abdullah

National Atomic Energy Commission
Republic of Yemen

Abstract. The National Atomic Energy Commission (NATEC) is the National Competent Authority in the Republic of Yemen. NATEC has all the requirements to carry out its mandate. In addition, it has the Assistance of the International Atomic Energy Agency (IAEA), mainly through its Model Projects for Establishment of Radiation Protection Infrastructure and Waste Safety (RAW/6/009, RAW/9008, RAW/9009), which have been going on for many years now. The sources of radiation in the country come from mainly the oil and gas industry and the medical practices, which is limited at present to diagnostic radiology. There are some radioactive sources, with little activity, used in education and research. NATEC has been implementing a comprehensive program in radiation safety in two aspects, the first is the protection of people and environment and the second is the safety and security of radioactive sources. Through, these Model Projects, we established inventory of radiation sources, systems of registration, authorization and enforcement, personnel monitoring program, etc. We believe that NATEC has a very competitive and strong radiation protection program if not the strongest in the region.

1. Introduction

The Republic of Yemen has established an institution responsible for all atomic energy maters including radiation protection issues. This institution is known as the National Atomic Energy Commission (NATEC). NATEC was established in 1999. NATEC has the mandate to regulate all activities involving radiation sources (competent authority). NATEC consists of 5 General Directorates, 4 of which are dedicated to care for radiation protection matters. NATEC is totally independent authority, financially and administratively. NATEC has a lot of mandates and has been carrying out a lot of tasks and addressing many needs in relation to radiation protection. Through the Model Projects for Establishment of Radiation Protection Infrastructure and Waste Safety (RAW/6/009, RAW/9008, RAW/9009), NATEC has developed and established inventory of radiation sources, systems of notification, registration, authorization and enforcement, personnel monitoring program and environmental monitoring program.

2. Status of Radiation Protection before NATEC Existence

2.1. Activities existed in the Republic of Yemen

- Medical – Only diagnostic and Interventional Radiology.
- Industrial – Radioactive sources mainly in oil and gas industry.

2.2. Regulation of activities

- Medical – There was no regulation neither control – This mandate was given to the Ministry of Health to basically issue licenses for importing and operating X-ray machines for the purpose of diagnosis. Radiation protection was not in the requirements of the installation and operation of these machines. Radiation protection was not invoked by any institution at then for many reasons, the most important of which was the lack of independent regulatory authority to care for radiation protection. Other reasons are the lack of trained personnel to carry out the task of radiation protection matters, the lack of proper monitoring equipment etc.

— Industrial – Many parties were involved as far as the administration process of importing and exporting such sources – No technical work was involved. There was no control, no radiation protection. It was up to the companies to do whatever they like. There was nothing worth mentioning as far as radiation protection. Everything was left to the end users. The only good thing that was carried out is that radioactive sources were accompanied by a policeman while transport. Of course this is true as long as the customs and the police know that a shipment received at the airport is a radioactive material. This has ensured sort of physical protection of the radiation sources. However, after being transported, sources are not followed anymore. Radiation protection was missing simply because of lack of knowledge and absence of technical institution to care for such sources as well as the protection people and environment.

3. Establishment of Radiation Protection Infrastructure

The Republic of Yemen has joined the Model Project RAW/9/006 in 1996, through which many things were achieved the most important of which was the establishment of an independent regulatory authority to be responsible of all nuclear matters in the country with priority given to establishment of radiation protection infrastructure in the country. In 1999 the National Atomic Energy Commission (NATEC) of Yemen was established. The law has given NATEC responsibilities over all nuclear activities in the country. NATEC managed to do the following:

— Hire technical people to carry out mandates assigned to it.
— Trained its staff in different areas of radiation protection.
— Provide and carry out services using equipment provided by the IAEA.

3.1. Achievement uder projects (RAW/6/009, RAW/9008 and RAW/9009

3.1.1. Milestone 1, The Establishment of legislative and regulatory infrastructure

Two Presidential Decrees were passed granting NATEC responsibilities of all activities related to nuclear technology especially radiation protection. These decrees spell out all responsibilities and tasks that NATEC should carry out to protect people and environment from the hazardous ionizing radiation. Five general directorates were formed at NATEC, 4 of which are designed to care for radiation protection. The law was initially drafted by NATEC with the assistance of the IAEA. NATEC is working on replacing these two presidential decrees with the Atomic Energy Law. All regulations are drafted or being drafted. However, it is worth mentioning that all radiation protection regulations are enforced since NATEC has adopted the Basic Safety Standards 115 as its reference in applying radiation protection rules and regulations.

3.1.2. Systems of notification, authorization and enforcementa

One of the general directorates was assigned the responsibility of registration, licensing and inspection of all radiation sources (radiation generating equipment as well as radioactive material). This directorate carries out inspections, licenses radiation sources and enforces radiation protection laws and regulations, which can be summarized as follows:

— Medical – NATEC has inspects diagnostic radiology departments, in governmental and private hospitals in the cities of Sana'a, Aden, Taiz, Dhamar and Amran. NATE has also distributed all relative radiation signs to all hospitals that were visited. NATEC has started personnel monitoring service at the city of Sana'a and moved to other cities. Currently we have covered Sana'a, Amran, Dhamar, Aden, Taiz. Till now we do not have radiotherapy nor nuclear medicine applications. This directorate is carrying out inventory of x-ray machines existing in the country. We have not licensed any of the x-ray department till now since we believe that these installations are not qualified enough to be licensed and can not be shut down either. As soon as we finish our program that is designed to help and assist these installations to reach the minimum requirements of radiation protection, we will start licensing.

— Industrial - NATEC is very much in control of the radioactive sources that are used in the industrial applications. In cooperation with the police and the customs and others such as airlines, NATEC managed in the last few years to get this sector very well taken care of. NATEC issues three types of licenses for each radioactive source, which are Import, Export and Possession and Use. No entity has the right to bring any source without prior written approval from NATEC. The second, the Possession and Use of the source, which is given upon meeting with all radiation protection and safety rules and regulations. The export license, is given upon the Yemeni law that requires all users of radioactive material to ship back their radioactive sources.

— NATEC inspectors inspect the sites regularly. NATEC impose very strict requirements on users regarding the use and the movements of radioactive sources. It is also worth mentioning here that no radiation source is moved within the country without NATEC approval and direct physical supervision.

3.2. Milestone 2: The establishment of occupational exposure control

3.2.1. External monitoring

An estimate of 2000 X-Ray machines exists in the country of Yemen with a population of 8 million. An estimate of 4500 radiation workers is in the medical field (x-ray only). To cover all these workers with individual monitoring, this need a lot of efforts. This service is very delicate and very much demanding technically and administratively. Not only that, but also requires a lot of efforts to maintain and sustain. NATEC started this service a few years ago at the capital city of Sana’a. It was successful. Upon this success, NATEC started to move into other cities. NATEC has covered the following cities: Sana’a, Aden, Taiz, Amran, Dhamar and soon will move into other cities. The approach is to start covering the cities where heavy population exists. The difficulties we face the most are logistics. X-ray machines are distributed all over the country and the geographical nature of the country makes it even harder to easily reach x-ray installations. We are moving in this area slowly but successfully. Before providing individual monitoring service, NATEC starts general inspection of an x-ray installation and then train the workers on radiation protection. A one-day training course is always presented to radiation workers on how to use and care for the radiation dose meters before giving them these dose meters. This is to ensure the success of our work in this area. NATEC has covered about 500 radiation workers in the above mentioned cities. NATEC is using the TLD type of monitoring devices (dose meters). Personnel monitoring is carried out every tow months.

3.2.2. Internal exposure

This program has not been activated yet. However, radiotherapy and nuclear medicine are underway and soon, hopefully, by the end of this year a radiotherapy center will be inaugurated followed by nuclear medicine.

3.2.3. Workplace monitoring

NATEC does monitor x-ray departments. This is part of our inspection process. As far as calibration and Assurance Programs are not in place due to lack of technical means to carry out such activities.

3.3. Milestone 3: Establishment of medical exposure control

We do not have radiotherapy nor nuclear medicine application as of yet. In diagnostic and interventional radiology, NATEC has established dose levels upon which investigation, and intervention are implemented. Quality assurance program is not in place yet.

3.4. Milestone 4: Establishment of public control

As this relates to public exposure, environmental monitoring comes as the big task for the Regulatory Authority (NATEC). We have not done a lot in this area mainly due to either lack of technical support (equipment, programs, expertise etc). As far as radioactive waste, we have no waste as of now. Radioactive material imported by industrial companies is required by law to be exported.

Transport of radioactive material is very much under control. Nothing is transported in the country unless physical supervision form NATEC, technical staff, and the police is in place. Even transport of radiation sources from one field site of a company to another is not allowed except with the existence of a technical person from NATEC and a policeman.

3.5. Milestone 5, Establishment of emergency preparedness and response capabilities

Emergency preparedness is basically looked at from tow sides, one is a need of emergency plan at the institution and the other at the level of regulatory authority (national plan). Emergency plan at the institution level needs technical input to ensure success while national emergency plan needs more political input. Emergency plan at the end user institution is a requirement of granting a Possession and Use license. NATEC also has an emergency team that is on duty 24 hours (shift base duty). This technical team has been trained reasonably and has reasonable equipment (source recovery equipment, monitors etc.). We at NATEC believe that any emergency that may occur within the country we can tackle and get it under control. What needs to be achieved is to establish a national systematic plan, which is being drafted.

3.6. Training

The most important achievement NATEC and the IAEA have achieved during the last 6 years was the human power development. If one looks at the situation in the country before 1997, it was not good. There was no trained personnel in radiation protection. With the assistance of the IAEA especially under the Model Project RAW/9/006 and the ones followed, NATEC managed to train more than 40 persons in different areas of radiation protection. This training was as short as one week and as long as 9 months. We have five persons graduated from the Radiation Protection Diploma Training Course and three to be graduated this year 2003. NATEC with the assistance of the IAEA hold national training course every year in different areas of radiation protection, which lead to the dissemination and creation of radiation safety awareness. With manpower development, NATEC managed to carry out many activities related to radiation protection as previously mention in this paper in details.

4. Conclusion

With national political will and commitment, dedicated staff, and good administration and leadership that NATEC is enjoying, and the assistance of the IAEA, the Republic of Yemen is enjoying the existence of Radiation Protection Infrastructure, that is meant to care for the safety of its people and environment. This magnificent achievement is contributing to the well being of the people in this country. NATEC, in a short period of time has managed to establish radiation protection infrastructure that addresses the need of this country as far as safety. One of the essential elements that lead to success of NATEC was the ability to hire people and the assistance of the IAEA to train these people. We at NATEC believe that building manpower is the key to ensure sustainability in this area.

REFERENCES

[1] Presidential Decree No. 162 for the year 1999, “Establishment of the National Atomic Energy Commission”.

[2] Basic Safety Standards 115

[3] Republic of Yemen National Report to the Regional Coordination Meeting for the Model Project RAW/9008 and RAW/9009, Abu-Dhabi, (31May – 4 June) 2003.

The Regulatory System for Radiation Protection, Radioactive Waste Management and Nuclear Safety in Cyprus

P. Demetriades

Radiation Inspection and Control Service
Department of Labour Inspection
Ministry of Labour and Social Insurance
Nicosia, Cyprus

Abstract. Cyprus does not operate any nuclear power plants, uranium mines of other nuclear installations nor does it possess any nuclear material. The main use of ionizing radiation in the country is for medical purposes either diagnostic or therapeutic. Ionizing radiation is also used for industrial and research purposes. A new regulatory system for the control of ionizing radiation has recently been established with the enactment of new legislation. This legislation is in line with the IAEA standards and the Euratom Acquis, as Cyprus will soon join the European Union as full member. Cyprus participated and continuous to participate actively in the IAEA Model Projects and benefited the most out of these initiatives during all stages of work to establish the Radiation Protection and Safety System and to improve the relevant infrastructure of the country.

1. Introduction

The main use of ionizing radiation in Cyprus, which has a population of 750000 and hosts around 2000000 tourists every year, is for medical applications either for diagnostic or for therapeutic purposes. Ionizing radiation is also used for industrial or research purposes. At present Cyprus does not operate any nuclear power plants uranium mines or other nuclear installations nor does it possess any nuclear material.

An inventory of ionizing radiation sources and users of ionizing radiation has been prepared by the Department of Labour Inspection. This inventory will be finalized and continuously updated through the licensing procedure required by the legislation.

Despite the fact that Cyprus is a member of IAEA since 1965, specific legislation for the regulatory control of ionizing radiation in the country has only recently been enacted. However, operational control has been practiced for many years at high standard and the expertise and safety culture existing in Cyprus, in the area of ionizing radiation, is at a very high level.

Cyprus is participating in the IAEA Model Projects since the beginning of their implementation and has benefited the most out of them. The assistance provided by the IAEA through the Model Projects was very helpful in the drafting and promulgation of the legislation, the training of personnel and generally for the improvement of the legal, administrative and technical infrastructure of the country in the area of ionizing radiation.

Cyprus is also a candidate country and soon will join the European Union (EU) as full member. Therefore, the system for radiation protection and safety is also fully harmonized to the Euratom Acquis.

2. Legal Framework

The regulatory basis for radiation protection and safety in Cyprus is the Protection from Ionizing Radiation Law of 2002 [1] which was enacted on 12 July 2002 and four sets of Regulations, issued on 25 October 2002 under the law [2,3,4,5]. This legislation applies both for natural and artificial radiation sources and covers all aspects of ionizing radiation risk control such as:

i. occupational and public exposure, including outside workers.
ii. medical exposure.
iii. supervision and control of radioactive waste.
iv. emergency preparedness and response.

The above law and regulations provide, inter alia, for:

i. the establishment of the Regulatory Authority (RA), named The Radiation Inspection and Control Service (RICS) as a distinct unit within the Department of Labour Inspection of the Ministry of Labour and Social Insurance. The Regulatory Authority will execute the powers under the law which The Minister of Labour and Social Insurance will delegate to it.

ii. justification, optimization and dose limitation of practices.

iii. the notification and licensing of practices and sources in relation to custody, use, manufacture, supply, handling, distribution, storage, import, export, disposal, recycling, commissioning, decommissioning etc.

iv. establishment of a Licensing Committee which advises the Minister of Labour and Social Insurance on licensing matters. Licence is granted, under certain conditions, by the Minister of Labour and Social Insurance, after receiving advice from the Licensing Committee. Six different ministries are represented in this committee which is chaired by the representative of the Ministry of Labour and Social Insurance.

v. appeals.

vi. obligations of employers and licensees.

vii. appointment and powers of a chief inspector and inspectors.

viii. enforcement actions and penalties.

ix. the design, erection, commissioning and decommissioning of nuclear installations.

x. the storage, shipment and disposal of radioactive waste, and spent or disused sources.

xi. the categorization of workplaces and workers.

xii. individual and area monitoring.

xiii. health surveillance of the workers.

xiv. public and environmental monitoring.

xv. emergency preparedness and response. Licensees should make a risk assessment, prepare a safety report, prepare an on-site or transport action plan if necessary and keep records. When necessary an off-site action plan is also prepared by the authorities.

xvi. transport of radioactive materials.

xvii. the establishment of a Radiation Protection Committee, with an advisory role to the Minister of Labour and Social Insurance and generally to the government on radiation matters.

xviii. the power of the Council of Ministers to issue Regulations on any matter related to the safe use of ionizing radiation and nuclear energy.

All the above legislation is based on the IAEA standards and recommendations. Moreover, this legislation is fully in line with the Euratom Acquis, since Cyprus is a candidate for membership and soon will become full member of the European Union (1 May 2004). In addition to the above, a number of European regulations and decisions on radiation protection and safety will automatically apply in Cyprus as soon as it becomes full member of the European Union.

Inland transport of radioactive substances is covered by the above legislation which will be supplemented by legislation that is now under preparation and that transposes the relevant EU directive on transport of dangerous goods. The final regulatory framework for transport of radioactive substances will also be in line with the relevant IAEA standards.

Further to the provisions of the above legislation, the radioactivity in drinking water and food products is covered by specific legislation in line with the relevant EU directives.

In addition to the above, Cyprus has rarified, signed or participates in a number of International Conventions, Protocols, Agreements and other Instruments in the area of nuclear energy and ionizing radiation, namely:

i. The Conventions on Early Warning and Assistance in the case of Nuclear Accident [6].

ii. The Convention on Nuclear Safety [7].

iii. The Convention on Physical Protection of Nuclear Material [8].

iv. The Treaty on the Non-Proliferation of Nuclear Weapons [9].

v. The Protocol Additional to the Agreement between Cyprus and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non – Proliferation of Nuclear Weapons [10].

vi. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Pending ratification).

Cyprus applies also the following international instruments for transport:

i. The United Nations Recommendations on the Transport at Dangerous Goods.

ii. The International Maritime Dangerous Goods Code (IMDG).

iii. The International Civil Aviation Organization (ICAO) Technical Instructions on the Safe Transport of Dangerous Goods.

iv. The Universal Postal Union (UPU) Convention.

3. Administrative Infrastructure

As mentioned above, the Radiation Inspection and Control Service (RICS) of the Department of Labour Inspection acts as the Regulatory Authority (RA) for Radiation Protection, Radioactive Waste Management and Nuclear Safety in Cyprus. In addition, RICS co-ordinates all other supporting institutions in the country on matters related to ionizing radiation. A decision for staffing the RICS has been taken by the government and following the established procedures the RICS will be initially staffed with one head and four inspectors, all qualified and well trained.

The operation of the RA will be supported by institutions which have capabilities for monitoring and analysis in the field of ionizing radiation. Such institutions are :

i. the Medical Physics Unit of the Nicosia General Hospital, which offers individual and calibration services (SSDL),

ii. the General Laboratory, under the Ministry of Health, which has an ionizing radiation section for water and food monitoring,

iii. the laboratories of the Ministry of Agriculture, Natural Resources and Environment, which can monitor agricultural and veterinary products or conduct soil surveys, and

iv. the laboratories of the Physics and Chemistry Department of the University of Cyprus which have monitoring and training capabilities. A project for a survey of the radioactivity levels in Cyprus, supported by the RA, is at the final stages of completion by the Physics Department of the Cyprus University.

The above laboratories will be encouraged to improve their monitoring capabilities by improving their equipment, increasing their manpower, training and participation in QA programmes.

Appropriate arrangements have already been made in all entry points of the country for combating illicit trafficking and terrorism. Within this context all customs and police officers involved have been trained on these matters and appropriate monitoring equipment has been installed or is used in all ports and airports. In addition, Cyprus participates in all initiatives of the United Nations, the IAEA and the EU for combating terrorism.

Cyprus has appointed the Competent Authorities and the National Warning Point under the IAEA Convention on Early Warning in case of a Nuclear Accident and participates in the IAEA Emergency Preparedness and Response Network. Competent Authority (Abroad) is the Ministry of Foreign Affairs and Competent Authority (Domestic) is the Ministry of Labour and Social Insurance. An emergency operations centre, has been established within the Civil Defense Administration which is the 24h Warning Point of the country in case of a nuclear or radiological emergency. The RA in collaboration with the above Administration is working for the preparation of a National Action Plan in case of Nuclear Emergencies. A modern early warning system for γ-radiation in air and a monitoring network for sampling and analysis of dust, rain and sea water, soil and other environmental variables, to cover the whole country, is under consideration. Cyprus will also participate in the ECURIE system of the European Union soon.

The whole administrative system for radiation protection and safety is presently operational, but further strengthening and improvement through the implementation of the Model Project RER/9/065 is under consideration.

4. Individual Monitoring

Individual Monitoring of the exposed workers is an obligation of the licensee or the employer and can be offered by any approved by the Minister of Labour and Social Insurance Dosimetry Service. Around 300 radiation workers are monitored in Cyprus by the Medical Physics Unit of the General Hospital of Nicosia using TLDs. The laboratory of this Unit is very well equipped and its personnel are very well trained, through various IAEA projects including the Model Projects. The results for the recent years show a continuous improvement and the occupational exposure doses are generally very low, compared to the established dose limits.

5. Participation in the Model Projects

As mentioned above Cyprus is participating in the Model Projects of the Agency since their early implementation and has received a lot of assistance under these projects which proved to be invaluable and of great help in establishing the system for Radiation Protection and Safety in the country.

With expert advice from the Agency through these projects:

i. a lot of disputes and misunderstandings were solved and decisions were taken by the government, based on the new standards and principles of IAEA, concerning the most appropriate Regulatory and Administrative System for radiation protection and safety the country.

ii. new legislation was drafted, discussed and is presently applied

iii. new equipment was purchased and is in use by the RA and other supporting institutions or hospitals and clinics for medical or research purposes.

iv. a number of people have been trained in Cyprus and abroad in all areas of ionizing radiation use.

v. a number of regional training courses and meetings were organized in Cyprus.

Without the assistance through the Model Projects the task for the establishment of the appropriate system for regulatory control of ionizing radiation in Cyprus would be more difficult. Therefore, Cyprus will continue its participation in the Model Project, aiming at the strengthening and improvement of the infrastructure in order to secure the safe use of ionizing radiation.

6. Conclusions

Operational control and safety culture concerning the use of ionizing radiation in Cyprus is of a high standard. Recently, a regulatory framework and the necessary administrative structure were established, in line with IAEA and EU standards. The participation of Cyprus in the IAEA Model Projects proved to be of great assistance in all phases of work towards the establishment of the radiation protection and safety system. The participation in the Model Projects in the future is considered necessary and invaluable for further strengthening and improvement of the relevant infrastructure of Cyprus.

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Implementation of the IAEA Model Project: Bangladesh Perspectives

C.S. Karim and A. S. Mollah

Bangladesh Atomic Energy Commission
Dhaka, Bangladesh

Abstract. Bangladesh is participating in the Model project. Its radiation control legislation is based on the BSS. Bangladesh has achieved the first Milestone of the IAEA Model Project. While not yet complete, Bangladesh is making good progress towards the implementation of Milestone 2 of the IAEA Model Project. As regards other milestones efforts are underway to achieve those in phases. The paper presents some lessons learned during implementation concerning the numerous activities involved in the model project.

1. Introduction

In Bangladesh, ionizing radiations are now used in a variety of fields and address the needs of a number of sectors of national economy, such as healthcare, industry, agriculture, construction, water resources, isotope production, food preservation, oil and gas exploration, etc. Uncontrolled radiological practices may cause detriments to radiation workers, public and environment. Necessary laws and rules have been introduced. The Bangladesh Atomic Energy Commission (BAEC), the national agency having the mandate to promote peaceful nuclear applications, has been given the responsibility of regulatory control. Bangladesh is participating in the Model project. Its radiation control legislation is based on the BSS. Progress has been made during the recent past and sincere efforts are being made to meet the legal requirements. The IAEA Model Project and projects under the RCA are providing useful support and assistance to the national efforts on the strengthening of the radiation and waste safety infrastructure. The paper presents some lessons learned during implementation concerning the numerous activities involved in the model project.

2. Implementation of the milestones

In a developing country like Bangladesh, availability of various technical services of relevance to nuclear regulatory activities is overwhelming. Infrastructure and capacity is being built to meet the demands for such services both by the users and regulators. The present status for implementation of the milestones under the IAEA model project is described below.

2.1. Milestone 1: It requests the establishment of a system of notification, registration, inspection, licensing and enforcement, including an inventory of radiation sources

The Nuclear Safety and Radiation Control Act-1993 [1] and the Nuclear Safety and Radiation Control Rules-1997 [2] are the legal basis for control of radiological practices in Bangladesh. The rules essentially incorporate the requirements of the International Basic Safety Standards (BSS) [3]. The act requires a license to carryout any radiological or nuclear practice in the country. Bangladesh has established an operational system of notification, authorization, inspection and enforcement for the control of radiation sources. This means that Bangladesh has achieved the first Milestone of the IAEA Model Project. The planed new law, revised on the basis of weakness identified in course of implementation of the existing law and feed back from the stakeholders, would improve the situation of nuclear regulatory obligations.

2.2. Milestone 2: It refers to the establishment of a national system of control for occupationally exposed personnel

The BAEC laboratories provide dosimetry and calibration services to the radiation facilities. Individual monitoring of occupational radiation workers is being carried out using TLD technique. At present only about 30% of the total workers are covered under routine monitoring services. The critical groups of workers engaged in industrial radiography (69%), radiotherapy (91%), nuclear medicine (100), research reactor (100%), isotope production (100%), nucleonic gauges (86%), radioactive waste facility (100%), neutron generator and accelerator (100%) and diagnostic x-ray radiology (25%) are, however, covered. A software of the Individual Monitoring System (IMS) has been developed by BAEC. The dose records in electronic form are being backed up on a quarterly basis. BAEC has participated in the IAEA/RCA inter-comparison with satisfactory results. There are still weaknesses in the personnel monitoring system. Efforts are being made to improve upon the situation through different types of interventions, such as making it mandatory for obtaining license, issuance of directives by the ministries, motivation, incentive, etc. The effect of the intervention is evident from the trend in growth of IMS coverage (Fig. 1).

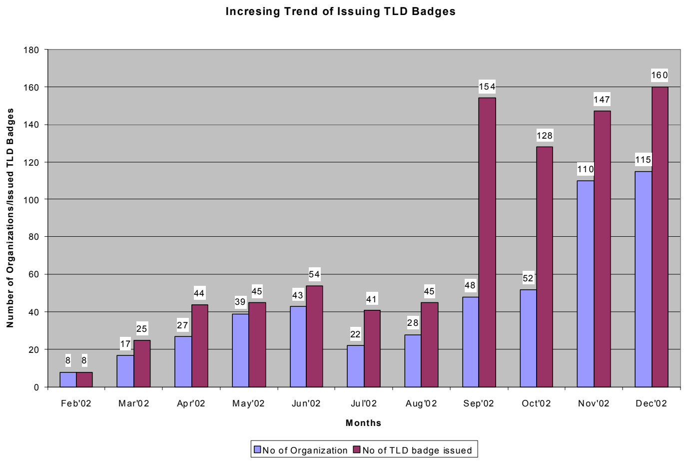

FIG. 1. Growth in the coverage of occupation workers under IMS.

Table 1 shows that the average doses received by radiation workers of different practices are below the acceptable level (20 mSv).

Table I. Annual average dose of radiation workers of different practices (2001).

Type of radiological practices	No. of radiation workers	Annual average personal dose equivalent (mSv)
Diagnostic Radiology	500	0.295
Nuclear Medicine	230	0.541
Radiotherapy	102	0.261
Industrial Radiography	52	1.604

In 1991, a Secondary Standard Dosimetry Laboratory (SSDL) was established for the purpose to calibrate and standardize the field instrument employed for radiation monitoring throughout the country. The facility has the capability of carrying out both therapy and protection level calibrations. SSDL participates in various intercomparison programmes. The results of such comparison show that the accuracy of dose measurements is within the acceptable limits.

BAEC recently conducted a nationwide workplace monitoring survey program, which included all the major radiological practices. The licensees were helped to classify their respective workplaces according to Basic Safety Series No. 115. Radiation protection practices in most of the facilities incorporate workplace-monitoring programmes. While not yet complete, Bangladesh is making good progress towards the implementation of Milestone 2 of the IAEA Model Project.

2.3. Milestone 3: This milestone relates to the control of medical exposures

The main task within this milestone is the establishment of adequate quality assurance programmes as well as to control of exposure of patients in radiotherapy , nuclear medicine and diagnostic radiology practices. Efforts are being made through feedback and interactions with medical facilities, concerned authorities and persons to improve the situation. The Ministry of Health and Family Welfare and the World Health Organization (WHO) are now being involved in the process. Government commitment to medical exposure control in manifested in its decision to create two centers of excellence, namely the National Institute of Cancer Research and Hospital in Dhaka and the radiology unit at the Osmani Medical College in Sylhet. An initial budget of Taka 20 Million (USD 320,000) has been allocated for this purpose. Another centre of excellence in Nuclear Medicine is also planned for the future. Qualified personnel are needed, in particular qualified medical physicists and qualified personnel in the medical sector. Certainly this fact should be taken into consideration when preparing and implementing national radiation protection and QA programmes. The implementation of these programmes is progressing.

2.4. Mileston 4: This milestone is related to the control of public exposure. The activities focus on radioactive waste safety, control of foodstuffs, and environmental monitoring

Efforts are being made to account all radioactive wastes in the country. All known radium sources of the country were finally collected, conditioned and stored safely in November 2000 with the technical assistance and support of the IAEA and the Pakistan Atomic Energy Commission. BAEC is constructing a Central Radioactive Waste Processing and Storage Facility at AERE, Saver. It will be used for conditioning and temporary of all radioactive wastes in the country. At present, BAEC maintains two temporary storage facilities at Dhaka and Savar, respectively. A national policy and programme for radioactive waste management in Bangladesh, including the legal instruments is going to be formulated.

A high-resolution gamma spectrometry system is used to analyze food and environmental samples. A certificate of radioactivity level is provided to customers for import and export foodstuffs. The Government empowered BAEC to conduct radioactivity testing in all food items for human as well as animal consumption. Ambient level radiation measurement is currently carried out by TLD technique on a quarterly basis.

2.5. Milestone 5: This milestone refers to the establishment of a system of emergency response and preparedness

The role and functions of the BAEC in radiological emergencies are prescribed in the Nuclear Safety and Radiation Control Rules of 1997. The BAEC is the contact point in the event of radiological emergencies. Article 93 provides for the BAEC to intervene and take appropriate action if required in the event of accidents or chronic exposure situations. Recently, BAEC has been included in the Committee of the National Disaster Management Bureau. This has opened up avenues for participation in the national disaster mitigation programs. Such participation would also enable BAEC to involve all other concerned in mitigation of a situation arising from nuclear and radiation induced emergency situation.

An organized structure for emergency response does not exist. BAEC is planning to design a national radiological emergency preparedness and response plan and elaborate the mechanism for subsequent approval by the appropriate bodies in the near future.

3. Key future action plan

A number of action plans have been envisaged that would ultimately help improving nuclear regulatory activities compatible with its designated objectives. Some of these will be taken up on a priority basis, while others can be materialized in phases. In many cases, Bangladesh would require support and assistance from external agencies, such as the IAEA. The salient aspects of this action program are described below.

— Act to be amended with the provision for establishment of an independent regulatory authority
— A programme to extend the monitoring service to cover all workers shall be developed with targets for completion.
— The inventory of radiation sources shall be updated. Conversion of the source inventory to an electronic database shall be implemented as soon as practicable.
— National Emergency Response Plan shall be developed as a part of the National Disaster Management Plan.
— A number of local activities, such as training workshop, open forum discussions, motivation programs, executive seminars, etc. shall be conducted for different groups of stakeholders.
— A training strategy shall be developed.

4. Conclusion

The perception of safety and protection is time, technology, space and situation dependent and also on the country concerned. Radiation safety is a collective responsibility with the licensees, regulators, workers, manufacturers and suppliers of radiation source/ equipment, the management, radiation protection officers and all other concerned persons are parties to the collective responsibility. The weaknesses cannot be removed overnight. Strong political commitment and cooperation and of the concerned persons and authorities will be required. The developing and least developed countries will need continued assistance from the UN bodies like the IAEA, WHO and ILO.

The Agency's Model Project has been effective in improving the situation in Bangladesh, however additional support from the Agency is recommended in order to achieve the Project targets as soon as possible (e.g. provision of personal monitoring dosimeters, calibration facility support).

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The Setting up of a National Infrastructure for Radiation Safety for Malta

P.S. Brejza, J. Cremona, R. Desai

Occupational Health And Safety Authority
Valletta, Malta

Abstract. Malta has recently started to set up a National Regulatory Infrastructure for Radiation Safety. Malta has had to address the need for a completely new legislation and the need to set up a national regulatory body, The Radiation Protection Board.

1. An overview of the situation before Malta started planning its National Infrastructure

Malta's use of ionising radiation commenced many years ago. The total number of radiation workers is in the order of 500 in approximately 120 locations. The main users of ionising radiation are in the governmental and private health sectors. Other smaller groups include: industry for non-destructive testing and gauging purposes; research and education. There are no nuclear activities in Malta.

Malta had in the past relied on the individual users to operate safely under their duty of care under general Health and Safety legislation. There was no coordinating body, which addressed matters relating to radiation safety. Different non-coordinated governmental bodies addressed radiation protection matters to the best of their abilities

The uncoordinated situation in the past was clearly not satisfactory as adequate control of radiation protection measures and radiation sources could not be guaranteed on the European level.

2. Government decision to address radiation protection issues

As part Malta's commitment to being a member of the International Atomic Energy Agency (IAEA) and also due to considerations being given to joining the European Union (EU) the decision was made by the Maltese government to set up a complete regulatory system for radiation protection and control of radiation sources.

3. Maltese Regulations

The Maltese radiation protection regulations have been written to ensure compliance with the commitments to the IAEA and to the EU directives.

The Nuclear Safety and Radiation Protection regulations 2003 (NSRP regulations) which were published in January 2003 are primarily concerned with ensuring compliance with EU directives on occupational exposure to ionising radiations 96/29/Euratom (Basic Safety Standards), 90/641/Euratom (outside workers) and with the setting up of the Radiation Protection Board (RPB). These regulations require that all radiation employers receive an authorization from the RPB. These authorizations will be issued for a set period of time. A comprehensive inspection system is planned consisting of: pre-authorization, annual routine announced and unannounced inspections.

These regulations will come into force later this year.

The Ionising Radiation (Medical Exposure) Regulations have been drafted and should be published later in 2003 and have been written to ensure compliance with EU directive 97/43/Euratom.

4. Regulatory Authority

The Radiation Protection Board is being set up as the national competent body coordinate all matters relating to radiation protection. The RPB will be composed of members from different governmental bodies. The RPB is show diagrammatically in Figure 1

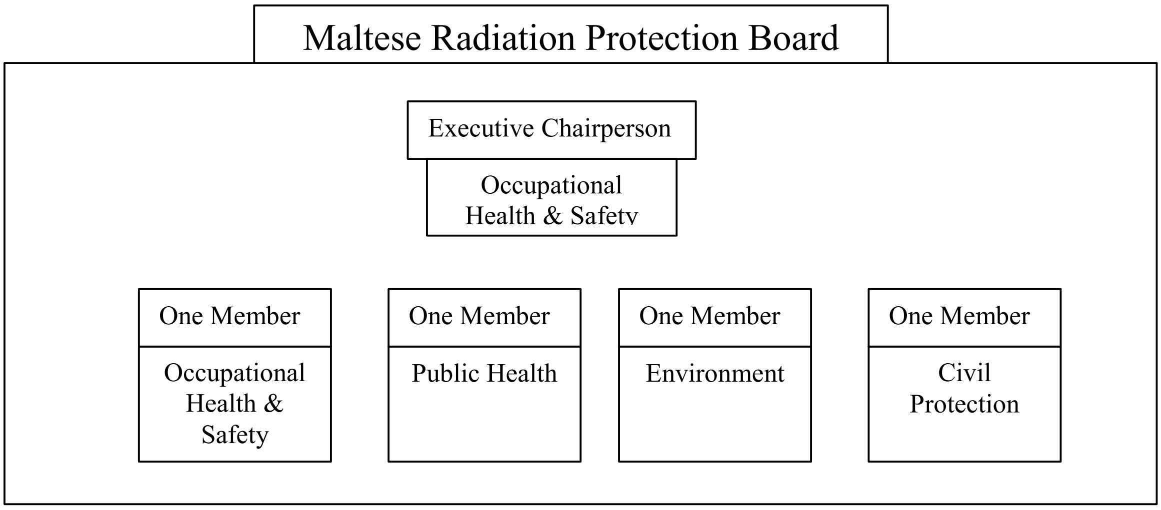

FIG 1. The composition of the Radiation Protection Board

The RPB will need to be able to have good lines of communication to ensure it functions effectively within the governmental structure of Malta, as shown in Figure 2. Where necessary formal systems will need to be set up, e.g. by Memorandums of understanding. If clear lines of communication do not exist there is a danger that there will not be clear assignments of responsibilities between the RPB and different governmental bodies. One advantage of this structure is that the independancy of the RPB is ensured by the direct subordination to the Prime Minister.

An important role of the RPB will be to give radiological advice to other governmental bodies to enable them to comply with their obligations in relation to radiation protection and radiation sources.

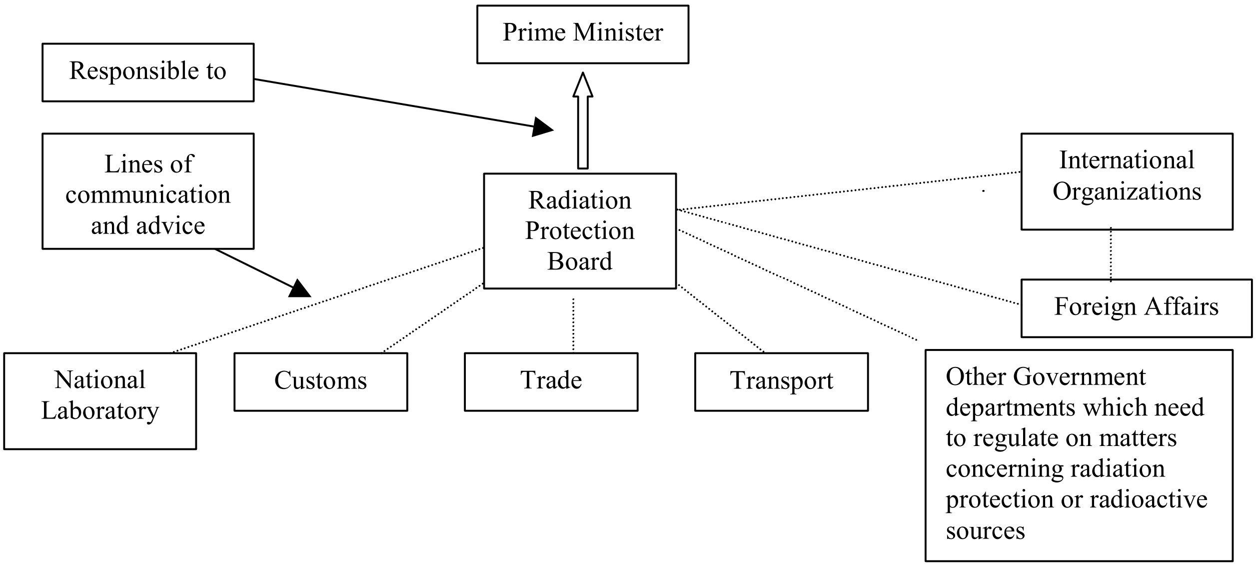

Fig 2. Position of the Radiation Protection Board within the administrative set-up in Malta.

The functions of the RPB as defined by the NSRP regulations are:

— take the necessary measures to improve the co-operation and co-ordination of the government bodies which have responsibility for issues related to occupational health and safety, environment, public health, and civil protection amongst themselves and with other interested parties;

— tender advice to the government on allocation of responsibilities in the field of nuclear safety and radiation protection when these are unclear or unresolved;

— co-ordinate the preparation of regulations governing notification, authorization of practices, work activities, radiation sources and establishing radiation protection and safety requirements;

— define criteria for exclusion, exemption and clearance from regulatory requirements;

— receive notifications, and issue authorizations andgrant exemptions concerning the possession and use of radiation sources, subject to any condition that may be required in the opinion of the Board and to revoke at any time any such authorizations if the Board feels that the required standards or levels of safety are not being complied with;

— coordinate and conduct inspections and enforcement actions to assess radiation safety conditions and compliance with applicable regulatory and authorization requirements and to protect the health and safety of workers and the public;

— compile a national register of practices, work activities and sources;

— set up and run a National Interim Storage Facility for orphan and disused radioactive sources;gather the required data to enable an assessment of total exposure from all practices and work activities in Malta and including the distribution of the individual occupational and public exposures for each type of practice, and to enable the setting up of a National Register for Occupational Exposure to Ionising Radiation;

— initiate surveys on background radiation and radioactive contamination of all environmental media;

— approve the capacity of persons to act as approved dosimetric services and qualified radiation experts for radiation employers;

— co-operate with other Regulatory Authorities abroad on relant issues and fulfill international obligations of which Malta is a signatory.

Until the RPB is formally set up later this year its work is being performed by an ad-hoc Radiation Protection Committee.

5. Individual Monitoring

Approximately 350 workers are routinely monitored by either TLDs or film badges. These monitors are obtained from a dosimetry service from a country within the EU, which is an approved dosimetry service for that country. Malta is looking at the feasibility of setting up dosimetry service within Malta with the assistance of the IAEA. A Maltese dosimetry service may have an application in monitoring patient doses and external doses in the environment. The collection of dosimetry data into a national database needs to be done is currently being worked on.

6. Emergency Response

The Civil Protection Department is coordinating the setting up a national emergency response plan for Malta. This is in an advanced stage and will be reinforced with assistance under an IAEA Technical Co-operation Programme.

7. Future Priorities for Malta

The regulatory framework in Malta is in its infancy. There are many challenges ahead but the near term priorities for Malta are to fully enact all the relevant regulations by the end of 2003 and to ensure that the RPB is fully functional as soon as possible. Once the RPB is fully operational it must earnestly address many issues. Some of the primary issues it will need to address are:

— To finalize the inventory of all radioactive sources in Malta, including orphan sources and radioactive waste of any kind

— Ensure all radiation employers are authorised under the NSRP

— To have a thorough and consistent inspection programme

— To set up a national interim storage facility

8. Conclusions

Following the governmental decision, Malta is setting up its national infrastructure for radiation safety. Malta has embarked on setting up its regulatory authority (the RPB) and is in the process of publishing regulations. As Malta is a small country the decision was made that the RPB will be made up from members from four different governmental organisations. The challenge ahead for Malta is to ensure that the governmental organisations that make up the RPB operate effectively to ensure that the RPB complies with its obligations.

National Infrastructures for Radiation Safety: Towards effective and sustainable systems, The Kenyan chapter

A.O. Koteng

Radiation Protection Board
Kenya

Abstract. Radiation Protection services in Kenya began in the 1960's as a small unit in the Radiotherapy Department of Kenyatta National Hospital, Nairobi. Initially, its mandate was to provide personnel dosimetry services to the hospital and other government institutions within the Ministry of Health. The Radiation Protection Act, CAP 243 Laws of Kenya, became operational in 1986, and provided for the establishment of the Radiation Protection Board as the national regulatory authority. The activities have now grown to include inspections, and licensing of radiation facilities, monitoring of transboundary movement of consumer products, among others. The staffing levels have also increased, with increasing responsibilities from the original two.

1. Introduction

Kenya joined the Africa Regional Model Project RAF/9/029 in the year 2001. At that time the priority areas of national concern and interest were:

— The expansion and upgrading of the QA programme for medical exposure control with emphasis on diagnostic radiology.

— The development of safety assessment plans for radiotherapy and nuclear medicine practices, including assessment of patient doses in radiotherapy.

— The initiation of a feasibility study, followed by the design and technical specifications for a centralized waste processing facility and a near-surface repository.

— The setting up of a national plan for response to a radiological emergency.

Upon joining the Regional Model Project, the Country made a request to the Agency for an assessment of infrastructure in all areas of radiation protection, including legislative and regulatory framework, and occupational radiation. This was done through a peer review mission the same year.

2. Legislation and Regulations

The following sums up the country's status from the beginning of the project up to the present moment.

The Radiation Protection Act (the Act), promulgated in 1982, was revised/enacted in 1985, and became operation in 1986. The Act provides, among other things, for the establishment of the Radiation Protection Board (RPB) as the national regulatory authority. A new draft of the revised Act was submitted to the Agency for review and comments in May 2001. The process was finalized. The revision is designed to follow the principal requirements of the International Basic Safety Standards. The Government intends to enact the new legislation as soon as possible. The National Council for Science and Technology (authorized IAEA co-coordinating body) has completed a policy guide to the Government on nuclear and radiation safety matters recommending autonomy of the regulatory authority. A set of by-laws/regulations governing specific duties, responsibilities and actions of the RPB is in place. New regulations on "Waste Management' are due for enforcement.[2]

2.1.Regulatory Authority

The Radiation Protection Board, under the Ministry of Health, discharges the duties and responsibilities of a national regulatory authority. The present legislation sets up the functions of the Board as follows:

— to advice the Minister for Health on matters pertaining to radiation protection and radioactive waste management.

— to implement the provisions of the Act and regulations made there under.

— to grant or refuse to grant or to extend the licenses issued under the Act, and to impose any necessary conditions on a license so granted.

— to keep a register of all radiation sources, irradiating devices, including their owners and users, and of premises licensed to dispose of radioactive waste.[1][3]

Under the Board, there exists an executive arm, the Radiation Protection Inspectorate (RPI), consisting of eight technical staff mandated to carry out a national regulatory programme. The programme has been in place for over a decade. Government support has been provided for the RPI to improve its working conditions (new office space), develop regulatory procedures and expertise. The system for notification, authorization and enforcement is operational. However, portable monitoring equipment used for inspection purposes were found to be largely worn out.[2] As a remedy the Agency has purchased three portable survey meters, two portable contamination monitors, five electronic pocket dosimeters for photon radiation with one dosimeter reader, and one handheld gamma spectrometer for the Country. The spectrometer is used on environmental monitoring on site. As there is no calibration facility in the country the calibration of equipment is provided by an external party and funded by the government.

The present executive arm to the Board (RPI) is to become the Radiation and Waste Safety Inspectorate (RWSI). This year, the Boards' function and staffing are due to be expanded. The advertisement for recruitment of seven (7) RWSI staff has already been undertaken. The Agency has been the main training partner for personnel through training courses, workshops, scientific visits and international conferences.

2.2.Occupational Exposure Control

There are approximately 2400 occupationally exposed personnel in the country. A national programme in this area is in place, and implemented through the following essential means:

— Each radiation facility or institution using radiation sources has a trained Radiation Protection Officer.

— Centralized film-based individual monitoring is carried out regularly.

— Workplace and area monitoring are part of radiation protection rules at most licensed institutions

— Radiation protection training of medical personnel is organized by the RPB regularly.

There was need to upgrade the individual monitoring system in the country. Dedicated laboratory space has been available. Managing and operating personnel, in charge of the system were designated during the mission.[2] Training of this group and the provision of a manual TLD-based system were included in the adjusted action plan for 2001. The Board has since acquired a Harshaw 4500 TLD reader with the relevant accessories, a table of irradiator and 1000 two element TLD Badges courtesy of the Agency. Personnel manning these equipment have been trained, and the monitoring of occupationally exposed personnel using this system commenced. The Board hopes that it shall eventually be able to cover the whole country using this system, to replace the film badge system.[1]

2.3.Calibration Capabilities

There is need for the country to establish a calibration facility. The Kenya Bureau of Standards (KEBS), already has laboratory premises, including dedicated irradiation bunkers, ready for this use. At present the calibration of radiation monitoring equipment is performed by an external party. Frequent delays and technical difficulties have been encountered in the process. In this connection, a request for technical assistance was renewed. The KEBS is ready to provide substantial national input to set up a radiation protection level calibration facility and have submitted a national project proposal to this effect for the TC cycle 2003 and 2004.[1]

2.4.Medical Exposure Control

The extent of radiation practices in both the public and private health sector is significant. There are approximately 1500 medical diagnostic x-ray machines, three teletherapy units (Co-60) two brachytherapy units and one nuclear medicine centre. In general, the radiation safety status at most medical institutions are adequate.[1]

A quality assurance (QA) programme in diagnostic radiology has been initiated in one national referral and teaching hospital. This should then be expanded to include other selected principal medical institutions (teaching hospitals), a medical technical training college (for diagnostic radiographers), and one regional hospital. The programme focuses on the assessment of patient doses for various examinations for given types and models of x-ray equipment. The adjusted action plan provided for assistance in the form of QA kits, of which two have already been received, to facilitate progress in this respect. Regular training events on radiation protection for medical and other personnel are organized by the RPB. The hosting by Kenya of a Regional Training Course on Radiation Protection in Diagnostic and Interventional Radiology, 14-18 January, 2002 under RAF/9/029 was a token of commitment and support to upgrading local and regional technical capabilities in this area.

2.5.Public Exposure Control

Priority in this area has been given to the safety of radioactive waste. A solid waste processing and temporary storage facility has been placed in a bunker and laboratory of the Material Testing and Research Department, Ministry of Roads and Public Works. There is a complete inventory of disused radiation sources stored in the facility, and the physical protection of the site is adequate. However, the existing facility does not provide for the storage of all low-level waste that arise from extensive practices, particularly in research.

Many of such practices, have been discontinued, but relatively significant quantities of spent or disused radioactive material are still being stored in makeshift backyard compartments or locked rooms at the user institutions. A decision to establish a central waste processing and terminal storage facility has been undertaken and a siting study initiated. Meanwhile the RPB encourages licensees to continue with the transfer of all disused sources and radioactive waste for temporary storage maintained by the Materials Testing Department, pending the establishment of the terminal storage facility.[1][2]

2.6.Emergency Planning and Preparedness

Activities in this area are being initiated under this Model Project. The Action Plan provides for the identification of key national agencies, training of specialists concerned and a systematic approach to setting up a national plan for response to radiological emergencies.[2] Kenya was well represented in the “Regional Training Course on Development of National Capabilities for Response to Radiological Emergencies” Vienna 26-30 November 2001. The country shall be represented in the “Training of Trainers Regional Training Course on Practical Response to a Radiological Emergency” Cairo, Egypt 1 –12 March 2003. The Board shall enhance co-operation with other agencies like the National Disaster Management Committee for capacity building.

2.7.Recommendations and Way forward

The Radiation Protection Board needs to be an autonomous and independent body to enable it execute its own action plans. At the moment it has no control to recruitment of technical staff, budgetary allocations, as well as mobilization of resources, among other issues. Some of the problems arising due to this situation are:

— Insufficient financial and technical resources means that the RPI is unable to inspect all facilities as planned.

— Being within a government Ministry, the freedom to organize and fund national training courses are at times hampered in red tape.

— Inability to take legal action against medical departments within the same government Ministry

— Due to the current understaffing the RPI is unable to fully implement the Model Project plans for QA and dose assessment in the area of medical exposure control.

The issue of staffing is paramount, and to ensure that personnel employed are retained, the Board is working closely with the relevant government organs to ensure that a scheme of service for the radiation protection cadre is published. In addition, the government is reviewing the terms of service for all civil servants, including those of radiation protection personnel.

Once it attains autonomy, the Board shall be in a position to achieve much more towards milestones in the Model Project, and also improve in the participation of the IAEA and other projects.

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National Regulatory Control and Implantation of the Radiation Protection Regulation in Paraguay

V. Romero de Gonzalez, M. L. Idoyaga de Duarte,
L. E. Moré Torres
Comisión Nacional de Energía Atómica
Universidad Nacional de Asunción
San Lorenzo, Paraguay

Abstract. In Paraguay there were two technically contradictory laws which established the two regulatory authorities in Radiological Protection, the National Atomic Comission reported to the University of Asunción and the Minister of Health. The regulatory control of radiation sources was very poor, and the country did not have the infrastructure required to carry out all the activities necessaries related with a good Radiological Protection Program.So, there was an urgent need for Paraguay to establish a State Policy in the Regulatory Control of radiation sources in the country. So with the assistant of the Agency (OIEA).through the Model Project, the country now has an unique law, that was signed by the President of Paraguay according the Decree 10754/2000of the Radiation Protection Regulatory that actually is in force. Now, there are two Regulatory Authorities, the Minister of Health and the National Atomic Energy Comission integrated by an unique law, but with the functions and responsibilities of both institutions well defined.

1. Introduction

Paraguay is one of the South American country that the infrastructure of Radiological Regulation is either not appropiate for the types of practices involve.

The basic legislation require to establish an adequate Radiation Protection infrastructure needs to be upgraded and must have adequated laws and regulations, an efficient regulatory system, supporting experts and services, and a "Safety Culture" shared by all those with responsibilities for protection, including both management and workers.

Paraguay has many problems in this aspect, because a time ago, had four regulation systems and very big confusion in the application by the Regulatory Authorities.

The recommendation of the Agency (OIEA) was to integrate both Authorities in only one, this was not possible but Paraguay get with the participation in the Model Project RLA/9/030 "Upgrading Radiation and Waste Safety Infrastructure" an unique law integrated by the Health Ministery and the National Atomic Energy Comission (CNEA), but with the functions and responsibilities of both well defined.

The Model Project contributed with expert mission, capacitation, equipments and scientific visits in order to get a relative useful Radiologycal Protection System.

The National Atomic Energy Comission (CNEA) and the Health Ministery in common sense began the activities to get the proper legislation with the help of the OIEA.

The President of Paraguay signed the Decree 10754/2000 of the Radiation Protection Regulation that actually is in force.

This poster show all the steps and difficulties that the National Atomic Energy Comission (CNEA) and the Health Ministery passed to elaborate and to implant the new law.

Now, Paraguay has the necessary tools to control this activities properly.

2. Objectives

— To improve the regulatory framework for radiation protection in all the country.

— To implant the Regulation of Radiation Protection and the Safety on Radiation source.

— To develop a Safety Culture shared by all the persons involved in it.

3. Activities

— Agreements of cooperation between the two Regulatory Institutions (Health Ministery and CNEA)

— Documents: Elaboration of the regulatory documents with some specialists.

— Expert Mission RLA/9/030: Exploratory Mission to Discuss the Integration of Regulatory Authorities (in only one) and make a diagnosis of the current situation in Paraguay.

— Judicial Decree 10754/2000 which put in force the Radiation Regulatory System (2000, October the 6th)

— Implantation of the Regulatory Laws.

— Participation in the Model Project RLA/9/041 "National Regulatory Control and Occupational Radiation Protection Programmes"

— Participation in the Model Project RLA/9/044 "Development of technical capabilities for sustainable radiation and waste safety infrastructure"

4. Difficulties

— **Decree 7884 – Presidential Decree –31 March 2000:**
Establish four Regulatories Authorities, each one on dependent and specific functions.

— **Decree 14136 – Presidential Decree – 31 July 2001:**
Abolish Decree 10754/2000 and adopted an modified document according the interest of interested group.

5. Goals

Decree 15332 – Presidential Decree – 14 November 2001:

— Abolish Decree 14136/2001 and entry in force again the last Decree 10754/2000.

— Unique Regulation of Radiologycal Protection implanted.

6. Conclusion

Since 6 October 2000, our country has an unique legal document, the "Reglamento Nacional de Seguridad para la Protección contra las Radiaciones Ionizantes y para la Seguridad de las Fuentes de Radiación" implanted and an important tool to control the activities related with Radiation Protection and the Safety on Radiation Sources.

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Capabilities and Infrastructure of the Regulatory Authority in Radiological Protection in the Dominican Republic
Results of the Model Project

G. Valconi[a], **L. Sbriz**[b]

[a]Centro Nacional de Protección Radiológica
Santo Domingo, República Dominicana

[b]Comisión Nacional de Asuntos Nucleares
Santo Domingo, República Dominicana

Abstract. The Dominican Republic is a country at the Caribbean with around 48,000 Km2 and nine million inhabitants. Although member of the International Atomic Energy Agency since its foundation, it was only as of 1991 that the ″Comisión Nacional de Asuntos Nucleares″ is restructured as a National Regulatory Authority, because the public opinion began to be disturbed when noticing the proliferation of nuclear techniques in several areas of the country. The government support to this initially poor institution was increased by the commitment assumed after being integrated to the Model Project. Here we show the achievements reached in those few years.

1. Introduction

Dominican Republic was integrated to the Model Project "Upgrading Radiation Safety Infrastructure" (INT/9/143) during the year 1996. The combined work of the ″Comisión Nacional de Asuntos Nucleares″ (CNAN) and the International Atomic Energy Agency (IAEA), pursued to strengthen the infrastructure of the Regulatory Authority in the use of the ionizing radiation and radioactive materials, in the following aspects:

- Human resources.
- Equipment.
- Normative.
- Enforcement

2. Situation of the country before the beginning of the Model Project

The Comisión Nacional de Asuntos Nucleares that by means of Decree 414-91 is the National Regulatory Authority in all concerns to the use of radioactive material or equipments that generate ionization radiation began its works since 1993. The situation in which it was to be able to fulfil its command is now presented.

2.1. Personal

In the aspect of human resources, the CNAN only had four professionals and six other people among technical and support personnel.

2.2. Equipment

The equipments available to carry on the jobs were out of day and with the same ones we could only verify the quality conditions of the ray-X machines at the radiodiagnostic centres. Due to it the first job performed by the CNAN was to carry out an inventory of these ray-X equipments at a national level, so much in the aspects of the physical conditions and the safety for the public and the occupational exposed personal as of the conditions of the quality of the beam.

2.3. Regulations

Besides the Decree 414-91 that constituted the CNAN and in which it is enunciated the mission and objectives, the institution had already been able to edit the "Regulation of Radiological Protection" which was emanated by means of the Ordinance 244-95 and that in the advances it would be the regulating framework through which the users of those practices related to the use of ionizing radiation should undergo.

2.4. Enforcement

One of the main limitations to which the CNAN faced in order to implant the Regulation for Radiological Protection was the legal difficulties to impose the execution of the new regulations in radiological protection when not having sanctioning instruments.

3. Goals that the CNAN and the IAEA intended to achieve with the support of the Model Project

3.1. Establishment of a normative infrastructure

This was the fundamental goal to be able to have the indispensable legal framework that allowed the imposition of controls in the use of the radioactive materials and equipments, which generates ionizing radiation.

With the support of the project the missions began creating the Norms that allowed the detailed general aspects of the Regulation of Radiological Protection. As a result the "Norm for Authorization of Practices Related to the Use of Ionizing Radiation" is published at the end of the year 1997.

Immediately after began the writing of a series of Guides that would facilitate the users the understanding and the application of the "Norma" in order to allow the future applicants to submit to the CNAN the applications of the Licensees that allowed them to operate the practices of its interest.

The following guides and regulation arise this way:

- Safety and Radiation protection Guides for X-Rays Diagnostic Practice.
- Safety and Radiation protection Guides for Nuclear Medicine Practice.
- Safety and Radiation protection Guides for Radiotherapy Practice.
- Safe Transport of Nuclear Material.
- Norm on Radioactive Waste Management

With the above mentioned, the country has the sufficient regulatory infrastructure for its system of notifications, authorizations, registrations and therefore a system for the control of the sources of ionizing radiation.

3.2. Establishment of a control for the occupational exposure

To strengthen this aspect a step forward was given to a plan of technical personnel's training in dosimetry as well as the acquisition of the necessary measurement equipments. Simultaneously the personnel of the ″Centro Nacional de Protección Radiológico″ (CNPR), in their inspections, verified that the personnel in the facilities received the dosimetry service, as well as the conditions of operation of the X-Ray equipments, protection devices, etc.

Nowadays the CNAN possesses a dosimetry laboratory, in which its main objective is not to give service (except to the personnel of the CNAN itself) but rather to serve as a control to those that do give it. The laboratory has TLD readers with a panoramic irradiator thanks to the project.

The dosimetry service in the country is offered by companies and we have already achieved that no relevant institution works without the personal dosimetry service, being in charge of the CNPR to maintain upgraded the dosimetric information of the occupationally exposed personal and to carry out the proper controls.

All this normative would not be as useful of if the National Regulatory Authority doesn't have qualified personnel for the evaluation of the centres that submits applications for licensees and authorizations. From there began a training plan that we consider has achieved that the CNAN is already under conditions of being able to evaluate the centres that want to begin its operations in the country.

Lately, the Facilities with relevant sources that have settled and requested permits to operate, which are the cases of new Braquiterapy centres and accelerators for medical purposes, the personnel at the CNAN has been able to face and to assume his duty as regulatory body and fulfilled their role without the help of support missions from the IAEA.

3.3. Establishment of a control for medical expositions

In this aspect it has been carried out efforts to train technical personnel of the CNAN in order to maintain some controls on the facilities verifying the quality controls that they should maintain.

In that order, the project acquired the necessary equipments and the CNAN has been able to maintain a continuous support to the institutions that require it while their technical personnel don’t finish being appropriately qualified.

The controls in this aspect have taken us to close facilities of nuclear medicine and radiodiagnostic that didn't fulfil the minimum requirements established by the CNAN.

3.4. Establishment of a control for public exposition

Related to this aspect a consistent work began, detecting all the radiation sources that existed in the country, those in use as well those not in uses. This inventory of sources has been a work of long search but has given good results because nowadays we consider the inventory it is practically complete.

Simultaneously to the job of searching sources, began another one related to training and teaching at national level, to the Costume Control Officers in order to avoid entrance of new radioactive materials without previous authorization of the CNAN. This work can be considered achieved and periodically we maintain the process of training the Customs Officers.

Thanks to this effort, the CNPR has an upgraded inventory of all the sources that exist in the country, as well as of the sources that continually enter to the country, mainly for medical purpose.

On the other it has been faced the problem of the radioactive waste that existed as well as to create the legal instruments to avoid them. For this, the Secretaría de Estado de las Fuerzas Armadas facilitated the restructuring of one of its warehouses of war material so that it was used as deposit of radioactive waste. In the same one all the radioactive materials are depositing; those radioactive materials declared in desuse as well as those radioactive waste. It is considered that this warehouse will be enough to receive the waste that can be generated during the next forty years.

3.4.1. Ra-226 conditioning

It is also important to note that we have retired all of Ra-226 sources that existed in the country and that has been immobilized with the support of the IAEA. All this Ra-226 is also stored in the deposit of radioactive waste.

3.5. Establishment of capabilities in preparedness to emergency response

After training of the technical personnel in this field, the CNAN has elaborated a project of Radiological Emergency Response which has been presented to the ″Centro de Operaciones de Emergencias″ (COE) in order to be adapted to the new protocols for national emergencies response that are been prepared in this centre with the purpose of been compatible.

There has been a good integration job in turn with the other sectors that intervene with the national emergency plan through courses for radiological emergencies supported by the Project. A feedback of it is that the CNAN has already participated in the last two national emergency simulation carried out.

4. Conclusions

It is opportune to give a synthetic summary of the advances achieved in the national regulatory structure with the support obtained by the Model Project.

It exists a normative, well enough for an appropriate operation of the Regulatory Authority.

It exists technical personnel in conditions to give answers and to evaluate the applications of licensees for the facilities of the different practices including some corresponding to Practice Type I.

It exists an inventory of all the sources for industrial use, medical, research and for service companies.

It exists a warehouse for radioactive waste and an inventory of the same ones.

The mechanisms of control of sources and punitive actions to the offenders have strengthened.

Exist basic equipment for the routine works to control the facilities.

It has been possible to increase the qualified technical personnel in the Regulatory Authority, from four professionals at the beginning of the project, to ten professionals and seven support personnel.

Radiation Safety Infrastructures in Myanmar

Nilar Tin , Ko Ko Oo

Department of Atomic Energy
Ministry of Science and Technology
Yangon, Myanmar

Abstract. The essential legal infrastructure for radiation protection is still being developed in Myanmar. The Atomic Energy Law 1998 (Law 8/98) designates the Department of Atomic Energy as the body with responsibility for control of radiation sources in Myanmar. The Ministry is preparing to submit the proposed Regulations under the Atomic Energy Law 1998 to the Government for approval. Regulatory activities such as authorizations and inspections are at an initial development stage.

1. Introduction

The application of radioisotopes in various areas like health, industry, agriculture, livestock breeding and veterinary, research and education etc. has been performed with great momentum in Myanmar. Department of Atomic Energy (DAE) was established in 1997 as a directorate headed by a Director General under the Ministry of Science and Technology to carry out research, development and training in the field of atomic energy and to ensure the safety of radiation sources and protection from nuclear radiation hazards.

DAE has four departments. They are Radiation Protection Department, Radiation Application Department, Reactor and Isotopes Department and Administrative and Finance Department. The current strength of DAE is about 90 of which about 50% are trainees.

2. Regulatory Function of DAE

Work on enacting Atomic Energy Law started in 1995. The Government of the Union of Myanmar enacted the Atomic Energy Law (The State Peace and Development Council Law No. 8/98) on 8th June, 1998 with the following objectives:

— to develop atomic energy utilization in the State;

— to ensure safety in utilization of atomic energy in the State;

— to lay down and carry out measures for prevention of atomic radiation effects on man and environment;

— to enable communication with local and foreign research institutes and organizations for the development of knowledge and technology related to atomic energy.

This law encompasses all aspects of Radiation and Waste Safety in Myanmar. The Atomic Energy Law consists of 14 Chapters and 39 Sections.

Following the mission of IAEA expert Mr. John Le Heron (An expert from New Zealand in Oct, 1998), a set of Model Regulations for Radiation and Waste Safety has been prepared. After this draft was rewritten to match the law and national conditions, the discussions among officers from Ministry of Health and Department of Atomic Energy were made. This draft was then submitted through the Ministry of Science and Technology to the Attorney General's Office. After reviewing for legal consistency, Attorney General's Office sent a draft Regulation to the Ministry of Science and Technology in April, 2001. In November 2002, DAE discussed again with the authorities from Attorney General's Office and the final draft of regulation was sent to our Ministry on 9th January, 2003. At the time of writing this report, the Ministry is preparing to submit the proposed Regulation to the Government for approval. The draft regulations have been awaiting approval.

The Regional Manager Mr. Sujit Dey made a courtesy call on the Minister for Science and Technology H. E. U Thaung to explain the importance of legal infrastructure for radiation protection during his expert mission in May 2002. The workshops organized by the Model Project are very helpful in drafting the regulation.

3. System of Regulatory Control of Sources and Practices

DAE has taken responsibility since 1997 for issuing license of radioactive sources. All new radioactive sources and radiation apparatus have been imported only under license issued by DAE with authorization by Ministry of Science and Technology. During 1997 to 2002, 73 applications for license were received. Only 10 applications for license were received during year 2002 of which 5 were new applications and 5 for renewal. The licenses for sources are valid for various periods from one year to three years. DAE also issued license for re-exportation of radioactive materials of foreign companies after finishing their job.

All the radiation sources have been registered by the DAE except X-ray machines from the private Health Sector since 1997. DAE officers have done inspection especially for private companies and government hospitals. DAE had performed inspection onto licenses, radioactive gauging and X-ray machine for Ministry of Finance and Revenue.

We are now using the software of RAIS (Regulatory Authority Information System) Version 2.0 which is a tool currently being developed by IAEA for Regulatory Authorities. X-ray Units in Government Hospitals are registered with the Department of Atomic Energy. After the regulations are approved, X-ray units from private health sector will have to be registered and licensed according to the regulation.

The Model Project provides RAIS software and application training. This software is used in the regulatory authority in Myanmar.

4. Occupational Exposure Control

Thermoluminescence Dosimetry service was started in 1991. Harshaw 4500 system supplied by the Agency was introduced in 1998. The DAE is extending personnel dosimetry services to the radiation workers on national level. At present, about 468 radiation workers engaged in 33 departments of the country are receiving this service. The number of radiation workers has increased considerably during the last three years. Since the objectives of the Model Project are to assist those IAEA Member States which have an inadequate radiation protection infrastructure. The TLD badges are distributed to the workers to wear during their duty hours and the exposure dosage checked every two months. Workers in Myanmar received an average dose of 0.50 mSv. This value is lower than the permissible level. Monitoring of health radiation workers in private sector was provided upon request. We have a plan to provide the service on compulsory basis. We have a future plan for individual and workplace monitoring programme to cover gradually all radiation workers and radiation workplaces in the country.

Personal monitoring services are done by using reader and cards provided by the Model Project. Application training is also funded by the Model Project.

5. Medical Exposure Control

The major users of radioisotopes in Myanmar are in the health sector. In 1999, Ministry of Health formed radiation safety committee (Health) including one of the staff from DAE. This committee will continue to be an important instrument of the health sector in the field of medical exposure control including quality control programme. We have conducted the following workshops with the help of IAEA and WHO in cooperation with Ministry of Health. We need to promote the technical capabilities on medical exposure control.

— National Workshop on Radiation Protection in Radiotherapy, Radiodiagnostic and Nuclear Medicine (November, 1999 IAEA)

— Workshop on Radiation Protection and Quality Assurance in Diagnostic Radiology (Jun-July, 2000 IAEA)

— Workshop on Quality Assurance in Diagnostic Imaging and Radiation Safety (November, 2000 WHO)

— Training Workshop on Radiation Safety in Hospitals (December, 2002 WHO)

Also, we are conducting lectures for Nuclear Technology students on Radiation Protection including Quality Assurance and Quality Control. Radioactive sources, which produce gamma rays, are now widely used in medical therapeutic. At Radiotherapy Department of Myanmar Government Hospitals in Yangon, Mandalay and Taunggyi, radioactive Cobalt-60 sources are used.

Model Project trained 3 staff from the Ministry of Health for Quality Assurance in Nuclear Medicine.

6. Public Exposure Control

Department of Atomic Energy has taken responsibility for radioactivity measurement in rainwater and air samples and radioactivity monitoring and certification of imported dairy products and agricultural products for export.

Disused radium sources that had been used by Myanmar General Hospitals were conditioned for safe storage with the assistance of the experts from the IAEA and Korea. A total of 205 sources containing 1429.5 mg of ^{226}Ra were processed. In total, three drum loads were conditioned, each containing 460-500 mg ^{226}Ra with individual dose rates at the surface of each drum ranging from 240-330 μSv/hr. The dose rate one meter from the surface was 18-25 μSv/hr. Radioactive waste and spent sources are stored at the Ministry of Science and Technology Compound.

One of the spent Co-60 Gamma Chamber 900A has already been sent back to India. Ministry of Health has very recently been replenished with five numbers of new Co-60 teletheray sources and old sources have already been sent back to the country of origin. At this time, radioactive wastes in Myanmar are being stored safely.

7. Emergency Planning, Preparedness and Response Radiological Accidents and Incidents

In our country, we already have a plan for emergency case. In this plan, the Director General of the Atomic Energy Department will act under the leadership of the Minister for the Ministry of Science and Technology. One thing we need is to give more training to the staff of our department, to provide more emergency kits and to fix the doctors and the hospitals for special emergency cases. We are going to establish one poison control center on health sector for giving necessary information services. This center has one division concerning radiation matter and one of our senior officials will be a member of that division. And also Yangon General Hospital has emergency unit and intensive care unit. We are planning to use these facilities in time of emergency.

Model Project provides training for the medical doctors on radiological emergency. The workshop on emergency response and preparedness is very useful for the planning of the establishment of the National Radiological Emergency Rescue Team.

8. Conclusion

The model project is very helpful for upgrading radiation protection practice in accordance with the requirements of the International Basic Safety Standards (BSS). Since the development of human resources through training is an important component of the model project. In Myanmar, training in nuclear technologies covered administrators, regulators, radiation protection specialists and medical personnel are provided by the Model Project in accordance with the 5 milestones.

Five trainees, three from Department of Atomic Energy and two from Ministry of Health, were trained one year Postgraduate Course on Radiation Protection under the Model Project. It is very helpful for strengthening of Radiation Protection Infrastructure in Myanmar.

DAE is trying to build the strength of its staff so that they are well trained in the field of nuclear technology. Also, DAE is preparing to establish a Nuclear Technology Training Center. Officers from DAE give lectures and guide the term papers and theses to B.Tech, B.E, M.E and PhD (Nuclear Technology) students at Yangon Technological University. In a few years, the manpower of DAE will have grown both quantitatively and qualitatively. This will enable the extension and upgrading of the DAE activities including radiation protection in the near future.

Implementation of National Infrastructure for Radiation Safety in Madagascar

R.D. Randriantsizafy, R. Andriambololona, A.J.F. Ratovonjanahary

Institut National des Sciences et Techniques Nucléaires (INSTN)
Madagascar-

Abstract. Madagascar was participating in the Model Project RAF/9/024 on ''Upgrading Radiation Protection Infrastructure''. The Ministry of Universities was the Regulatory Body and Madagascar INSTN was the technical Body as defined by the former regulation in Radiation Protection. At the present time, the radiation protection legislation is based on the BSS115[3]. The new legislation defines the ANPSR as Regulatory authority, and the OTR and OCGDR as technical body for respectively Radiation Protection and and Waste Management. When the new law on protection against the harmful effects of ionisation radiation and the radioactive waste management in Madagascar was promulgated on 2nd January 1998, its application decrees were approuved in July and October 2002. Implementation experiences with problems encoutered, National education and training program, emergency prepardness and occupational exposure are related in this paper.

1. Establishment of regulatory authority

1.1. Legal Framework of Radiation Protection and Safety in Madagascar

The law n° 97-041 on protection against the harmful effects of ionisation radiation and the radioactive waste management in Madagascar was promulgated on 2nd January 1998 [1]. Following this promulgation, 4 decrees in application of the law were approved by the Government :

(a) Decree n°2002-569 on 4th July 2002 dealing with designation, roles and functions of the" Autorité Nationale de Protection et de Sûreté Radiologique (ANPSR), Organe Technique de Radioprotection (OTR), Office Central de Gestion de Déchets Radioactifs" (OCGDR),

(b) Decree n°2002-1199 on 7th October 2002 dealing with the basic principles of radiation protection against ionising radiation,

(c) Decree n° 2002-1274 on 16th October 2002 dealing with the basic principles of radioactive waste management,

(d) Decree n° 2002-1161 on 9th October 2002 dealing with the detention and utilisation of ionising radiation sources in the medical field.

The first decree establishes the ANPSR as the regulatory authority. It establishes the OTR as the technical body for radiation protection and the OCGDR as the technical body for radioactive waste management. The ANPSR is not effectively established yet. According to this decree, the department of Radiation Protection and the department of Radioactive Waste Management of Madagascar-INSTN will ensure respectively the functions of the OTR and the OCGDR.

2. Establishment of a national programme for medical exposure control

2.1. Radiation protection of the patient in diagnostic radiology

In order to comply with the principle of justification, the use of ionising radiation devices in the medical field is only restricted to medical physicians, who have the agreement of the Ministry of Health or under his or her supervision and with his or her medical prescription. It is also restricted to radiographers or qualified technicians who have the agreement of the Ministry of Health. We refer to the BSS 115 [3] for the guidance levels of dose.

Table I. Training of nuclear medecine staff (IAEA)

	Medical Doctors	Technicians
Number of staff trained	3	1

Regular quality controls of the equipment's parameters are done in order to have quality assurance of the doses delivered to patients.

Four radiologists and two radiographers have participated in Regional Training Course on radiation protection in diagnostic and interventional radiology organized by IAEA since 2000. Two of them are presently responsible for the training of radiation protection at the school of radiographers of the Ministry of Health in Antananarivo and one is teaching at the Faculty of Medicine at the University of Mahajanga.

Presently, the training need for Madagascar in the field of radiation protection in diagnostic and interventional radiology is the train-the-trainers course type.

2.2. Radiation protection of the patient in radiotherapy

The CHU HJRA hospital Ampefiloha Antananarivo has one therapy unit using Co-60 teletherapy and one Cs-137 brachytherapy which is not calibrated yet due to the lack of training in dosimetry, and the system is not in use yet.

The same requirements as in diagnostic radiology applies regarding the principle of justification. Medical prescription by an oncologist having the agreement of the Ministry of Health is required prior to any radiotherapy act.

A computerised treatment planning is available for external radiotherapy but is not working. The hospital does not have a radiophysicist and the treatment planning is done manually by the radiation oncologist. Obviously, training of a radiophysicist is a high priority need for Madagascar.

Two times per year measurements of the output of the machine are performed by the SSDL staff of Madagascar INSTN. Madagascar INSTN is participating in the annual TLD-postal dose inter-comparison of the IAEA/WHO network.

2.3. Radiation protection of the patient in nuclear medicine

The Laboratoire de Radio-Isotopes (LRI) of the University of Antananarivo is the one nuclear medicine center in Madagascar. I-125, I-131 and Tc-99m are used for diagnostic and therapeutic purposes

The same requirements as mentioned in diagnostic radiology applies regarding the principle of justification. Medical prescription by a physician having the agreement of the Ministry of Health is required prior to any use of radioactive material. We refer to the BSS 115 for the guidance levels of activity.

3. Establishment of a programme for public exposure control

Dose limits for the public, generic action levels for foodstuff as well as modalities of the radioactive waste management are defined in our national regulation, however, whenever a lack is observed, this regulation allows us to refer to the international standards.

The prime responsibility in the management of radioactive waste falls to its producer. However, in the case of orphan sources, the responsibility of its management falls to the state which entrusts the OCGDR the task of doing it.

4. Preparedness and response to a radiological emergency

4.1. Legal framework

The OTR has the responsibility to establish the emergency plan which has to be approved by the concerned authorities. Intervention levels are determined by ministerial by-law and have to comply with the BSS 115.

4.2. Training the trainers

Madagascar participated in the regional workshop on development of national capabilities for response to radiological emergencies in December 2001. Following this workshop, one seminar has been organised in January 2002 in order to sensitize the authority and to initiate the implementation of the national infrastructure on emergency planning and preparedness.

Madagascar participated in the train-the-trainers regional training course on practical response to a radiological emergency organised under the RAF/9/029 project in march 2003 and has committed to organise a national workshop following this workshop. Sensitization of stakeholders has been made during the first quarter of 2003.

4.3. Designation of NEPC

Madagascar has not yet designated the (NEPC) Nuclear Emergency Planning Co-ordinator, however, the interim national contact person has been designated in 2001.

4.4. Establishment of an interim group

Presently, the interim working group is composed of the interim national contact person and the national responsible of technical aspect of the project RAF/9/029. This group has to be strengthened by involving more representatives from all parties concerned with the process of implementation of national emergency response and preparedness infrastructure.

In February 2003, this group organised a seminar which aim is to sensitize decision makers. This was the opportunity to initiate the preparation of the emergency response plan.

5. Occupational exposure

Madagascar INSTN is in charge of the individual monitoring in Madagascar. The institute ensures the personnal monitoring of more than 200 workers involved in medical, industry and research fields throughout the country. The thermoluminescent dosimeters (TLD100) are read forth a year. The user center sends the TLDs by post or carries on their own to Madagascar INSTN. The average doses per year and per person measured since 1989 are 1.19 mSv for Hp(10) and 1.27 mSv for Hp(0.07)

The calibration of the TLD reader (Hp(10), Hp(0.07)) is perfomed following the Safety Report Series 16 [2]. Harshaw TLD4000 is the TLD reader used by the institut, but at the present time, the institute is organising to change(Administrative, management) to the TLD6600 reader.

6. Development of national programme for radiation protection training

Table II. Number of trained students for the professional training since 1999

Academic year	Number of students	National	Foreigner
1999-2000	12	12	0
2000-2001	11	11	0
2001-2002	11	09	2
2002-2003	16	12	4

Table III. Capacity building

Lecture room	Library	Laboratory	Computer room
2	1	1	1

6.1. University

Radiation Protection course is included in the curriculum of Physics and Chemistry at the University of Antananarivo. The course is also provided at Medicine Faculty of Antananarivo and Mahajanga.

6.2. Professional High School

A training course for technician in radiation protection and waste management is officially opened since the academic year 1999-2000 at Madagascar INSTN. This 2 years training programme is intended for 25 students who have got a diploma of "Baccalaureat" (French system). The language of the course is French. The course accepts foreigner students and since 2001 2 students from Cameroon and 4 students from Comoros attended the course. The training consists of theoretical and practical courses during the first year and finalised by vocational courses and a dissertation at the end of the second year. The diploma will allow those who have it to be responsible for radiation protection and waste management in workplaces where ionising radiation sources are utilised. Tables 2 and 3 summarized the number of students since 1999 and the capacity building

6.3. Online courses and informations

Madagascar INSTN is starting the conception of an online radiation protection and ionizing radiation course. This course will be designed for students, researchers, workers and concerned public. The course is scheduled to be ready in may-june 2003 and will be used on internet or CDRom.

7. Conclusion

Based on this document relating the status of our national infrastructure of radiation safety and the experiences shared with other participants, discussion of project related issues is hoped to help in speeding up the process of upgrading radiation protection infrastructure in the country.

ACKNOWLEDGEMENTS

On behalf of the Malagasy government, we would like to express our sincere thanks to the IAEA and to the Government of Morocco for the organisation of this conference.

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Implementation of National Regulation of Safety for Protection against Ionizing Radiations and for the Safety of Radiation Sources (RNSR) in Paraguay, in Model Project

M. L. Idoyaga de Duarte, L. Moré Torres, V. Romero de Gonzalez

Comisión Nacional de Energía Atómica(CNEA)
Universidad Nacional de Asunción, Paraguay

Abstract. The present work details the way how implement the RNSR by means of the constant support gives the Project Model RLA/9/030, RLA/9/041, RLA/9/044, RLA/9/045 with the purpose to have control the safety use the all ionizing radiation sources in Paraguay. It is devoted special attention to the medical area to be the one that possesses the biggest quantity ionizing radiations and Ocupacionalmente Exposed Workers. The National Commission of Atomic Energy create the Coordination Nuclear Safety and Control of Sources(CSNCF) which main function is to carry out, Notification, Authorization: Registration or licensing and Inspection in Industry, and Inspection in concerning to all the medical facilities that use ionizing sources for treatment. In the framework of the CSNCF it was created a Technical Committee of Evaluation(CTE) which function is to evaluate the relating documentations technically to the Regulatory Organ, members are Responsible Inspectors the following areas: Radiotherapy, Nuclear Medicine, Industry, Research and Education, Importation and Transport.

1. Introduction

Paraguay is a Mediterranean Country with a surface of 406.754 Km2, it limits to the North with Bolivia and Brazil, to the Southwest with Argentina, it is part of the Common Market the South (MERCOSUR), it has an approximate population of 6.000.000 millions of inhabitants, with two very marked Geographical Regions, the Oriental Region and Western Region or Chaco, with 17 Departments in total.

In the year 1965 for Ordinance Law 1081 the CNEA was created in order to Investigating the use of ionizing radiations source, to Dictate Regulations and Standards, for the control of the, Importation, Production, Operation and Commercialization of radioactive material. For Ordinance of the Executive Power N° 13.166/65 it was approved the Regulations for the Use of Radioisotopes and ionizing radiations and for Ordinance of Executive Power N° 9590/74 it was approved the Standards Radiological Security that were not Implemented by lack of personal qualified in the topic. This Standards was upgraded in 1994 and implemented partially and supplemented with a Service of Personal Dosimetry.

Later in 1996, the Paraguay enters to participate of the MODEL PROJECT, through this project the country began to receive help as for training and appropriate equipment.

As the country it has two Regulatory Entities that are the CNEA and the Ministry of Public Health (MSPyBS), both with its respective Regulations, through the Project Model it was elaborated an only National Regulation of Radiological Security (RNSR) based on the Safety Series N° 115 the IAEA, that crossing for many difficulties during 4 years, give you ends up approving for Resolution N°: 10754/00 of the Executive Power, which is in stage of implementation.

2. Legal Framework

The Regulation, in their Art. 7° establish the competitions of both Regulatory Entities.

2.1. The Ministry Public Health (MSPyBS)

- In the concerning thing to the habilitation, licenses, inspection and enforcement to users of generating hardware of X Rays of medical uses in radiodiagnostic. And

- In the concerning thing to the habilitation, licenses and enforcement to users of ionizing radiation generation for treatment in all medical practice.

2.2. The National Commission Atomic Energy (CNEA)

- In the concerning thing to the habilitation, licenses, inspection and enforcement to users of all sources and radioactive facilities, excluding the concerning thing to the MSPyBS. And

- In the concerning thing to inspection of all the facilities of medical practices that use ionizing sources for treatment.

3. Licensee and Inspection System of CNEA

From the year 1993 were carried out the first inspections with a very precarious training the personal Inspector (graphic 1), but from the year 1996 were carried out the inspections, based on the training received by the personnel through the Project Model, with an effective regulation that was outdated in that moment, in that same year began to elaborates you the RNSR that later on before their approval it was already being implemented partially, parallels to the inspections it work in the licensee area, the task it was in slow principle, since only had two people that were being qualified also for this tasks, the staff it was increased with 3 people more. In the Regulation some modifications were made in the competitions, passing the MSPyBS the licensee the facilities you prescribe for treatment, having that the CNEA to pass over the documentations to the Ministry.

4. Course

They were carried out the following trainings for all the personal involving with ionizing radiations.

- Inspectors: Training of 7 officials of CNEA, which 6 plow technical peoples, 1 Advises Law and 5 officials give the MSPyBS through the Project Model of IAEA.
- Radiation Protection Officers: The first Course carried out in Paraguay by experts gives the IAEA(Project Model).
- Workers: The CNEA has realized 11 Basic Courses that gives qualifying Radiological Protection, with an average of 20 students for course.

5. Import and Transport

Was implemented of REGULATION FOR THE SURE TRANSPORT OF RADIOACTIVE MATERIAL (ST-1) REQUIREMENTS of IAEA, from the year 2000.

6. Waste Management

The country do not have to facilities for waste management but the source in disuse is kept in its own facilities and controlled by the CNEA. Through the Project RLA/9/044 was elaborated National Standard for waste management (in future approval).

7. Radiological Emergencies

The country do not have a Radiological Emergency Plan. Through the Project RLA/9/041 was Elaborated of Radiological Emergency Plan (in future approval)

8. Personal Dosimetry User´s

The Graphic 2 show the evolution of Workers with dissymmetric control .

9. Achievements

— Only One National Regulation based on THE SAFETY SERIES N° 115 OF THE IAEA

— Transport regulation it adopting the REGULATION FOR THE SURE TRANSPORT OF RADIOACTIVE MATERIAL (ST-1) REQUIREMENTS of IAEA.

— Standard National waste management (in future approval)

— Elaboration of Emergency Radiological Plans (in future approval)

— Enforcements implement in the RNSR

— Implementation of quality control in Teletherapy in all countries installation.

— Conditioning of all the needles of Ra-226 (268 mg or 9.9 GBq) (Project Manager INT/4/131-08)

— Training of 7 officials of CNEA, which 6 are technical peoples, 1 Advises Law and 5 officials give the MSPyBS

— The system of Personal Dosimetry Intercomparation of CNEA, through Secondary Laboratories for Dosimetry Calibration Regional (Project RLA/9/030)

— Implementation of Insurance system in Quality of the Laboratory of Personal Dosimetry (ARCAL XLI), the only Laboratory of the Project that fulfilled all the established requirements.

— The checklist was upgraded of the Inspections based on the TECDOC 1113 of the IAEA.

— Traffic Illicit Control of Radioactive Material.

10. Difficulties

— The separation of competitions for Licenses, Enforcement and Inspection in the medical area for **Treatment** between the two Regulatory Entities has created the following difficulties:

- Irregularity in the Grant of Licenses.
- No execution of the agreement among the Authorities on the part of the MSPyBS
- No Application of the Enforcements.

— The Economic Crisis of the Country and of the Region.

11. Conclusion

It is suggested to carry out a revision of the RNSR with respect to competitions between the entities.

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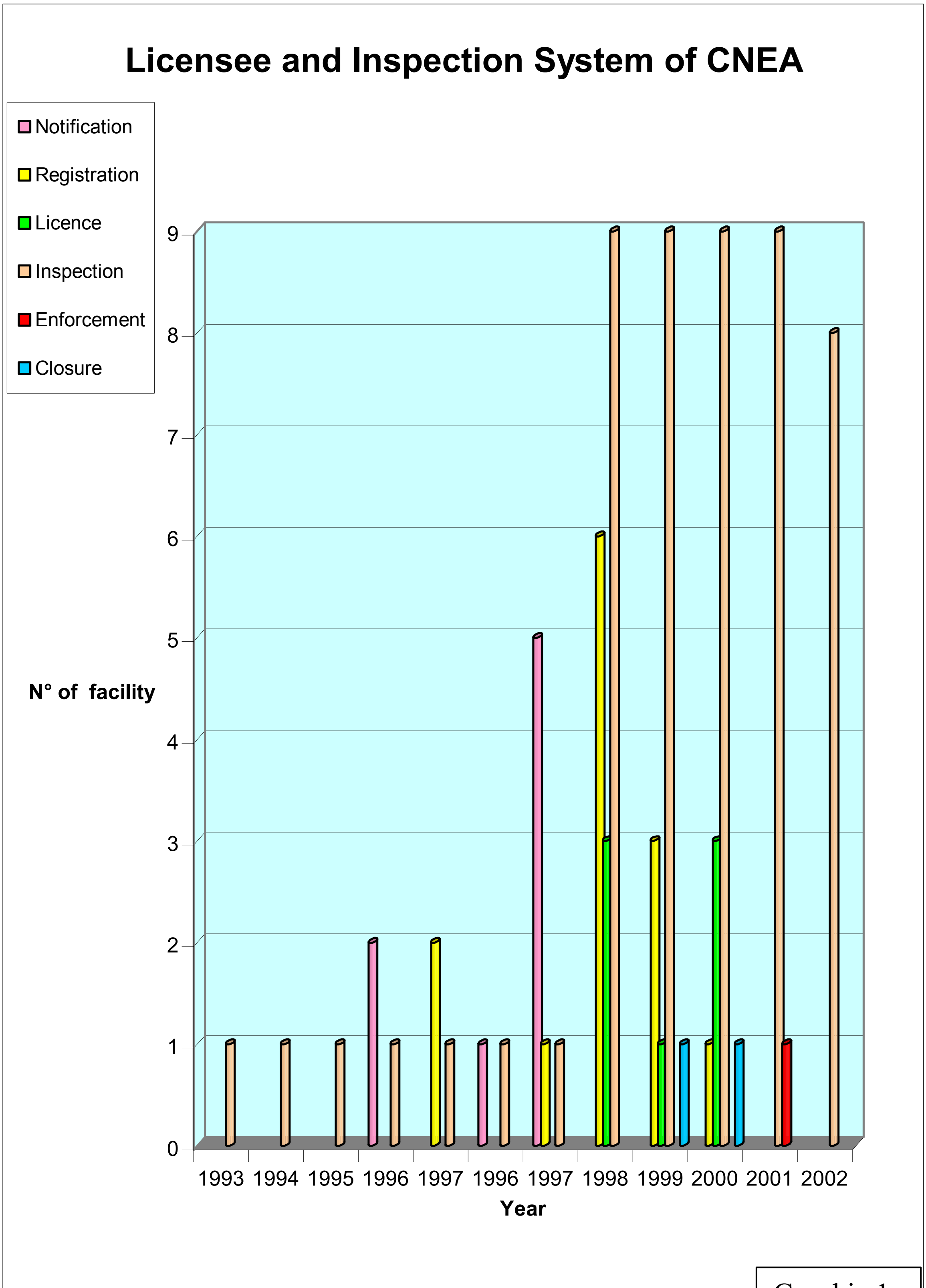
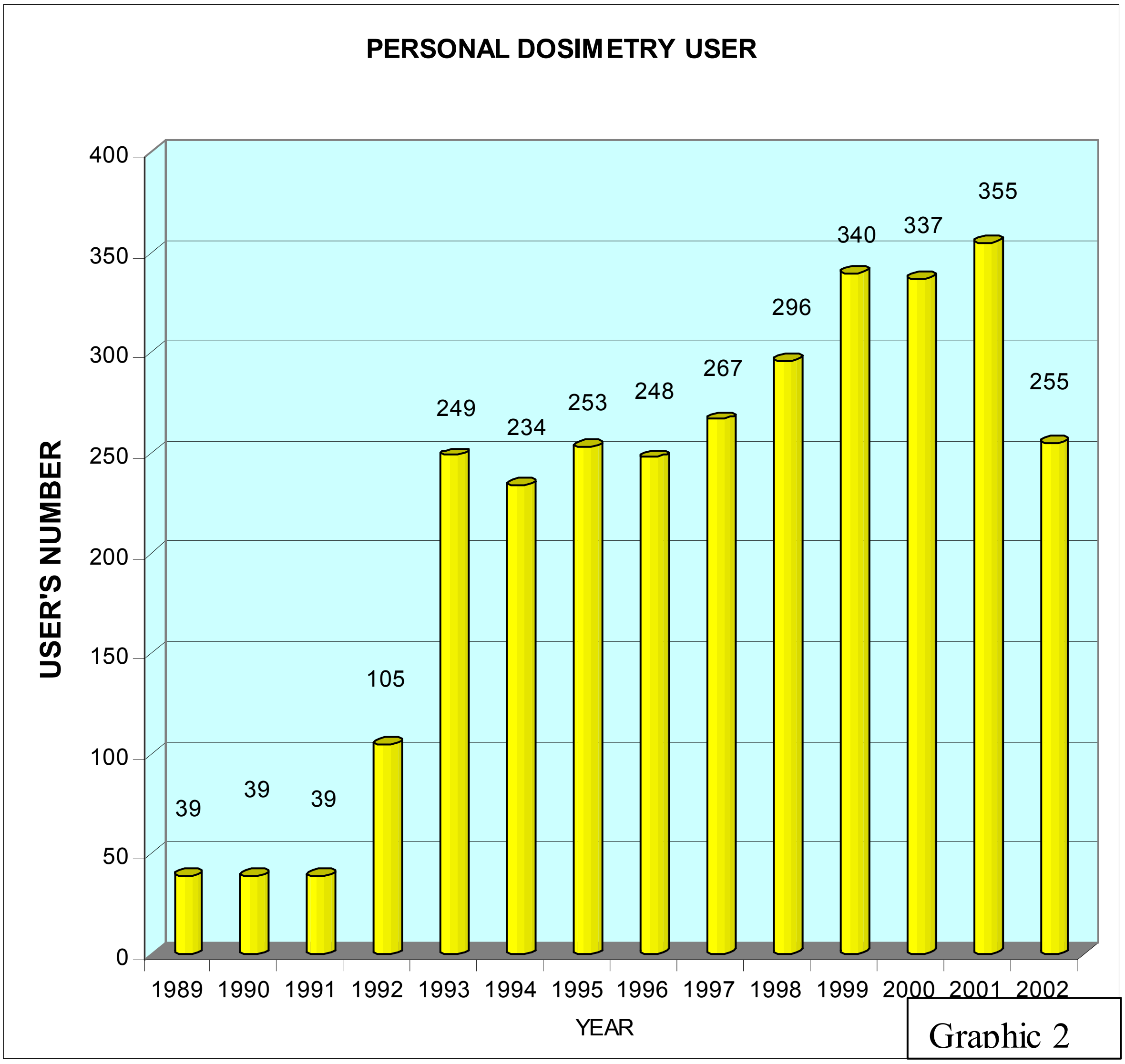

Licensee and Inspection System of CNEA
Notification
Registration
Licence
Inspection
Enforcement
Closure
N° of facility
0
1
2
3
4
5
6
7
8
9
1993
1994
1995
1996
1997
1996
1997
1998
1999
2000
2001
2002
Year

Graphic 1


PERSONAL DOSIMETRY USER
USER'S NUMBER
400
350
300
250
200
150
100
50
0
39
39
39
105
249
234
253
248
267
296
340
337
355
255
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
YEAR

Graphic 2

Niger Experience in Model Project

A. M. Niandou

Ministère de la Santé Publique et de la Lutte Contre les Endémies
Niamey, Niger

Abstract. As a uranium-producing country Niger needs a strong radiation protection infrastructure. Strategy, regulations, control of occupational and medical exposure, environmental monitoring, and waste management issues were addressed in the scope of the IAEA Model Project. The associated training, scientific visits, coordination meetings, and expert visits have yielded substantial benefits to the people of Niger.

1. Introduction

Niger is member state of International Atomic Energy Agency (IAEA) since 1962. Being uranium producer, the country has two uranium mines: one is open sky (SOMAIR) and another in underground (COMINAK) where radiation protection activities are undertaken.

Up to 1979 radiation protection activities were regulated under the Act n° 31 MMH.

At the national level, radiation Protection activities started from 1991 with the RAPAT Mission the country; main recommendations conducted to the creation of a National Centre of Radio Protection and the elaboration of the regulation in all activities in all application fields. Very quickly an interdepartmental technical committee was created and appointed for elaborating regulatory texts.
From 1992 in connection with the Project NER 007 and the Creation of the "Centre National de Radiation Protection (CNRP)", some materials and equipment were supplied and the staff members were trained by the IAEA.

The administrative slowness and the political instability didn't permit the fast adoption of these texts.

2. Realization of the Model Projects

2.1. Model Project INT/9/143, 1994

Niger joined the 1st project model INT/9/143 in 1994.

A very big program is set up, consisting of equipments and materials supplying, Expert mission for elaborating regulatory texts and verification of their compliance with the B.S.S requirements, scientific visits and training for staff members in radiation protection. As the program was not realistic, most of the planned activities were not achieved.

Following factors constrained the good development of the planned activities:

— Difficulty to plan mission;
— Delay in the submission and assessment of application forms for training activities;
— Most of candidate to be trained have not the adequate;

— Delay in the adoption of the regulatory documents ;
— Absence of a radiation safety infrastructur

2.2. Model Project RAF/9/024, 1996 – 1998

The basic infrastructure for radiation Protection and safety were introduced in 1996 due to Model Project RAF/9/024 :

— Improvement of the Radio Protection infrastructure, a plan of work including the legislation and regulation;

— Promulgation of the Regulatory Authority Program;

— Occupational Radiation Exposure;

— Medical Exposure ;

— Public exposure ;

— Waste Management and Emergency Plan;

— Technical Material.

For every category, a lot of activities and tasks to execute in delays that rode were often proposed. There was neither steps nor priority, each country had to organize itself and had to lead its activities.

But for Niger, we concluded that the formation was priority, especially to improve the human resource expertise and the maintenance and a supply of material by the IAEA and the generating devices of X-ray used in our Services of radiology.

2.3. Model Project RAF 9/027

A new strategy was initiated and five miles stones have been defined according to Countries priorities:

— Law and Regulation;
— Occupational Radiation Exposure;
— Medical Exposure Control;
— Public exposure and Environmental Monitoring ;
— Waste Management and Emergency Plan;

What obliged countries to be first interested to the legislation and the regulation before the other poles. It permitted a spectacular advanced. So, thanks to the shrewdness of M. KAROL SKORNIK and to the regular assessment mission that permits some necessary adjustments.

We can say that it is under this Model Project that Niger recorded a considerable meaningful progress these last years. The country arranges an operational authorized organism currently (National Centre of Radio Protection) entirely equipped by the Agency; a legislative and regulation setting based on the protective International Fundamental norms against dangers of ionizing radiation and safety of sources (NFI); and an inventory of sources.

3. Advantages of Models Projects

On the legislative and Regulation:

Adopted Texts:

— Law n°98-011 of May 07 1998, carrying creation of the National Centre of Radioprotection;

— Decree n°97-252/PRN/MME of July 10, 1997, carrying creation of the Consultative technical committee for the Radioprotection and the Nuclear Techniques (C.R.T.N);

— Decree n°99-431/PCRN/MSP of November 1st, 1999, carrying approval of statutes of the CNRP;

— Decree n°99-432/PCRN/MSP of November 1st, 1999, carrying protection against dangers of ionizing radiation;

— Decree n°003/MME/DM of January 8, 2001, carrying protection against dangers of ionizing radiation in mining;

— Decree n°0266/MSP./LCE of December 7, 2001, structural regime of declaration, authorization, inspection and control of practices and sources of ionizing radiation.

Texts pending an adoption

Project of decree carrying Safe Transport of radioactive material. It is about making adopted by decree the regulation of the IAEA on the radioactive material Transport.

As regards to the technical materials

The main things of which arranges the CNRP (Devices of detection and measure, computers, test tools of quality control in diagnostic radiology and complete equipment for external dosimetry by thermoluminescence are provided by the IAEA.

Activities of training of the personnel of CNRP by regional training courses and workshops and Experts services involvement.

As regards to activities led by the CNRP

Inventory of sources: since 1998, exhaustive to this day; External dosimetry to workers by TLD; Regulatory controls and inspection of facilities and sources according to a yearly action plan; delivery of authorization for practices and sources.

4. Conclusion

These are much actions that have real impact and that guaranteed the success of these Model Projects.

— Most of training given before the Model Project were not benefit to the Countries members because people doesn’t work in Radiation Protection services;

— With Model Projects, Training programs and action plan of centres take into account the real needs of countries;

— The regular co ordination meetings permit comparisons and experiences exchange: the example of Niger for the creation of an interdepartmental consultative technical committee has been kept by other countries members;

- The scientific visits in least advanced countries permit the international and Regional collaboration establishment to resolve some problem;
- Training programmed according to the real needs of the country permitted to improve some human resources;
- Missions of assessment of the project permit the review and the adjustment of activities and needs;
- The Expert missions permit to adjust some precise problems in the precise domains, revision of a text, development of a specific project, setting up of an equipment and the formation to its utilization.
- Top priority activities.

In spite of all presented realizations, Niger must lead activities here-after in order to satisfy completely to the requirements of Project RAF 9/027 milestones 1 and 2:

- Elaboration and enactment of a law on Radiation Protection (end 2003);
- Revision of the Law created the Centre National de Radio Protection (end 2003), in order to put it under the Office of the Prime Minister for its real independence
- Revision and Enactment of the Decree N° 99-432 in order to take into account the recommendation of the BSS (end 2003);
- Elaboration and Enactment of two decrees on Radioactive Waste Management and Safe Transport of Radioactive Material (end 2003);
- Widening of authorization procedures (2004) and of authorized inspection in all sectors, including uranium mines and establishments of research as the institute of Radio Isotopes (IRI);
- Extension of the external exposure control to all public and private users of X-Ray generators in the sector of health and to workers in the mining sector with the objective to cover this sector to 100% by the end of 2004;
- Launching of an insurance quality program to the National hospital of NIAMEY and the National hospital of LAMORDE (2003);
- Needs of control quality kits for devices of scanning and mammography;
- Setting up of a program of environment survey in mining (2004).

In this year 2 003, Niger has decided to plan the creation of a Radiotherapy Centre with the IAEA co-operation. So it is necessary to reinforce the Regulatory control and the human resource quality to face the good function of this future centre:

- Development of a national emergency plan;
- Setting up of a secondary laboratory of standardization in the CNRP.

In conclusion our countries really need the continuation of this Project as well as the fruitful co operation with the International Atomic Energy Agency (IAEA).

Regulatory Control of Radioactive Sources and the Dose Register of Radiation Workers in Hungary

L. Koblinger[a], S. Pellet[b]

[a]Hungarian Atomic Energy Authority
Budapest, Hungary

[b] National 'Frédéric Joliot-Curie' Research Institute for Radiobiology and Radiohygiene
Budapest, Hungary

Abstract. In Hungary, the control and book-keeping of radioactive material have long traditions. A central registry contains all relevant data of all sources. External dosimetry of radiation workers (altogether about 15,000 people) is carried out centrally by a nation-wide system based on film dosimeter readings. Internal contamination measurements and registers are not centralized. In the operation and development of the system support gained via Model Project RER//9/062 of the International Atomic Energy Agency is utilized.

1. Development of the registry of radiation sources

Wide scale application of radioactive materials in Hungary started in the early 1960s. At that time, the only company authorized for importing and distributing artificially produced radioactive material was the Institute of Isotopes of the Hungarian Atomic Energy Commission. Realising the serious health issues involved, the Institute exercised a strict control over radioactive materials and established a registry of the imported and manufactured products at a very early stage.

Many years later, when new legislation established the central registry of radioactive materials, the registry of the Institute of Isotopes served as the starting point, and the Institute was mandated to maintain the central registry. Due to this continuity, the central registry has an almost complete inventory and history of radiation sources and open radioactive substances in Hungary.

2. Legal background

Act CXVI. of 1996 on atomic energy (hereafter Act) stipulates that 'In the use of atomic energy, safety has priority over all other aspects'. The Act defines the legal responsibilities of the users of nuclear energy and of the authorities.

Decree 16/2000. (VI. 8.) of the Minister of Health lays down the basis of radiation protection in accordance with the recommendations of ICRP 60, IAEA Safety Series No. 115 and 96/29/EURATOM. This Decree defines the basic rules of the application of radioactive materials.

According to the Decree, all activities related to radioactive substances (application, production, marketing, export, import and transportation) are subject to licensing. Licences are given for a fixed period, and the licensees must be regularly inspected. Unused, superfluous radiation sources and old sources that have exceeded their working time should be disposed of. Furthermore, the Decree defines the basic qualifications needed for working with radioactive material, and describes the requirements of a training programme for radiation workers.

The legal basis for the central registry of radioactive material is given in the Act. Decree 25/1997 (VI. 18.) of the Minister of Industry and Trade and Tourism regulates the system of local and central registries of radioactive material. 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.

The initial reporting to the central registry is the duty of the distributor (at this moment there are only three licensed distributors in Hungary). Later, licensees are required to report any changes in their stock (distribution, transfer, disposal, export, import etc.). Prior to the final disposal, the radioactive waste management company (Public Agency for Radioactive Waste Management) reports to the central registry.

3. Regulatory infrastructure

Licences are issued by offices of the State Public Health and Medical Officer Services (SPHAMOS). General inspections are performed by the 20 regional institutes of SPHAMOS. The frequency of inspections are determined according to the level of hazard involved (type and amount of radioactive materials and the type of activity). In case of abnormalities SPHAMOS may impose a fine or suspend or withdraw the licence.

The computerized central registry of radioactive materials is supervised by the Hungarian Atomic Energy Authority and maintained by the Institute of Isotope and Surface Chemistry of the Hungarian Academy of Sciences. Hungary obtained the computer of the registry from the International Atomic Energy Agency, and in the development of the computer program for data acquisition experiences gained from the Agency's software were utilized.

The central registry helps the SPHAMOS inspections by regularly providing the lists of radioactive materials. In addition, the Hungarian Atomic Energy Authority, together with the Institute of Isotope and Surface Chemistry, performs its own inspections. These inspections focus on the proper maintenance of the local registries, and help to ensure the validity of the central registry. In the case of any irregularities the findings of the inspection are reported to the relevant authorities. In case of serious or continued abnormalities the Hungarian Atomic Energy Authority itself may impose a fine, or initiate the withdrawal of the licence.

4. Inventory of sources

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 1010 Bq) is about 3000 (see Table). 60Co and 137Cs are still the most frequently used nuclides. 192Ir is still extensively used in industrial radiography, while 3H is mainly used in research applications.

There is a relatively great number of ^{241}Am sources in industry and research, and the number of neutron emitting sources (Pu-Be and Am-Be) can not be neglected either.

Table I. Radiation sources with activities above 10^{10} Bq (as of February 2003)

source type	*number of sources*	*total activity (Bq)*
Am-241	106	3.6E12
Am-Be	81	2.0E13
Cm-244	9	2.4E11
Co-60	1312	2.2E16
Cs-137	206	7.3E14
H-3	1666	1.9E15
Ir-192	160	5.4E13
Kr-85	4	5.6E10
Pm-147	1	3.2E10
Pu-238	1	8.9E10
Pu-239	1	1.1E10
Pu-Be	120	2.1E13
Sr-90	14	5.8E11

5. Dosimetry of workers

People working with radiation are regularly controlled in Hungary since 1965. The dose limits set by Decree 16/2000. (VI. 8.) of the Minister of Health are 100 mSv for five consecutive years and 50 mSv for any single year.

A national personal dosimetry service is operated at the National 'Frédéric Joliot-Curie' Research Institute for Radiobiology and Radiohygiene. The external doses are evaluated by film dosimeter readings. Dosimeters are distributed to about 15,000 people working at about 1300 institutions (about 58% of them in healthcare, 27% in the nuclear energy production). All data are recorded and preserved when the dose at a single reading exceeds 0.1 mSv.

In addition to the centralized dosimetry system, TL dosimeters are used at Paks Nuclear Power Plant and at the Atomic Energy Research Institute by altogether about 1300 workers. At the power plant, the research reactor and the training reactor personal and work-place neutron detectors are distributed.

According to Decree 16/2000. (VI. 8.) of the Minister of Health the licensee should specify those workers who are possibly exposed to internal contamination and should therefore be monitored regularly by whole body counting or analysis of excreta. Moreover, special measurements are carried out in cases when somebody is suspected to inhale or ingest significant amounts of radioactive material. There are about 2000-3000 measurements for internal contamination per year.

In the period of 1991-1995 nobody's exposure exceeded the dose limits, from 1996 to 1999 there were two cases when the dose absorbed was higher than the limit. Since the year 2000, no doses above the limit have been measured.

6. The role of the Model Project

Though we daresay that 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 Project RER/9/062 'National Regulatory Control and Occupational Radiation Protection Programmes' lead by the International Atomic Energy Agency.

In the frame of this programme two Hungarian health physicists were delegated to expert missions and two were invited to present lectures at international training courses. Three Hungarian scientists gained support to scientific visits to famous laboratories in developed countries and 12 Hungarian delegates participated at regional workshops or training courses.

Hungary had the privilege of hosting one regional training course in 2001 on the 'Assessment of Occupational Exposure due to Intakes of Radionuclides', in the framework of the Model Project.

A dozen of doserate meters with accessories was received by the National 'Frédéric Joliot-Curie' Research Institute for Radiobiology and Radiohygiene.

7. Conclusion

According to the achievements outlined above Hungary has passed milestones 1 and 2 specified by Model Project RER/9/062. Hungary is ready to continue its activities in the framework of Model Project RER/9/065.

8. Acknowledgements

The authors wish to thank Drs Á. Pető, J. Sáfár, P.P. Szabó (Hungarian Atomic Energy Authority), L. Ballay, I. Bojtor and A. Kerekes (National 'Frédéric Joliot-Curie' Research Institute for Radiobiology and Radiohygiene) for their help.

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Impact of the Model Project of Radiological Protection in Bolivia

A. A. Miranda Cuadros, L.R. Berdeja Amatller

Bolivian Institute of Nuclear and Science Technology (IBTEN)
Radiological Protection Center
La Paz - Bolivia

Abstract. The development and all the implementation of the system of Radiological Protection in Bolivia, has had two phases, clearly defined, before the Model Project (**MP**) and with the **MP**, the results and advances, in which refers to legislation, training, services, discharge, have been important. And it has passed of practically nothing to count on a radiological system of protection, that should be sustainable and continuous in order to count on an adequate control of the use give them ionizant radiation in the country.

1. Introduction

When is initiated the Model Project in the year 1995, the radiological conditions of protection in Bolivia, they were found in a basic and very elementary state, with the consequences that this aspect involves.

It is necessary that so that a Competent National Authority in the control of the ionizant radiation can exercise in full form this faculty, the overseeing, should count on the essential elements as doing it. The fundamental elements for this purpose are four:

- Legislation.
- Human resources qualified .
- Adequate equipment.
- To be linked with other competent authorities.

To the start of the Model Project of Radiological Protection (**MP**) not a Legislation existed, just a single Law but without its regulation, what toward that could not be applied this Law, they counted on themselves very little personnel, and this changed periodically, was not an attractive sector for the professionals, the equipment was minimum, and the link with other competent authorities was nil.

This panorama was devastating, since in spite of repeated efforts was not possible that these efforts could be channeled of form such to count on a continuous system of radiological protection in Bolivia.

From the participation of Bolivia in the MP, the commitments that represent to participate in it, did that the results be increasingly promissory, and we find us in the 2003 with a completely different reality to that of 1995.

Development and law enforcement of Protection and Radiological Security.- In September of 1982 is approved the Law of Protection and Radiological Security, but before this some efforts existed above all tending toward conforming a radiation Committee species regarding with Ionizant radiation , that was conformed by several institutions, among them the Bolivian Commission of Nuclear Energy (COBOEN), said Committee created in the year 1969, does not function, in the seventies some laws are approved referred to ionizant radiation creating authorities as the Department of Labor and/or

Department of Health, treating the theme as any element of the dangers for the health of the population and for the workers.

Thus when the Law of Protection and Radiological Security is approved, abrogating the previous dispositions, an important fact is marked, to count on a Law specifically destined to the control of the ionizant radiation, from 1982, the COBOEN, prepares a series of Regulations to supply the use of the Law approved. Eleven versions during the fifteen years were done that delay the approval of the regulations, but the determinant thing for the approval was the MP. Since the legal aspect was the main and basic requirement for the continuation, proceeded to the revision so much on the part of the Bolivian Institute of Science and Nuclear Technology (IBTEN), institution that is the successor of the COBOEN, disappeared in 1983, as the contribute valuable of the advisors of the MP.

In this manner in January of 1997 are approved the regulations of the Law, appointed unmistakably to the IBTEN as the Competent National Authority for the control of the use of the sources of ionizant radiation in Bolivia.

In subsequent form was necessary to continue with the assembly of the legal structure that support the legislation approved, with that objective we can observe in the following picture board the documents and its degree of advance:

Table.I

No.	Document	State
1	Specific dispositions for Registration and Licensing of Radiological Installations – Health Area	It approved
2	Dispositions for Registration and Licensing of radiological Installations - Gammagrafia and Industrial radiography	It presented
3	Radiological regulation of Emergencies	Elaborate
4	Radiological plan of Emergencies	In Elaboration
5	Specific Dispositions in dental radiography	In Revision
6	Dispositions for the importing and exporting of radioactive material	In Revision
7	Specific dispositions for the radioactive Management of waste and sources in disuse	In Revision
8	Dispositions for the national transportation of radioactive material	In preparation
9	System of Quality in radio diagnosis	In preparation

These documents were supported in its design, elaboration and revision by the **MP** jointly with the group of the IBTEN that works in radiological Protection.

Dosimetry and Calibration.- The individual dosimetric control in Bolivia comes being developed from the seventies, in principle through the dosimetric film that was supplied and treaty in France; with the consequent delays and lost of information. In 1975 the first system is implemented by thermo luminescence, in the laboratories of the COBOEN, at present IBTEN.

Since then this control is carries out by means of the technique of thermo luminescence but at par was necessary to count on laboratories that guarantee the information provided what does that the IBTEN implement the calibration laboratory, where not alone are calibrated the personal dosimeters, but also detectors of the IBTEN, as the of all the country. These laboratories that cooperate the task of the Competent National Authority were mounted and its personnel went and is qualified inside the MP.

In the following picture we can observe the evolution of the personal Dosimetry distributed per year, as well as that of the level of action of the Competent National Authority:

Table. II

Personal Dosimetry

YEAR	QUANTITY	RECORD LEVEL	RESEARCH LEVEL	INTERVENTION LEVEL
1995	1680	1676	3	1
1996	1880	1867	10	3
1997	2200	2189	8	3
1998	2130	2110	15	5
1999	2140	2111	23	6
2000	2130	2086	36	8
2001	2420	2377	26	17
2002	2780	2769	7	4

The growth is maintained and above all support the capacity of these laboratories the periodic inter comparisons referred to the calibration and personal Dosimetry.

Training.- Inside the tasks of the Competent National Authority, IBTEN, is found not alone the to qualify to its personnel that has counted with the support of the MP but also the knowledge that offers the to participate in the radiological evaluations of installations to permitted to count on a group although reduced, very but very active. Also this the to diffuse and to qualify the workers that utilize sources of radiation. For this purpose the IBTEN has developed course to different specialties, which will see in the Picture III:

Table. III

Radiological Protection courses

SECTOR	YEAR	DEVELOPED COURSES	No. PARTICIPANTS	APPROVED	ASSISTANCE
Industry and relatives	1998	2	11	4	7
	1999	---	--	---	---
	2000	3	39	25	14
	2001	4	28	19	9
	2002	3	35	22	13
	2003	2	28	23	5
Health	1998	4	108	55	53
	1999	22	49	28	21
	2000	4	46	25	21
	2001	-	--	--	--
	2002	5	117	80	37
	2003	-	--	--	--
TOTAL		30	461	281	180

Licensing.- Inside what is the radiological system of protection of Bolivia, is done necessary to count on an inventory of the sources of radiation ionizant, likewise to know location, state and who are to charge and/or use these sources, a complete inventory of the existing radioactive material counts in Bolivia, 498 sources of diverse species. In which refers to producing equipment of radiation such as

X-ray equipment, just a partial inventory was completed but enough advanced, subsequently we have the inventory of Installations and/or sources of radiation:

Table. IV

Inventory of Installations and/or sources of radiation

SECTOR	EXISTENCE		REFISTERED		INSPECTIONATED		LICENSED
	Installations	Sources	Installations	Sources	Installations	Sources	Installations
Dental - RX		600e		48		40	1
Research	5		1		1		0
Gammagraphy	15		14		11		7
Petrolum Prospection	3		3		3		3
Other applications	13		0		0		0
Mammography	22		9		9		9
Conventional RX		400e		216		216	5
Simulator	2		2		0		0
Radiotherapy	6		6		6		1
Accelerator	1		1		1		0
Tommography		32		10		10	0
Nuclear Medicine	9		7		7		0

In the previous picture is observed that 26 installations count on license, seems to be an under number in comparison with the total volume of sources of radiation and installations, but is important to observe that many installations are completing the documentation or rectifying the observations carried out in the inspections, which would indicate us that it exists a high number of installations that to would be about to comply the requirements and asi to obtain the license.

In the following picture we have the persons that have obtained its individual license, fits to clarify that it exists also an important number of persons that they are dealing with it:

Table. V

Individual licenses

SECTOR	INDIVIDUAL LICENSES	RESPONSIBLE LICENCES
Industry and relatives	63	7
Health	46	4
TOTAL AMOUNT	109	11

Conclusions.- According to the previous thing we consider the following conclusions:

The key point for that the Radio protection can begin to walk in the country has been the approval of the regulations of the Law of Protection and Radiological Security, without which not to have been possible to advance what I advance.

Is significant the support and contribution of the MP, and above all determinant, because has developed a loyal species of competence among the participants, at the same time that each one of the countries of the MP, know that could count on the others. This it does that the MP in the majority of the countries that participate be a success.

Inside the MP, it is important to consider the work of the Regional Manager, that has coordinated a lot of activities of different nature, with positive results, and above all with a resources optimization work so much economic as humans, that give an optimum performance of the PM, in which refers to Bolivia.

The road has to travel through is even long, but advances, Bolivia counts on a small but efficient group, it has basic capacities, that needed to be improved, but already an important base exists. Because of it should continue competent with all the competences as to exercise its attributes, normalization and supervising.

But the to count with these regulations does not guarantee to count on an adequate system of control and supervising of the sources of radiation, by which was necessary to complement with other documents that can support this task, by which they devised different documents, some of which already are in phase of consideration, and in some cases already they were approved. During this year as in the following years continued this task, for the purpose of count on a capable radiological system of protection of enabling an optimum control about the use of the sources of ionizant radiation.

Personal.- This aspect has been one of the most important, and more keeping in mind that in the training in many cases were taken into not alone account to the regulatory part but also to the user, the IBTEN since the approval of the regulations has developed a work of extension and spreading of what is the radiological protection, this has given as a result the training of users regarding with the meaning of radiological protection on the order of the 700 persons, courses for the ones have been carried out already that would come to be the responsible for radiological Protection in areas as nuclear medicine, radiotherapy, industrial Gammagraphy and petroleum research.

Equipment.- A competent National authority cannot exercise its authority in full form if does not count on the four covered elements, personal, legal aspect, equipment and relations with other authorities.

The equipment provided through the OIEA has been of great importance.

Radiation Protection Infrastructures in Albania

R. Paci [a] **F. Ylli** [b]**, K. Dollani** [b]

[a]Radiation Protection Office
Tirana, Albania

[b] Institute of Nuclear Physics
Tirana, Albania

Abstract. The paper intends to present the evolution and actual situation of radiation safety infrastructure in Albania, focusing in its establishing and functioning in accordance with BBS and other important documents of specialized international organizations. At the same time in this paper are described the legal framework of radiation safety, the regulatory authority, the resources and the services as well the practice of their functioning. It is discussed also the important role of the Model Project for upgrading and updating of mentioned infrastructure in the country for an effective implementation of the legislation, effective functioning of the regulatory body, training of the personnel and providing of modern equipment.

1. Introduction

The issue of the establishing and functioning of the radiation safety infrastructure in Albania was considered as a prerequisite for a good practices development in the peaceful uses of atomic energy. The existence of the adequate legislation and the regulatory authority, functioning based in the BBS, are the necessary condition providing the fulfilment of the most important issues in the mentioned field.

The first document on radiation protection in Albania stated that "for the safe use of radiation sources it is mandatory that the legal person should have a valid permission issued by Radiation Protection Inspectorate". A special organ was established in the Ministry of Health to supervise providing of the radiation protection measures. This organization of radiation protection showed many lacks as result of the low efficiency of the developed activity. The personnel monitoring, import, transport, waste management and training of workers were in charge of Institute of Nuclear Physics (INP). In 1992 an IAEA RAPAT mission visited Albania and proposed some recommendations for radiation protection improvements. The mission concluded that "the legislation of the atomic energy including radiation protection should be developed" [1]. In 1995 Albania was involved in the IAEA Model Project "Upgrading of Radiation Protection Infrastructure". This project, which is still in course, intended to establish the modern radiation safety infrastructures in the countries with low efficiency ones and to update and upgrade all aspects related with radiation safety: legislation and regulations, regulatory authority, radiation sources control, occupational, medical and public exposures, emergency response and preparedness etc.

2. Radiation Safety Infrastructure

BBS states that the primary responsibility for the good practices related with radiation sources safety belongs to the legal person, who is authorized to conduct this activity.

However it is presumed that the government has the responsibility for the enforcement of the legislation through Regulatory Authority for planning and taking action in different circumstances [2].

After a long and carefully process and based in the radiation safety standards, Albanian Parliament approved the Radiological Protection Act in 1995. Based in this law, the National Radiation Protection Commission (NRPC) was established in the Ministry of Health. As executive body of the NRPC was established the Radiation Protection Office with four full time staff.

The tasks of the NRPC are to issues regulations, guides and codes of practices, which are obligatory for enforcement by all legal persons, oversees the enforcement of the provisions related with radiation protection, issues the licences, performs technical management of all national and local authorities for immediate enforcement of necessary manners for the mitigation of nuclear accidents effects, makes the recommendations and proposals for the improvement of the forced radiation protection legislation, approves the Basic Safety Standards for radiation protection, co-operates with national and international organisations for radiation protection issues, performs the commitment of research institutions of the country for solving of national issues in radiation protection area, defines the structure of the Radiation Protection Office, performs nomination and dismissing of the Head of RPO, co-operates with State Labour Inspectorate.

The Radiation protection Office was established as executive organ of the NRPC and is performing the following tasks: represent in NRPC for approval the legal acts for radiation protection activities, oversees the enforcement of legal acts in radiation protection practical area, performs the inspection of radiation installations, collect information and performs necessary analysis and measurements for radiation protection control, prepare2 the files for giving, suspension and abolition of licences and represents them to the RPC for approval, prepare the materials of Commission meetings as well as the commended reports.

The first regulations described the rules for the processes of the licensing and inspection. The licensing process is preceded by the notification and continues with the special application in which are described in details all characteristic of the radiation sources, the purposes of the use, radiation protection measures, emergency countermeasures etc. A special information is requires for the radiation protection officer related with his qualification and working experience. The license is valid only for two years and after that period it is needed to renovate.

The process of inspection is performed in regular basis and is exerted by the nominated inspectors in accordance with duties foreseen by the legislation. The safety culture is required to implement by inspectors and users, aiming the upgrade of the quality of the control.

Other important regulations were prepared for the safe handling of the radiation sources, licensing and inspection. These regulations describe the most important rules for radiation safety, including the personal dosimetric monitoring, medical surveillance, controlled and supervised areas, radioactive waste management etc.

The preparation of the mentioned regulations was performed in collaboration with experts from the interested country organizations and was consulted with IAEA experts.

With the assistance of IAEA experts we have in final draft form three other regulations: the regulations for the safe transport of radioactive materials, the regulations for the radioactive waste management and the regulation on national standards.

The preparation of the Codes of the practice is another important activity for good practices implementation in the different areas of radiation sources implementation.

The Code of Practice in Diagnostic Radiology, Codes of Practice in Radiotherapy and Nuclear Medicine, Code for Construction and Shielding of Radiology Area have already been prepared.

RPO has prepared the check list in radiology, nuclear medicine and radiotherapy.

3. Radiation Source Control

The control of radioactive sources is applied in Albania through two processes Notification and Licensing (based on IAEA TECDOC No 1113) for all the sources, which are of activity higher than the foreseen values from BSS tables NR. 115.

Concerning the licensing process in 2001 we licensed the entire user in Tirana and some in different district and 2002 was licensed for first time about 85 % of whole country. Concerning the enforcement we evaluate as weak point we have.

The control and inspection covered by RPO for about 400 centres of ionising radiation (350 x-ray generator and 50 radiation sources). In total are about 1200 workers of ionising radiation.

Radiation Source Control includes inventory as well. Now this inventory contains nearly 95% of the radiation sources in the country. All the sources that entered Albania before 1990 were registered from the Institute of Nuclear Physics in Tirana. After this year, nevertheless the law was still in power; not all the radiation sources coming from abroad were under state control, because of decentralisation of Albanian economy. Practically after 1990 there is a lack of all radiation sources inventory. On the other side the radiation sources used for military purposes, being independent, were not included in the inventory of the Institute of Nuclear Physics.

At 1995 IAEA assisted Albania with software for the inventory called SRS. All the data available were arranged under this software. RPO is responsible for the inventory of the radiation sources. We have on the RAIS system all inventory of the sources include licensing and inspection. We are going to have an online system with the custom office and INP .A copy of inventory has to be in INP. We receive information through special permission from RPO for import-export of radioactive material

The final aspect of radiation source control is connected with radioactive waste management. In Albania radioactive waste management consists in segregation of radioactive sources, their conditioning and interim storage. Actually we have now a new centre for the managing of radioactive material which is constructed in compliance with international norms but still it is not well equipped.

4. The Status and Trends of Radiation Safety

Based in the five milestone of the Model Project in the country exist a modern regulatory framework. The efforts are focused to improve the efficiency of the regulatory authority

related with license and inspection control as well the enforcement of the radiation safety legislation by the users.

The occupational monitoring of the workers based in the thermoluminescent dosimeters and Harshaw Reader 4500 now exist for nearly 300 persons in the country. The yearly average dose of the workers based in the measurements performed by the Institute of Nuclear Physics (INP) is 2,6 mSv, including natural background. INP posses the necessary capability to cover the monitoring of radiation occupational workers of the country and is in permanent process of expansion for the mentioned monitoring in co-operation with Radiation Protection Office.

The medical exposure control is related with different difficulties, which derive from the obsolescence of the X-ray machines park in the country. The efforts in this area are focused to the quality control and quality assurance implementation for different diagnostic and therapeutic procedures.

This year it is planed the implementation of the national project of technical cooperation with IAEA "Establishment of a Secondary Standards Dosimetry Laboratory", which will improve the quality of the measurements in the field of the medical exposures. Albanian government has invested for the SSDL facility construction the sum of 20.000 USD.

The public exposure control developed in the country intends to protect the public and environment by radiation detriment. The radioactive waste management is an important related activity, which is exerted in the country since 1992, when the first quantities of radioactive waste were conditioned in standard drums. Three years ago, a new facility was constructed for radioactive waste conditioning and interim storage. The cost of this facility, an investment of Albanian government, is 100.000 USD.

This year begin the implementation of the national project of technical co-operation with IAEA "Improvement of Radioactive Waste Management", aiming the transformation of the mentioned facility in the most important centre in the country concerning the management of radioactive waste.

The last milestone of the Model Project is related with emergency response and preparedness. Albanian specialists have prepared the national plan of emergency response, which is approved by the NRPC, and now is in the process of its implementation. A telemetric radiation monitoring network, based in modern equipment will be installed in six stations around the country, for on-line measurements of the environmental radioactivity. There are established two emergency teams, the process of personnel training is in course and an emergency field exercise 'lost source" is planed to develop in the first half of this year.

Actually we have approved a national plan for education of workers of ionising radiation. We will have centre at INP where will be trained workers form different field one or two weeks a year every 5 year. IAEA have support Albania every year with organising National courses from 1997.

5. Conclusions

The radiation safety infrastructures in the country are in the process of the implementation and the Model Project has contributed so much for the consolidation of the mentioned results. This conclusion has stated by the Peer Review mission n Albania, developed be the IAEA two years ago.

For the full implementation of the radiation safety infrastructure in the country and for upgrade of its efficiency needed much more efforts. Albanian Radiation Safety Authorities are aware on their long way to have a modern, effective and sustainable radiation safety infrastructure.

We are especially thankful to Dr. J.Sabol Regional Manager of Model project RER/9/065, for his attention in process of realizing of work plan and his help to solve our problems.

We consider that Albania have fulfilled the most important steps in the framework of the Model Project and we hope that co-operation will continue and in the future.

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Implementation of the Model Project: Ghanaian Experience

C. Schandorf, E. O. Darko,
J. Yeboah, S. D. Asiamah
Radiation Protection Institute
Ghana Atomic Energy Commission
Legon, Ghana

Abstract. Upgrading of the legal infrastructure has been the most time consuming and frustrating part of the implementation of the Model project due to the unstable system of governance and rule of law coupled with the low priority given to legislation on technical areas such as safe applications of Nuclear Science and Technology in medicine, industry, research and teaching. Dwindling Governmental financial support militated against physical and human resource infrastructure development and operational effectiveness. The trend over the last five years has been to strengthen the revenue generation base of the Radiation Protection Institute through good management practices to ensure a cost effective use of the limited available resources for a self-reliant and sustainable radiation and waste safety programme. The Ghanaian experience regarding the positive and negative aspects of the implementation of the Model Project is highlighted.

1. Introduction

Several IAEA Projects provided Ghana the framework for building the basic infrastructure for protection and safety which covered the period 1980-1992. The project outputs covered were:

a. Establishment of Radiation Protection Services;

b. The establishment of a Secondary Standards Laboratory; and

c. Human Resource Development in Radiation Protection.

The Model Project concept provided the framework for upgrading /strengthening the infrastructure to be consistent with the International Basic Safety Standards for Protection Against Ionising Radiation and Safety of Radiation Sources [1].The project began in 1992 with an ambitious five primary objectives which covered:

i. Establishment of the Legal Framework for the Control of Radiation and Radiation Sources;

ii. Establishment of a National Programme for Occupational Exposure Control Programme;

iii. Establishment of a National Programme for Medical Exposure Control;

iv. Establishment of a National Programme for Public Exposure Control Programme; and

v. Development of a National Level Capacity to Respond to Radiological Emergencies.

Ghana graduated from the Model Project RAF/9/024 on “Upgrading of Radiation Protection Infrastructure” in 2000. This involved the fulfilment of the requirements for the establishment of a legislative framework and occupational radiation protection programme which included individual monitoring for external exposure and workplace monitoring. Good management practices are being used to maintain and sustain these on-going activities. Ghana started the Model Project RAF/9/029 on “Development of Technical Capabilities for Sustainable Radiation and Waste Safety in 2001. This project focused on Medical Exposure Control, Public Exposure Control and the Development of a National Level Radiological Emergency Response Capacity.

The strengths, weaknesses, opportunities and treats of the implementation phases of the two Model Projects based upon the Ghanaian experience is presented.

2. Management of the Project

Good management practices have played a key role in the implementation and sustainability of the projects. The key management tools in use include communication, team building, collaboration with key stakeholders, monitoring, evaluation and feedback and resource allocation. The management approach includes a system of responsibility, authority and accountability at all levels of the organization. However adequate resource allocation by Government has been a challenging weakness. This situation has necessitated the need to evolve strategic plans for enhanced revenue generation from regulatory fees, technical support services and developing partnership for development with end-user institutions of our expertise.

Good rapport and communication with all the Regional Managers appointed by IAEA since the inception of the Model Project has also contributed to the achievements made by Ghana.

3. Human Resource Development

A core staff of well trained and motivated staff was available for implementation of the system of notification, authorization, regular inspection and enforcement once the legal framework was established in 1993.

The entry requirements for staff appointed in terms of qualification, certification and working experience are comparable to that of the Universities in Ghana. This policy provides the means for the availability of high calibre of material for the implementation of the project. Programmed opportunities are provided for staff to upgrade their knowledge and skills.

The main setback is the bureaucratic process for human resource recruitment and constraints on the number of staff that can be employed within the framework of Governmental overall budget for personal emolument. This situation puts a strain on staff available since they have to cope with regulatory activities, protection and safety services, national and practice specific training programmes and research. Three departments have been established to give focus to all the implementation strategies. The Model Project has provided opportunities for training of staff available for implementation of the project and other staff of user agencies at the introductory and basic levels. On the job training has been used to supplement the IAEA assisted group training in order to sharpen the knowledge and skills of trainees and make it relevant to national needs.

The mean annual growth rate of staff over the last ten years has been 5.6% .

Table I shows the current staff profiles for the three departments of the Radiation Protection Institute of the Radiation Protection Board.

Table I. Staff profile for the Departments of the Radiation Protection Institute

Department	Scientists	Technicians	Supporting staff	Total
Directorate	1	-	9	10
Regulatory Control	4	2	1	7
Radiation and Waste Safety	4	2	1	7
Human Resources Development and Research	2	1	1	4
Total	11	5	12	28

4. Legal Framework

Upgrading of the legal infrastructure has been the most time consuming and frustrating part of the implementation of the model Project due to the unstable system of governance and rule of law coupled with the low priority given to legislation in technical areas such as safe applications of Nuclear Science and Technology in medicine, industry, research and teaching. The Development of the basic legislation started in 1987 but the Provisional National Defence Council Law 308 establishing the Regulatory Authority and regulations for the control of possession and use of ionising radiation and radiation sources were promulgated concurrently in 1993 [2, 3, 4, 5].The legal framework was strengthened by the issuance of further regulatory guidance documents to upgrade the system to be consistent with the BSS [1].

The Radioactive Waste Management regulations prepared in 1997 is still in the process of being enacted.

5. Occupational Exposure Control

Individual Monitoring for external exposure has received systematic upgrading since its establishment in 1980. The Harshaw TLD 2000 System was commissioned in 1980, followed by the Harshaw TLD 4000 System in 1990 and the Harshaw TLD 6660 system in 1995 [6,7]. The main setback has been the non- available of critical replacement parts for prompt maintenance and repairs. Initial purchase contracts did not include maintenance and repair kits. However Regional Managers assisted as and when problems arise. Replacement of TLD cards which have passed their useful lifetime and purchase of additional cards needed to expand the service presented a major capital investment challenge in making the service self-reliant and sustainable.

Safety assessment of the workplace through workplace monitoring is carried out for purposes of authorization and regular inspection. For practices which possess and use Category 1 sources [8] as part of authorization requirements must have available calibrated survey meters for workplace monitoring.

6. Medical Exposure Control

Three approaches have been adopted for medical exposure control which include:

i. Safety assessment and quality control audit for the purposes of authorization and regular inspection of medical diagnostic and therapeutic facilities ;
ii. Promotion of institutional level quality assurance and quality control programmes.
iii. Training of key staff to implement protection and quality assurance programmes.

Under these scheme three (5) regional training courses and five (5) national training course have been organised on the subject of medical exposure control. Ghana has hosted IAEA five (5) fellows for training in this area.

Some of the resources of Model Project earmarked for Ghana have been used to purchase quality control equipment for four tertiary medical Institutions including two teaching Hospitals to enhance institutional level quality control capacity building.

7. Public Exposure Control

Public exposure control was assured by through an effective authorization of the safety and design of buildings, plants and installations, approval of correct operational procedures, and safety and security inspections.

8. Development of a National level Radiological Emergency Response Plan

Facility level emergency plans are part of the requirements for authorization to possess and use ionization radiation and radiation sources. The final draft of a National Level Radiological Emergency Response plan has been prepared. The interim emergency response group has been nominated.

The gamma irradiator and gamma radiography facilities of the National Nuclear Research Institute have developed their emergency response procedures. The Ghana Research Facility (GHARR-1) is yet to complete their emergency response procedures based upon the approved final Safety Analysis Response (SAR) submitted in 2001 to the Regulatory Authority.

9. Conclusion

Implementation of the Model Project on Radiation Protection Infrastructure over the past ten years has underscored the importance of competence building for regulatory staff, licensees, registrants and service providers. Effective competent building should include the acquisition of:

i. operational knowledge;

ii. operational skills;

iii. relevant operating experience; and

iv. positive learning attitudes commensurate with the level of protection and safety culture requirements for practices and sources within practices.

A learning organization and management systems have been created where all stakeholders are being challenged to contribute towards protection and safety improvements on a continuous basis.

Committed cooperation and collaboration between the International Atomic Energy Agency and the Radiation Protection Institute of Ghana Atomic Energy Commission has facilitated competence building in a challenging economic environment. The need to make the radiation protection and safety regime self-reliant and sustainable has demanded a paradigm shift from bureaucracy to a business approach where we have to supplement dwindling Government support with internally generated funds from our regulatory activities and services [9].

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Experiences of Implementing IAEA Model Project and Setting-up National Infrastructures for Radiation Safety in Uganda

A. Kisolo[a], M. Emaru[b]

[a] National Radiation Protection Service
Department of Physics
Kampala, Uganda

[b] Ministry of Energy and Mineral Development
Kampala, Uganda

Abstract. Uganda has greatly benefited from the IAEA Model Project of Upgrading National Infrastructure for Radiation Safety. Government and Stakeholders are more aware of the need for the safe use of radiation sources and their roles in providing security of radioactive sources and wastes. The Draft Bill for the enabling legislation - The Atomic Energy Bill 2002 and Regulations are in the final stages of enactment into law. The Government of Uganda has designated the National Radiation Protection Services (NRPS) as the National Regulatory Authority pending the completion of the legislative process. NRPS with the support from the Ministry of Energy and Mineral Development as the responsible Sector have been executing the regulatory functions of notification, authorization, inspection and enforcement on a regular basis. It is expected the new legislation and regulations and the Regulatory Authority – The Atomic Energy Council will be in place during the year 2003. Uganda hopes to achieve the minimum requirements specified by the BSS No. 115 during the year 2003.

1. Promulgation of Legislation and Regulation

Uganda participates in the IAEA Model Project RAF/9/027 on Upgrading Radiation Safety Infrastructure. The country completed the drafting and consultations with stakeholders on the new legislation in December 2001 and Draft Atomic Energy Bill was presented to Cabinet in October 2002 and is now in the final stages of promulgation into law by Parliament. We hope this to be achieved by June 2003.

Ionising Radiation Regulations were drafted and await the promulgation of the Bill.

1.1. Positive Experience

— The new legislation proposes to establish the Atomic Energy Council as the Regulatory Authority and the system of notification and authorization, and compliance.

— There is increased public and stakeholders awareness of legal obligations and regulatory control of radiation sources and practices.

— Stakeholders, line ministries, police, security and customs have been trained and sensitised on the requirements for safe use of radiation sources and security of radioactive sources. Some users, police and customs officers have been trained in basic requirements for radiation protection and security of radioactive sources.

1.2. Negative Experience

— Delayed in promulgation of the new legislation has led to delays in attainment of Milestones I which provides the minimum regulatory infrastructure specified by the BSS and IAEA Board of Governors recommendation GOV/1999/67.

2. Establishing the National Regulatory Authority

— Pending the completion of the legislative process, Government designated the NRPS the defecto Regulatory Authority. The NRPS is a government body established by the existing law the Atomic Energy Decree No. 12 of 1972. The staff at NRPS constituted the Technical Secretariat of the Regulatory Authority headed by the Chief RSO.

2.1. Positive Experiences

— Regulatory work of authorization, inspection, quality assurance, inventory of sources, and Radiation and Waste safety are being provided regularly. NRPS undertakes about 30 QA annually.

— The inventory has about 100 X- ray units, 35 sources including three backscatter gauges, five moisture gauges, Cs-137 brachytherapy sources and two Co–60 teletherapy sources and is upgraded annually.

— NRPS provides personal monitoring for 450 occupational exposed workers, some food and environmental monitoring in collaboration with the Uganda National Bureau of Standards.

— Trained staff who include four RSO and one Technician are available for recruitment. Other staff are available for recruitment and training.

— NRPS and the Ministry have been providing training courses to stakeholders and public awareness information on radiation safety and security of radioactive sources. Training courses for Police & Customs Officers were held in September & November 2002. A total of 60 people were trained.

2.2. Negative Experiences

— The NRPS does not at the moment have sufficient funds and resources to undertake all the necessary regulatory activities.

— NRPS needs to recruit more staff to reduce the shortage manpower.

3. System of Notification, Authorization, Inspection and Enforcement

— NRPS licenses new and existing users regularly. There are about 80 licensed users. Approximately 10 new users are licensed annually. Licensed users approximate 50% with majority of unlicensed users comprising private medical units upcountry.

— Importers are aware of the requirement for notification.

— Inspections of existing users are conducted regularly, depending on the magnitude of activities and risks.

— Enforcement for non-compliance has been put in place.

3.1. Positive Experience

- Users are aware of the need for notification and authorization.
- Generally good working relations between the regulator and users.
- Equipment for QA and inspections provided by IAEA.
- Calibration of radiation sources at regional SSDL in Arusha under assistance of IAEA Model Project RAF/9/027.
- Sensitisation of other stakeholders like users, police, customs, security , Uganda Press, etc. has been started.

3.2. Negative Experience

- Some old and used equipment and sources are imported without notification and authorization. This is particularly applies to X-ray equipment and some moisture gauges.
- Funds, resources, facilities and manpower to undertake effective inspection of authorized users particularly upcountry not adequate.
- Inventory of radiation sources has not been completed.
- There is need to increase border surveillance and increase public awareness to control the problems of illicit trafficking of radioactive sources. A national task force to promote training and public awareness in radiation protection and safety matters is to be established.

4. Concluding remarks

- The Atomic Energy Bill 2002 will be enacted into law during the year 2003 and the Regulatory Authority with adequate manpower, sufficient budget, resources and facilities will be set-up.
- The goals for Uganda for the year 2003 is to set-up the legal and institutional infrastructures and meet the basic standards for the regulatory authority defined by the BSS.
- Under the Model Project, on Upgrading Radiation Safety Infrastructure in Uganda has received radiation detectors and dosimeters, training of its R.P.O. in dosimetry, radiation protection and safety, and quality assurance and regulatory control of radiation sources and radioactive substances.
- There is increased awareness of safety of radioactive sources and practices and security of radioactive sources and wastes by stakeholders, police, customs, security agencies, the Uganda Press, etc.
- Uganda is very grateful to the IAEA and the Model Project Managers for support and guidance in upgrading the National Infrastructures of Radiation Safety for Uganda.

Radiation Safety in Indonesia
An overview of infrastructures

Nasukha

R & D Center for Radiation Safety and Nuclear Biomedicine
National Nuclear Energy Agency (BATAN) of Indonesia

Abstract. Basic Safety Standards state that essential of a national infrastructure are: legislation and regulation; a Regulatory Authority empowered to authorize and inspect regulated activities and to enforce the legislation and regulations; sufficient resources; and adequate numbers of trained personnel. This paper discussed history, present and prospects future of radiation safety infrastructures in Indonesia. After The Second World War and the declaration of freedom, Indonesia initiated to realize that the potential hazard of the use of ionizing radiation should be controlled. The first highest regulation concerning control of the use of ionizing radiation was Act. No. 31 Year 1964. To execute the Act, The Government Regulation No. 33 Year 1965 has been enacted. Then to implement radiation safety, The First Regulation for Radiation Safety was The Government Regulation No. 11 Year 1975 followed the others regulations. Due to the development in nuclear science and technology, the Act. No. 31 Year 1964 was superseded by The Act No.10 Year 1997. The main different of the new act is separation the authority in executing and controlling into different institution. The regulatory body is now called Nuclear Energy Control Board (BAPETEN), and one of the executing bodies which is National Nuclear Energy Agency (BATAN). Resources (facilities and services), education and training programs to support radiation safety infrastructures are also discussed in this paper. By the competent authorities and institutions, Indonesia has the legal legislation and adequate infrastructure to ensure implementation, enforcement and compliance with the radiation safety nationally in the near future.

1. Introduction

The word "nuclear" become a term to fear after The Second World War. But after that it was followed also the word "radiation". Radiation is simply energy transmitted through a distance. Two types of radiation are ionizing radiation and non-ionizing radiation. Ionizing radiation causes ionization as it travels through any medium (such as x rays and gamma rays), and non-ionizing radiation does not have sufficient energy to cause ionization (such as light, and infra-red rays).

There are two types of ionizing radiation, ionizing electromagnetic radiation and particulate radiation. In applications of nuclear energy, ionizing radiation is used. Hence, the term of radiation in this paper will be used to mean ionizing radiation.

Major sources of radiation are applied in Indonesia for medicine (such as diagnosis, therapy and biological research), industrial activities (such as sterilizer, gauges and industrial radiography), research (such as reactor research, tracers and electron microscopes) and soon.

The Basic Safety Standards [1] state that the acceptance by society of risks associated with radiation is conditional on the benefits and protected against by the application of radiation safety standards. In Indonesia, there are three types of challenges to improve radiation safety infrastructures, the scientific, technical and democratic challenges. These challenges will require a communication process between all parties involved - the regulators (the national regulatory bodies), the implementers (the executing bodies) and the general public. Good communication with the general public is now especially important to the regulatory bodies, since they are in the end accountable to the general public, whose safety they have been given the task to protect. Effort to socialize nuclear science and technology is essential for public perception. The enhancement of awareness and right participation to public is conducted by using any media.

2. The Independent of Regulatory Authority

The regulatory authority first interest is to protect public health and safety. Based on the Basic Stipulation of Atomic Energy Act number 31 of 1964, Government Regulation number 33 of 1965, President of Republic of Indonesia decision number 82 of 1985 and the Director General's decree number 127 of 1986 that Atomic Energy Control Bureau was under Deputy of Administration of BATAN. This history wrote that regulatory authority for nuclear energy in Indonesia at that time was also as implementers. Now, by The Act.No.10 Year 1997 on Nuclear Energy is separation the authority in executing and controlling into different institution. By this act, the regulatory authority must also be independent of the implementers of radiation sources used in practices. The regulatory authority for nuclear activities is now called Nuclear Energy Control Board (BAPETEN). Not only as a function of on regulation, BAPETEN also carries out inspection routinely to several nuclear facilities and licensing for any radioactive materials and radiation sources in Indonesia. To be remember that the goal of regulation, inspection and licensing is radiation safety to all, individual or population.

Regulatory framework should be included national regulations, standards and recommendations of the International Commission on Radiological Protection (ICRP) and the International Atomic Energy Agency (IAEA). So, for the future, it is not only independence, but also hope that further important regulator attributes are objectivity and fairness. The implementer has a wish list of qualities that they would like to see in all regulators. This control system to be a legal order achievement for radiation safety which become a culture.

3. Facilities and Services

The utilization of radiation to be safe, reliable, clean and environment friendly needs sufficient resources. Sufficient sources for national infrastructures could be laboratory and service facilities. These facilities and services are needed for intervention, calibration and intercomparison of radiation measuring equipment, personal dosimetry, environmental monitoring, and radioactive waste management [2].

3.1. Secondary Standard Dosimetry Laboratory (SSDL)-Jakarta

The laboratory facilities are resources that back up all activities. BATAN has several radiation laboratory facilities situated in Jakarta, Serpong, Bandung and Yogyakarta. In metrology, BATAN has a Secondary Standard Dosimetry Laboratory (SSDL) -Jakarta that a member of The International Atomic Energy Agency/World Health Organization Network of Secondary Standard Dosimetry Laboratories (IAEA/WHO Network). The responsibilities of SSDL are such as maintaining secondary standard instruments in agreement with international measurement system, performing of radiation measurement equipment and issuing calibration certificates with all necessary information, including the estimated uncertainties. The SSDL-Jakarta also serves to calibrate radiation monitor instruments and audit the output calibration of absorbed dose in radiotherapy nationally.

Radiation measuring instruments which used to monitor or measure exposure rate in working place or in a given environment are calibrate at SSDL-Jakarta. Some laboratory facilities for this purpose are being built at several cities in Indonesia, such as in Surabaya, Makassar and Medan.

At SSDL-Jakarta, standardization of radionuclide sources carried out by using either absolute or relative method. A standardized source is useful for calibration of instruments. To maintain the accuracy in standardization of the sources, intercomparison were done with several international laboratories, such as BIPM of France.

3.2. Personal Monitoring Dosimetry Laboratory

The system of dose limitation to encompass probabilistic situation by introducing the concept of potential exposures was extended International Commission on Radiological Protection (ICRP). A clear national strategy for the management of dose limitation should be based on sustainable development, precautionary approach, and risk-benefit distribution. ICRP 26 and 60 to be assessed and implemented nationally for the system of dose limitation. To estimate radiation doses received by a radiation worker is used personal dose monitoring. In Indonesia, personal dose monitoring is conducted by BATAN and Department of Health. BATAN uses film badge and TLD badge, and Department of Health uses film badge for this purpose. The results of radiation worker doses from external dose monitoring are reported to BAPETEN. For the internal radiation dose monitoring, BATAN uses in-vitro bio-assay technique by measuring the radioactivity in urine samples of the workers and also through in-vivo by using a whole body counter.

3.3. Environmental Monitoring Laboratory

Environmental monitoring is carried out through measurement of radioactivity and radiation levels in the local ecosystem of the nuclear facilities and also national radiation facilities. This monitoring is conducted continuously for some places in Indonesia by R&D Center for Radiation Safety and Nuclear Biomedicine (BATAN) of Indonesia. The other activity of this laboratory also issues the radioactive-free certificate for exported or imported foodstuffs and conduct measurements of radioactive content levels from such products as milk, tea, coffee, nutmeg and ginger.

3.4. Radioactive Waste Laboratory

Radioactive waste should be disposed of in a manner that protects both man and the environment from the harmful effects of radiation. BATAN carried also out the radioactive waste treatment, and responsible in handling and treatment of radioactive wastes arising from the nuclear research, industry and medicine activities. The installation consists of three buildings, the waste processing, the media and electricity and an interim storage building. The radioactive wastes, either solid, liquid and spent resin from the nuclear facilities are transported from producer's storage tank to the storage tank in the processing building by trailer.

4. Education and training

Adequate numbers of trained personnel are very important to success radiation safety programs in nuclear and radiation activities. Qualified personnel will be able from the best education and training programs. The Education and Training Center of BATAN have responsibility to manage, develop, hold, and coordinate all activities either technical or non-technical by means of self-done or cooperation based on the policies. Higher education for nuclear sciences and technology is also managed by the Education and Training Center of BATAN, situated in Yogyakarta. Some special programs are also conducted jointly with The University of Indonesia (UI), such as a postgraduate program in Medical Physics. The master degree in nuclear instrumentation was also jointly done at The Institute of Technology Bandung (ITB). Some personnel that work in BATAN, BAPETEN and the other radiation facilities are also graduated from overseas universities.

Training programs for any special topics are done by the Education and Training Center of BATAN. Training on Radiation Protection for Workers, Industrial Radiography, and others are topics of training that annually are scheduled. In cooperation with of the International Atomic Energy Agency (IAEA), some personnel from several institutions follow such as from hospitals. Seminars, symposiums, and the other scientific programs in nuclear and radiation meetings nationally or internationally increase the capabilities and qualities of human resources. The seminars or symposium are also jointly with association of expertise, like Indonesian Radiologist Association, Indonesian Oncologist Association and others. These mean that human resources for conducting radiation safety in Indonesia play in comprehensive development for nuclear sciences and technology.

5. Conclusion

National infrastructures every country are likely different, as Indonesia has. This overview of infrastructures is far from a complete image. However, some essential parts of infrastructures have been explored and discussion. BAPETEN as a control institution needs more work to produce regulations, good management in licensing, and smart in inspection to implementers. As well as BATAN and other such as hospitals and industries as implementers will always be increased with an emphasis on nuclear science and technology utilization to increase the nation quality, value and status, and enhance people prosperity.

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Jordan Experience in Participating in the IAEA Model Projects

N. N. Abutaleb

Licensing and Inspection Department (JAEC)
Amman, Jordan

Abstract. This paper refers to the sensible progress in the country for upgrading Radiation and Waste Safety infrastructures, particularly in the Regulatory Framework. The establishment of Jordan Atomic Energy Commission (JAEC) is a fruitful outcome of the IAEA Model Project which is considered as the main factor that leads to this progress. The paper also reflects our needs for more co-operation and assistance from the IAEA in the field of Medical Exposure Control and in implementing different emergency scenarios. Some recommendations which I feel essential for effective and sustainable systems of the National Safety Infrastructures are being included in this paper.

1. Introduction

Jordan started dealing with radiation and waste safety issues through the Ministry of Industry and Trade (1980-1985). Later, the Ministry of Energy and Mineral Resources (MEMR) was in charge of this responsibility. In 1987 Nuclear Energy and Radiation Protection Law No.14 was promulgated. By this law the Commission of Radiation Protection was established, which has the right of controlling Radiation Protection in Jordan including the issuing of the radiation licensing through the Nuclear Energy Department which acted as the technical arm of the Commission. Jordan participated in the Model Regional Projects: RAW/9/008 ***"National Regulatory Control and Occupational Radiation Protection Programmes"***, RAW/9/009 ***"Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure"*** in the year 2001 .The most valuable results gained from these projects are the systematic approach of Radiation Protection Milestones, representing awareness in Radiation Protection especially in Medical Applications.

In July 2001, The Nuclear Energy and Radiation Protection Law was modified and promulgated, as Law No.29 . By this Law, Jordan Atomic Energy Commission (JAEC) was established as an independent body. The Administration Council (AC) of the (JAEC) was established and is playing the role of the Regulatory Authority (RA) in Jordan. The (AC) is chaired by the Minister of Energy and Mineral Resources (MEMR). The (JAEC) consists of (6) Departments Five of them are technical, while the sixth is the Administration and Financial Department.

2. Legislative and Regulatory Status

2.1. Legislation

The Nuclear Energy and Radiation Protection Law No. (29), entered into force in July 2001. The Major topics of this Law are:

- Technical and Administrative aspects of (JAEC).
- Missions, Tasks, and Responsibilities of (JAEC).
- Formulation, Tasks, and Authorities of (AC).
- Responsibilities and Authorities of the Director General (DG) of (JAEC).
- Financial Resources and Administrative Affairs of JAEC.

- Legal frameworks of radiation protection, Licensing & Inspection, and non-compliance of the law and regulations.
- Technical, financial, and administrative regulations to be issued according to this Law.
- Issuing of required regulation guides, and standards in radiation safety.
- Applying the notification, registration, licensing, and inspection system for all kinds of ionizing radiation sources.
- Providing the legal rights of inspectors to assure full implementation of this Decree.
- Providing the suspending conditions of licensing including penalties.

2.2. The Regulatory Authority (RA)

The (AC) of (JAEC), consists of (11) members representing, JAEC, Ministry of Health, General Corporation for the Environment Protection , Natural Resources Authority , some universities, and members from the private sector. This Council is chaired by the Minister of Energy and Mineral Resources and acts as the (RA). The Radiation Licensing and Inspection Department (RLID) and the Radiation Protection Dep. (RPD) at JAEC are considered as the technical arms of the (RA), these departments work under the supervision of the Director General (DG) of (JAEC).

2.3. Regulations

Regulations according to the law are related to different Radiation Practices (transport, waste, licensing & inspection … etc), were approved and entered into force, while others will be approved soon. The main components of the regulations and rules are:

- General rules.
- Basic principles of radiation.
- Requirements of licensing of radiation sources, users and producers
- Duties and responsibilities of licensees.
- Requirements of radiation safety in medical exposures.
- Requirements of radiation safety in occupational exposures.
- Requirements of radiation safety in public exposures.
- Safe transport of radioactive materials.
- Definitions
- Legal rules.

2.4. Inventory of Radiation sources The inventory of radiation sources is the responsibility of the (RLID). (RAIS) system is used to maintain the inventory, in addition to local computerized and manual filing system. Major radiation sources (around 90% of ionizing radiation sources) are included in the inventory. Co-operation the co-ordination between JAEC and other concerned Governmental Bodies are important factors in locating these sources.

3. Occupational Exposure Control Individual external monitoring is undertaken in the country for persons occupationally exposed to ionizing radiation. Monitoring of internal dose will soon be established, hopefully, with the co-operation of the IAEA through the Model Projects on Upgrading Radiation Safety Infrastructures.

Table I. Number of institutions and radiation sources in Jordan according to radiation practices.

Radiation Practices	No. of Institutions	No. of Radiation Sources	Percentage of each practice to the total volume	No. of workers
Radiodiagnostic	206	692	74.24%	1700
Nuclear Medicine	14	17	1.82 %	35
Radiotherapy	3	9	0.965 %	20
Industrial Applications	19	185	22.96 %	600
Total	311	932	100 %	2355

Jordan has two centers that provide external radiation monitoring. The first one is at the Royal Scientific Society (RSS) and the other one is at JAEC. Both of them are using the (TLD) system. JAEC has started to use the finger TLD system for the concerned workers. The doses of the Individuals in the country are recorded and monitored by the JAEC, (90%) of them are monitored and covered by this service. Inter-comparison tests were implemented with the IAEA and are considered as an approval on the competence of the providers of dosimeter services. Harshaw 4500 and Vinton 813 provided through the IAEA are used for measuring the doses. The number of monitored persons are around 1700, while the total number of radiation workers exceeds 1900.Monitoring services are made every (3) months. JAEC intends to reduce this duration to be done once a month.

4. Medical Exposure Control

A national programme for Radiation Protection and Quality Assurance for Radiotherapy, Nuclear Medicine, and Diagnostic Radiology is available in the country, but it is not adequate. Moreover, radiation protection handbook, local roles, emergency preparedness and instructions are available. A recent programme in Medical Exposure Control is being activated and improved as a result of previous and recent visits of the IAEA experts to Jordan. . Jordan is suffering from the shortage of physicists, specifically medical. Upgrading of their qualifications especially in QA and applying the code of practices are highly recommended, for establishing a systematic, proper and scientific QA programme . National efforts and the Agency's assistance are needed to strengthen and upgrade the National Secondary Standard Dosimetry lab. (SSDL).

5. Public Exposure ControlJAEC is responsible for the public exposure control. Radiation Protection Department, Detection and Measurement Laboratories, besides the Radiation Licensing and Inspection Department are serving as the technical arms for the JAEC to control discharges of radioactive substances to the environment. According to the Limits, conditions, and recommendations of the IAEA (Basic safety standards).

Prior approval for consumer products or materials which may emit ionizing radiation is needed before supplying it to the members of the public, and also needed for disposal of the contaminated materials and products.

JAEC is responsible for Radiation Environmental Monitoring all over the country. Continuous Monitoring Networks are installed. Environmental Radiation Survey Programme including collection, preparation and analysis of environmental samples are applied.

Radiation controlling stations are installed and operated at the entrance borders.

6. Radioactive Waste Safety

The Radiation Protection Department at (JAEC) is responsible for the control of radioactive waste materials produced from radiation applications in Jordan, mainly from medical applications. The Government of Jordan dedicated a facility for safe storage of radiation sources at the end of their useful life, while, other sources are returned back to the suppliers by Regulations.

The Radioactive waste Regulations have been approved by the (AC) of (JAEC). The Basic recommendations of the (IAEA) experts describing arrangements dealing with the sources and disposal levels have been taken into considerations. The (AC) has approved Instructions and Roles for Safe Transport of Radioactive Materials in the country, based on the Regulations for Safe Transport of Radioactive Materials, recommended by the IAEA, edition 1996 (ST-1).

7. Emergency Preparedness and Response

The establishment and maintenance of national emergency response plan and procedures for emergency response are required by Regulations. The Regulatory Authority identified the needs for contingency plan (s) for ionizing radiation, sources or practices in the country that could lead to accidental, exposure of workers, or respective dose limits. The (RA) acts to credit the plan (s) for the end users, which is considered as one of the main requirements for issuing the licensees. Clear duties and responsibilities of the National Agencies or Organization response to radiological and nuclear emergency are clarified in the plan (s).

8. Recommendations

To achieve effective and sustainable systems for National Infrastructures of Radiation Safety in member state the following recommendations are drawn.

- Independent, specialist and, empowered Focal Point Organization sponsored by legislative and Regulatory framework should be established.
- Number of qualified staff in the Regulatory Authority and also with the users in different applications, representing at least the minimum critical mass of professionals should be appointed.
- Adoption, with co-operation of the IAEA and other Organizations concerned, appropriate and sustainable training programmes.
- Sufficient budget and logistics.
- Strengthen regulatory controls to achieve an effective security system of radioactive materials, in the national regional and global scales.

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Implementation Experience with the Model Projects in Kazakhstan

S. Abdykhalikova, A. Kim

Atomic Energy Committee of the Republic of Kazakhstan

Abstract. Status of implementation of the IAEA TC Model projects in the field of upgrading radiation safety infrastructure in Kazakhstan; in particular there are considered points on quality control of radiation safety in industry, radiotherapy, diagnostic radiology, nuclear medicine, and points of emergency preparedness.

1. Introduction

Republic of Kazakhstan joined to IAEA members in 1993, since this time Kazakhstan actively started to participate in the IAEA TC Program. The Kazakhstan Atomic Energy Committee is responsible for co-ordination, organization and supervision of all activities on defining of priority directions of cooperation with IAEA TC Program, selection, control of implementation of projects, selection of Kazakhstan candidates to training courses and etc. Different Kazakhstan institutions take part in the IAEA TC Program, such as institutes of the National Nuclear Center, medical institutions, universities, industrial enterprises and others. The Atomic Energy Committee is in close cooperation with such governmental bodies, as Ministry of Health Care, Ministry of Energy, Agency on Custom Affairs, Agency on Emergency Situations and etc.

There are 1 NPP under decommission, 4 research reactors, 4 electron accelerators, one cyclotron in Kazakhstan. About 100 000 radiation sources with total activity 25 000 Ci are used in industry, science and medicine. Annually about 10 000 of sources set out in storages.

Every year Kazakhstan carries out about 5-7 national TC projects under IAEA TC Program, different Kazakhstan organizations participate in the IAEA regional and interregional TC projects, also every year Kazakhstan organizations participate in the IAEA Research Contract Program. More than 300 Kazakhstan specialists were trained in different IAEA training courses, upgraded practical skills and received new knowledge.

2. Status of implementation of the Regional Project RAW/9/008 “National Regulatory and Occupational Radiation Protection Program”

2.1. Establishment of legislative and regulatory infrastructure

Starting from 1995, in the framework of implementation of IAEA Model projects on upgrading of radiation safety infrastructure, Kazakhstan developed and established legislative base in the field of atomic energy use. There is the following legislation base in this field at the present time in Kazakhstan: Law on Atomic Energy Use, Law on Radiation Safety of Population of Kazakhstan, Decree of Government No. 100 “On Licensing of Activity Connected with Atomic Energy Use”, and about 100 regulatory documents.

Different governmental bodies are included in the system of state regulatory control and supervision in the field of atomic energy use. In accordance with governmental provisions such organizations as Atomic Energy Committee, Agency on Emergency Situations, Ministry of Health Care, Ministry of

Internal Affairs, Ministry of Energy and Mineral Resources, Ministry of Environmental Protection are responsible for development and implementation of regulatory control, supervision on radiation safety, and they are in close cooperation each other. Now Kazakhstan has establishing system of authorization, notification, enforcement and inspections.

In April 2001 there was meeting with representatives of Atomic Energy Committee, Ministry of Health, Agency on Emergency Situations, National Nuclear Centre on coordination and plan of implementation of the IAEA regional projects with purpose to upgrade the system of radiation safety infrastructure in Kazakhstan.

Under the regional project there are provided and upgraded knowledge and practical skills of staff included in the system of authorization, notification, enforcement and inspection. In particular, there is planned to train 10-12 regulatory staff from Kazakhstan in 5-week regional training course on regulatory authorization and inspection of radiation sources.

2.2. Inventory of radiation sources

One of the main directions for upgrading radiation safety infrastructure is inventory of radiation sources, in this content the Kazakhstan Atomic Energy Committee in cooperation with the Agency of Emergency Situations and the Ministry of Health Care started to collect full information on inventories of sources from all institutions.

2.3. External Exposure Control

There are 12 governmental and private institutions in Kazakhstan which received governmental licenses for individual dosimetry services. Under recommendations of IAEA's experts it is necessary to develop clear policy for provision of individual monitoring services, to develop quality requirements for the service providers, to establish national database.

2.4. Internal Monitoring

As it is known, Kazakhstan takes one of the first places in the world on quantity of prospected uranium stocks (about 50 % of uranium stocks of former USSR). The development of more than 20 uranium deposits was and is conducted during a long time (more than 40 years). There is necessary to establish internal monitoring services for uranium mining industry. There is planned to train and develop internal dosimetry laboratory on the base of the National Company "Kazatomprom" in the framework of implementation of the IAEA regional project and under IAEA experts recommendations.

2.5. Calibration Programme

One of the important directions for establishing of quality assurance in occupational exposure control is to develop calibration programme for radiation protection equipment, individual dosimeters and survey instruments. There are planned to upgrade the existing calibration laboratory, to train staff of the laboratory, to give IAEA experts assistance and assessment, and as result to improve calibration of the instruments and dosimeters for quality measurements in external dosimetry and radiotherapy.

3. Status of Implementation of the IAEA Regional Project RAW/9/009 "Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure"

3.1. Quality Assurance in Radiotherapy

National seminar on quality assurance in radiotherapy was conducted last September, about 60 radiotherapy specialists from all Kazakhstan regions and from Uzbekistan and Tajikistan participated in the seminar, IAEA experts and Kazakhstan specialists presented lectures in the seminar. Kazakhstan radiotherapy specialists (clinicians, medical physicists) take part in the IAEA regional training courses, seminars and fellowship trainings. There is planned to carry out IAEA expert assessment of few Kazakhstan radiotherapy centres on quality level of clinical dosimetry, planning system, and determine centres with high quality level (or to improve knowledge level of one-two centres), and as result to use these centres for conducting expertise, assessment and determination of list of quality requirements for radiotherapy centres.

3.2. Quality Assurance in Diagnostic Radiology

National workshop on quality assurance in diagnostic and interventional radiology was conducted last November, about 40 radiology specialists from Almaty town, Uzbekistan and Tajikistan participated in the workshop, improved their practical skills and knowledge. IAEA experts conducted and tough participants. The pilot project on improving practical skills and image films quality is started this year in five hospitals. Quality control kits were disseminated to the hospitals under IAEA shipments. Results of the project will be presented in the September 2003 in the second national workshop for radiology specialists. Also in May 2003 there will be national conference on quality assurance in diagnostic and interventional radiology, there will participate and present papers the experts from IAEA and other international organizations. There are planned to conduct national one week workshop for technical engineers on medical x-ray equipment this year, to conduct third national workshop for radiologists in 2004, to provide fellowship training for several radiology specialists from biggest Kazakhstan regions, to participate in regional training courses. Next step is to distribute the experience to all Kazakhstan regions, and as result of the activities is to develop quality assurance in diagnostic and interventional radiology in Kazakhstan.

3.3. Quality Assurance in Nuclear Medicine

There are planned: to provide IAEA expert for assessment of radiation protection and safety in nuclear medicine hospitals, to distribute IAEA training materials in Russian language, to participate in regional training courses, to provide fellowship training for nuclear medicine specialists. The results of the activities will establishing the training centre for nuclear medicine specialists on the base of the republican hospital.

3.4. Emergency Preparedness and Response

There are planned: to provide IAEA experts missions for assessment of legislative base, regulatory documents, development of National Emergency Plan, status of emergency preparedness in facilities. The meeting with IAEA expert, Atomic Energy Committee and Agency on Emergency Situation on discussion and determination of joint activities on upgrading of emergency preparedness and response was conducted last November.

In accordance with Kazakhstan legislative base, each user has detail instructions (rules) on emergency response, on radiation safety, emergency plan. Also each user has the Radiation protection officer responsible for all the activities in their staff structure.

There are planned to conduct national workshops for staff of the Agency on Emergency Situations, to participate in regional training courses, to develop, in cooperation with IAEA experts, project of the national Emergency Plan, to collect full information on radiation sources in Kazakhstan, to improve knowledge and practical skills of medical doctors of the Kazakhstan medical centre of emergency response in the framework of the model projects.

4. Nearest future steps for upgrading of radiation safety infrastructure in Kazakhstan:

- Regarding Provisions of the Radiation Protection Law to adopt new version of Basic sanitary rules radiation protection.
- To improve knowledge level and practical skills of staff responsible for authorization, notification and inspection.

— To develop regulatory documents for licensing procedures in the Kazakhstan Atomic Energy Committee.
— To collect information of radiation sources and to complete database on inventory of all radiation sources in Kazakhstan.
— The Secondary Standard Laboratory will be upgraded to calibrate radiation protection and radiotherapy equipment, individual dosimeters and survey instruments.
— To present results on the pilot project in diagnostic radiology and to distribute this experience to all Kazakhstan regions.
— To improve knowledge level of medical physicists in radiotherapy and to upgrade quality control in radiotherapy.
— To develop National Plan on Emergency Response.

5. Conclusion

Currently Kazakhstan through the IAEA Model Projects has established a regulatory infrastructure with a radiation safety law, law on atomic energy use, regulations, standards, and sanitary rules for major practices, and has a regulatory authority. At the same time Kazakhstan needs to upgrade system of notification, authorization and enforcement and to increase the efficiency of all activities carried out by national regulatory authority.

Thailand's Experience in re-structuring its Radiation Safety Infrastructure

M. Aramrattana, W.Wanitsuksombut

Office of Atoms for Peace
Bangkok, Thailand

Abstract. Thailand has the Atomic Energy for Peace Act B.E. 2504 (1961) as the basis for safety regulation of radiation sources. The past IAEA's interactions with the OAEP and the radiological accident in 2000 set political and administrative commitment to re-structure the OAEP into two entities separating regulatory management from its research and development management. The policy of re-structuring the overall government bureaucratic system gives mandates to re-structuring OAEP. Thailand's participation in the Model Project on Upgrading of Radiation Protection Infrastructure has been the important element and fruitful development to implement the mandate. Regulatory requirement for enforcement of safety regulations is presented and the present structure of OAP (new name of the OAEP) is discussed. An effective and efficient independent regulatory authority has yet to be fully functional as a required legislation for establishing TINT has not been enacted. Restructuring effort is to be continued, and the contribution of the Model Project continue to be essential.

1. Introduction

1.1. Background

The use of radiation for diagnostic radiology and of radioactive sources for medical research started in early 1950s. Atomic Energy for Peace Act was enacted in B.E. 2504 (1961) [1], hence designated Atomic Energy for Peace Act B.E. 2504 (1961), following becoming a member state of the International Atomic Energy Agency (IAEA) in 1957.

The Act establishes number of key organizations to facilitate legal instruments for promulgating Ministerial Regulations for safe uses of radiation sources in Thailand. They are establishment of Atomic Energy for Peace Commission (Thai AEC) as the policy organ for formulation of national policy on peaceful utilization of atomic energy and safety regulation of radiation sources, and establishment of Office of Atomic Energy for Peace (OAEP) as Secretariat of the Thai AEC. The Thai AEC is empowering to designate sub-committees for conducting specific tasks. The key organizations are to facilitate, among others, development of Ministerial Regulations (MR) as regulations for safe uses of radiation sources and nuclear materials. For radiation safety, the MR No. 2 on Licensing of Radiation Sources and Nuclear Materials was the main regulation to be enforced upon users of all radiation sources and nuclear materials in Thailand.

1.2. Organization

The OAEP, apart from being the Secretariat, was also entrusted by the Thai AEC to conduct major research and development on nuclear science and technology using nuclear research reactor and Co-60 large radiation source, and empowered by the Thai AEC to regulate safe uses of radioactive materials and nuclear materials. The Thai AEC also empowered a Sub-committee on Medical Applications (SMA) to regulate safe uses of radiation sources from X-ray machines having the Department of Medical Sciences (DMSc) to perform technical evaluations and recommendation on applications for licensing of X-ray machines. In addition, on other applications of atomic energy, the Thai AEC designated number of sub-committees to perform the required tasks. Apart from uses of radiation sources at the OAEP, there had been users of radiation sources nationwide for healthcare, industrial production, agricultural research and product development, and education.

1.3. Regulatory Authority

By delegation of the Thai AEC, there were two regulatory authorities for radiation safety in Thailand. They were the OAEP and the SMA through technical support of the DMSc, and they enforced the regulation with different procedures, i.e. the OAEP entrusted by the Thai AEC to perform notification, inspection and enforcement including issue licenses, signed by the Secretary General, to users, while the DMSc entrusted by the Sub-committee to perform similar tasks for issuing licenses to be signed by the Chairman of the SMA. Furthermore, both organizations were designated to perform two main functions within the same management, i.e. the regulatory function and the research and development function. Therefore, licensing performance and enforcement of the regulation was not effective, accountable and transparent. Major restructuring would be required to establish an effective regulatory authority.

1.4. Regulatory requirements

Since 1961, utilization of radioactive sources has been continuously increasing until now. The major sources have been a neutron source from a 2-MW Thai Research Reactor (TRR-1); Co-60 and Cs-137 for irradiation, Co-60 and Ir-192 for radiography, X-ray machines for diagnostic radiology and industrial radiography, linear accelerators for radiotherapy and basic research, and a synchrotron accelerator facility for basic research. The rest are low and medium activity sealed sources for research, specific clinical treatment applications, industrial process control and inspection; and open radiation sources in nuclear medicine and academic research. In addition, there are a research reactor facility and a central radioactive waste storage and processing facility to be regulated. Table I are the account of facility and radiation sources to be regulated for radiation safety in Thailand.

Table I. Account of facilities and radiation sources to be regulated in Thailand.

Applications	No. of Facilities	No. Radiation Sources	
		Machines	Materials
1. Research Reactor	1		1
2. Radioisotope Production	1		various
3. Central RWSP	1		various
4. Medical Applications			
- Diagnostic Radiology	2,235		
• X-ray		3,875	
• Computed Tomography		261	
• Mammography		100	
• Dental X-rays		1,678	
- Radiotherapy	25		(Co-60) 25
			(Cs/Ir) 18
- Others			97
5. Industrial Applications			
- Irradiation	4	1 unit	4 units
- Radiography	11	438	123 units
- Others			219
6. Research Applications			
- Radioactive sources	3		3 units
- Neutron generator	1	1 unit	
- Accelerator	1	1 unit	
- Synchrotron	1	1 unit	

7. Others - Laboratories and lightening arrestors	327 units

1.5. The radiological accident

The radiological accident in February 2000 led to number of swift actions by the then Ministry of Science, Technology and Environment (MOSTE). A Ministerial committee was set up to review the effectiveness of the Act and the management of regulatory authority (OAEP). The committee decided to review, revise and draft two new Ministerial Regulations, which are to be in force in August 2003. They are Ministerial Regulation on Licensing of Radiation Sources and Nuclear Materials, and Ministerial Regulation on Radioactive Waste Management.

In addition, the International Atomic Energy Agency (IAEA) was requested, under the *Convention on Assistance in the case of a Nuclear or Radiological Emergency* [2], to provide experts for taking account of and advising lessons to be learned from the accident. An IAEA's published a booklet on the experts' accounts of the accident and distributed to its Member States. Among the others, an important lesson to be learned from the accident for the national authority would be [4]:

"National authorities need to review their legislative and regulatory systems and, where necessary, make modifications to these systems in order to achieve compliance with the BSS. . . ."

It was noted that the above lesson to be learned was not new to the national authority as the IAEA often reminded, through its past interactions, the authority of the same advice.

2. Re-structuring Mandates

2.1. Government policy

Prior to the present government, apart from the Ministerial directive on revision of the MR No. 2, there was not any substantial policy indication to seriously take up the above advice from the IAEA due to lacking of political commitment to proceed and lacking of resources commitment to initiate. Upon the high level directive from the present government to re-structure overall structure of the government bureaucratic system in 2001, the OAEP was to be restructured into two entities with the following objectives:

— To improve effectiveness of policy- making coordination;
— To improve management of nuclear and radiation safety, and security of nuclear material; and
— To improve better impact of nuclear technology research and development.

The OAEP was to remain a government bureaucratic agency and be re-structured to implement policy co-ordination and regulatory authority role and would be renamed as Office of Atoms for Peace (OAP). A new Public Agency was to be established to manage research and development of nuclear science and technology and its provisional name would be Thai Institute for Nuclear Technology (TINT). Both entities were to be independently functional by October 2002.

2.2. Upgrading of radiation protection infrastructure

To establish an effective and independent regulatory authority management was the central criterion for the re-structuring. The mandates fit well with the ongoing participation of Thailand to the IAEA's Model Project on Upgrading of Radiation Protection Infrastructure (RAS/9/026 and RAS/9/027) [4] since 200. The BSS 115 [5] was used as the main reference to establishing operational content of a new regulatory authority, to ensure their alignment with the internationally accepted practices.

2.2.1. *The model project*

A national work plan was established under the implementation plan of the Model Project. Development to meeting requirement of the Milestone 1 was the priority. Joint discussion between the IAEA project manager and the local specialist through out the fiscal year 2001 and 2002 was focused and productive. Key elements of the national radiation protection infrastructure were identified and their management structures were decided, which led to a decision to establish a single regulatory authority at the OAP. Furthermore, it was recognized that, to be more effective, the basic atomic energy legislation would have to be revised, and subsequent revision and upgrading of safety regulations would have to be accordingly established.

Hence, the role of the Model Project to the re-structuring has been substantially for Thailand. Its contribution continues.

2.2.2. *Establishing independent Regulatory Authority*

OAP, being legal equivalent entity to the OAEP, was established as the single regulatory authority by the Act. Toward a single and independent regulatory authority, the major components of the required national infrastructure were identified, and their operation units were decided as shown, comparatively to the previous structure, in Table II.

Table II. Radiation Protection Infrastructure

Major Components	Previous Organization	Present Organization
Legislation and regulation		
- Law	The Act 1961	The Act 1961
- Regulations	MR 2	MR on RM Licensing MR on RWM
Regulatory Authority	OAEP and DMSc	OAP
Facilities and Technical services		
- Central RW Storage	OAEP	TINT
- SSDL	OAEP	OAP
- Dosimetry	OAEP and DMSc	DMSc and TINT
- Environmental Monitoring	OAEP	OAP
- Internal Dose Measurement	OAEP	OAP
Resources for Intervention	OAEP	OAP and TINT
Education, Training, and Information Exchange	OAEP	OAP
Public Information	None	OAP

3. Current Status

As the re-structuring mandates were adjusted toward the deadline, the separate management of the OAP and to-be TINT were not materialized as the required legislation to establish TINT would require more time to be enacted.

Therefore, OAP and to-be TINT are under the same management of the OAP. The to-be TINT's activities are grouped as number of programmes. The present structure of OAP is the following:

Present Structure of the Office of Atoms for Peace (OAP)	
Government Agency (OAP)	**To-be Public Agency (TINT)**
- Office of General Secretary - Bureau of Atomic Energy Administration - Bureau of Radiation Safety Regulation - Bureau of Nuclear Safety Regulation - Bureau of Technical Support for Safety Regulation	- Radioactive Waste Management Programme - Radioisotope Production Programme - Research Reactor and Nuclear Technology Operation Programme - Radiation and Nuclear Safety Programme - Irradiation for Agriculture Research Programme - Chemistry and Material Science Research Programme - Physics and Advance Technology Research Programme

4. Conclusion

The present government has committed to re-structuring the overall government bureaucratic system for more effective and efficient organization toward public service. The re-structuring development of the OAP to be an effective single and independent regulatory authority will continue. Each major element of the national infrastructure will be upgraded and strengthened. Hence, the Model Project has been essential support for the re-structuring and will continue to be essential for the remaining tasks to establish an effective and efficient radiation protection infrastructure in Thailand.

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Report on the Implementation of the IAEA Model Project RER/9/062 "National Regulatory Control and Occupational Radiation Protection Programms" and Model Project RER/9/065 "Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure" in Slovenia

M. Križman[a], H. Janžekovič[a], D. Škrk[b]

[a]Ministry of Environment, Spatial Planning and Energy
Slovenian Nuclear Safety Administration
Ljubljana, Slovenia

[b]Ministry of Health
Slovenian Radiation Protection Administration
Ljubljana, Slovenia

Abstract. Slovenia took part in the IAEA Model Project RER/9/062 "National Regulatory Control and Occupational Radiation Protection Programmes" and Model Project RER/9/065 "Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure" in the period of modernization of legal framework for radiation protection and safety infrastructure. The basic data regarding the radiation protection needs in the country are given as well as the impact of the participation of Slovenia in those projects.

1. Introduction

The implementation of Model projects RER/9/062 and RER/9/065 in Slovenia has been co-ordinated by the Slovenian Nuclear Safety Administration (SNSA), the responsible national body for international co-operation in the field of nuclear and radiation safety. The staff of two regulatory bodies have been mostly involved in the implementation, the SNSA from the Ministry of the Environment, Spatial Planning and Energy and the Slovenian Radiation Protection Administration from the Ministry of Health namely. The approved technical support organizations (Institute for Occupational Safety and Jožef Stefan Institute) have been also involved in the project.

The implementation of both projects in Slovenia means a great advantage and an aid in establishing the new regulatory structure, in creating new legislation and in introducing the latest radiation protection issues into practice. The *Act on Protection against Ionizing Radiation and Nuclear Safety* (2002 Act) came into force on October 2002 and was created according to the EU basic safety standards regarding radiation protection and also to IBSS, IAEA SS No.115 (1996). Till 2004 new regulations on radiation protection will replace the existing ones which are still based on the 25 years old ICRP recommendations (ICRP 26, 1977).

The general problem which is encountered in small countries like Slovenia is a great lack of competent and knowledgeable people performing their duties and introducing new tasks of a regulatory body; and teams do not achieve "the critical mass". Furthermore, providing the necessary funds is always an open issue.

2. Legislative framework and other regulatory infrastructure

2.1. Legislation on radiation protection

The new Act on *Protection against Ionizing radiation and Nuclear Safety* came into force on October 2002 and covers the following items: radiation protection of workers, patients and the public, nuclear safety, non-proliferation, safeguards of nuclear material, physical protection of nuclear substances and nuclear facilities, emergency (intervention), radioactive waste management and inspection. The 2002 Act replaced two acts from the years 1980 and 1984 respectively. It established a comprehensive system of protection against ionizing radiation and nuclear safety. Besides the fundamental law, the 2002 Act, other laws also partly regulate some specific issues regarding radiation protection, for example the *Act on Carriage of Dangerous Goods* from 1999, the *Decree on Export and Import Regime of Specific Goods* from 2001.

As the inputs to the new 2002 Act the following literature was used: the existing legislation, conventions, treaties and agreements that bind Slovenia, fundamentals (Safety Series of the IAEA), EU legislation within *Acquis Communitaire* from the *Euratom Treaty*, recommendations of different missions which took place in Slovenia in recent years (IRRT, ORPAS etc.) and also similar legislation from other countries. In this respect the participation of the regulatory staff in the RER/9/062 was valuable in order to recognize the deficiencies of legislation. The basic changes in updating the licensing processes are:

- inclusion of the notification in the process of licensing;
- well defined licensing process which comprises safety assessment plan including normal and potential exposure;
- date of expiry.

In the past, notification as a separate process, as it is defined in BSS, was not specified in the previous legislation at all. Notification was an inherent part of the licensing process: all sources with activities and specific activities above the exemption levels set in regulations should be licensed. The license was issued if the requirements set by the 1984 Act were fulfilled. The notification was required only in case of transport: transporters had to notify individual transports regarding the conditions in their licenses at least 48 hours in advance. According to the new 2002 Act every intention to purchase a source and engage in a radiation or nuclear practice must be notified to the competent authority in advance. After checking the ability of an applicant to use a source safely, the authority issues the appropriate license.

The updated licensing process includes also emergency plans for case of an accident and appropriate storage. In case of nuclear facilities the procedure is very strict and a number of safety conditions must be fulfilled before issuing the appropriate license or the approval. The licensing system for nuclear facilities consists of four licensing steps: site license, construction license, commissioning license, start of operation and licensing of modifications of nuclear installations.

The 2002 Act establishes a comprehensive system related to radiation protection. It defines also:

- the role of qualified experts of protection against radiation which will be approved by the Ministry of Health;

- the role of the approved experts of radiation and nuclear safety which will be approved by the Ministry of the Environment, Spatial Planning and Energy;

- a new system of qualification of radiation protection officers including an exam prescribed by the Ministry of Health and the Ministry of the Environment, Spatial Planning and Energy in agreement with the minister responsible for education;

— a new system for establishing the content and conditions for training of workers by the Ministry of Health in agreement with the Ministry of the Environment, Spatial Planning and Energy.

According to the 2002 Act the service providers for dosimetry, and for medical surveillance will be authorized, in compliance with the prescribed criteria, by the Minister of Health. The authorization period will be limited at the maximum of five years.

The 2002 Act prescribes a large number of new regulations, almost thirty regulations shall be elaborated and approved in the period of the next 1.5-2 years. A two - level system of regulations is established: the ordinance is prescribed by the Government and the regulations by the competent ministries. At present (February 2003), governmental ordinance on licensing of practices and radiation sources are in drafting process, and on dose limits and intervention as well.

2.2. Regulatory authorities

Two national competent authorities responsible for governmental administration and supervision in the field of radiation protection, are empowered to issue licenses and for carrying out inspection. These are the SNSA of the Ministry of the Environment, Spatial Planing and Energy and the SRPA of the Ministry of Health. The SNSA acts as the national regulatory authority for nuclear safety and radiation safety. The SNSA is competent in the area of radiation protection related to industry, research and education as well as for authorization of commissioning, operation and decommissioning of nuclear installations. The SRPA has its competence for practices and radiation sources in medicine and veterinary medicine. Besides this it also covers radiation protection issues regarding health of patients, workers and the public.

The SNSA has 45 employees (March 2003) including 8 inspectors, three of them are assigned for the field of radiation protection. The SRPA has 3 employees in the field of radiation protection (March 2003).

The inventory of radiation sources which should be regulated by the SNSA and the SRPA includes heterogeneous sources. The largest radiation sources in Slovenia are the Krško nuclear power plant with electrical output 700 MW which has been operating commercially since 1983, the nuclear research reactor TRIGA Mark II with the power 250kW operating since 1966 and radiotherapy sources at the Institute of Oncology where three linear accelerators, two Co-60 therapy units and isotopes Cs-137, Ir-192, Sr-90/Y-90 are used.

Other radiation sources are also widely used in medicine, where besides unsealed sources mainly used for diagnostics nearly 700 X-ray devices are also used. Approximately 600 sources with radioactive isotopes are registered in industry (mainly radiographic sources, moisture and density gauges, level gauges, thickness and density gauges etc.), 40 % of them are disused. Nearly 100 X-ray devices are used in industry. Besides the above - mentioned sources, X-ray devices and radioactive isotopes are also used in research and education. One research accelerator of Tandetron type with the maximum voltage of 2 MV is in operation at the Jožef Stefan Institute (JSI).

The public service for radioactive waste management is given to the Agency for Radwaste Management (ARAO). The ARAO agency is also the operator of the Interim Central Storage for Radioactive Waste at Brinje (near Ljubljana). The storage is a near ground surface storage and has been in operation since 1986. All disused or obsolete sealed sources are safely stored there, mostly from medicine and industry, including orphan sources.

In Slovenia, the main producer of radioactive waste is the Krško NPP. The spent fuel is stored in a pool on the site. Low and intermediate waste (LILW), produced by the Krško NPP are also stored at the site.

At the Žirovski vrh Uranium Mine relatively low grade ore (less than 0.1% U_3O_8) was excavated and treated from 1985 to 1990. Today two types of radioactive waste are present at the site. Chemical tailings of 610 000 tonnes were deposited on a dry disposal site and the mine radioactive waste rocks of 1.5 million tonnes (70g/tonne U_3O_8) were deposited at a separate disposal site. The decommission and remediation is going to be finished in 2005.

The participation of the SNSA and the SRPA in the project RER/9/062 clearly showed the lack of the regulatory staff regarding the inventory of radiation sources in Slovenia and the necessity related to the preparation of the new legislation. In 2002, the number of inspectors at the SNSA increased while at the SRPA the number of inspectors is going to increase to about 10 in next years.

2.3. Qualified experts and service providers

According to the 1980 Act technical and medical support organizations were authorized by the decision of the Ministry of Health. Two technical support organizations were authorized in 1981 to perform specific tasks within the scope of radiation protection in Slovenia, the JSI and the Institute of Occupational Safety (IOS). Additionally five medical support organizations were authorized.

The 2002 Act defines qualified experts, as well as approved dosimetry and health services.

A qualified expert of protection against radiation is approved by the competent ministry and has the required knowledge to carry out the physical, technical and radiological-chemical tests necessary for the assessment of doses, to give advice related to the protection measures against ionizing radiation.

Three approved dosimetry services perform regular monitoring of the occupational exposure: JSI, IOS and the Krško NPP. At workplaces, where the internal exposure of workers may occur, intakes of radionuclides and corresponding doses are estimated and evaluated. At present, monitoring of internal contamination is regularly performed at the Krško NPP and occasionally at the Nuclear Medicine Centre at the University Medical Centre Ljubljana. The systems have not been approved yet by the Ministry of Health as required. The Žirovski vrh Uranium Mine performs only measurements and dose assessment related to radon and radon progeny. The lack of data flow chart regarding occupational exposure was evident. The Computerized Dose Registers were established at the SNSA and SRPA in 1999.

The participation in the RER/9/062 and RER/9/065 enables the staff of previous technical service providers to come in contact with the state of the art regarding the intake of radionuclide, external radiation, public exposure, in problems regarding industrial radiography, diagnostic radiography, radiotherapy, radiological emergency etc.

3. Conclusions

The participants from all structures - regulatory bodies, technical support organizations (qualified experts and service provider), and users - were involved in the projects. Regarding out-of-date legislation which was replaced during the course of the projects the participation of Slovenia is reflected in the new legislation as well as in the application of radiation protection standards at technical support organization and users of radiation sources.

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Experiences in the Implementation of Model Projects RER/9/062 and RER/9/065

M. Lalić, J. Ducica

Public Health Institute, Radiation Protection Department
Banja Luka, Republika Srpska (BiH)

Abstract. The study shows the scope and manner of improvement in the area of National Radiation Safety Infrastructure in Republic of Srpska during the implementation process of model projects RER/9/062 and RER/9/065.Difficulties that have great impact on final outcomes in projects implementation have been described. Recommendations have been provided for improvement of the current situation in this very important area. Agency experts have shown sincere willingness and great professionalism assist us in achieving our goals.

1. Introduction

Republika Srpska is one of the entities of Bosnia and Herzegovina that was created after the civil war, by the Dayton Peace Accord in 1995. It represents a relatively small community with approximately 1.5 million inhabitants. It belongs to a class of economically poorly developed countries, a country in transition with a high unemployment rate and undeveloped economy. As many countries, members of former SFRY, after SFRY's collapse, it introduced all the institutions that characterize the statehood of a country. So, efforts are being undertaken in order to achieve satisfying level in the area of protection from ionising radiation, application of ionising radiation, and safety of radiation sources. This issue was neglected until 2001. although Republika Srpska, as a part of Bosnia and Herzegovina became a member of IAEA in the year 1995. This situation can be ascribed to economical difficulties, slow post-war consolidation, as well as to unawareness of the importance of this subject. Even today, Republika Srpska, just like some other countries of former SFRY, is using regulations of the former state regarding ionising radiation.

2. Law and Regulatory Authority

After the visit of representatives of IAEA to Republika Srpska, in the beginning of the year 2001, the cooperation with this institution begun. The same year, in April, a national training course on Regulatory Control of Radiation Sources was held in Banja Luka. At the end of September and beginning of October of 2001 a basic course in protection from ionising radiation and dosimetry were held in Vinča – Belgrade for five candidates from Republika Srpska. On 17th of October 2001 the government verified the law on ionising radiation and on sources of radiation, under the name: ***'Law on Radiation Protection and Radiation Safety'***. This law is the umbrella legal act that defines all the categories connected to ionising radiation. It was made in accordance with **Basic Safety Standards (BSS)** and other IAEA documents. Based on the demands of the law, a regulatory body (Regulatory Authority) was formed as a part of the Ministry of Health and Social Welfare of Republika Srpska. The Authority was established by a decree of this Ministry in the mid of 2002. It has two members. One of them is, at the same time, the director of the Authority and an inspector for industrial radiography. Under provisions of the law, a department for ionising radiation protection was formed. This department has a role of a service for regulatory authority.

Regulations that define the law provisions more closely are still being prepared and they will be supplied to IAEA for the evaluation and then announced by the Ministry of Health and Social Welfare of Republika Srpska.

The following laws have also been promulgated in Republika Srpska: Law on Health Care and Environment Law. Dangerous Chemicals Transport Law is currently under review (in parliamentary procedure), and it includes provisions regarding transport of dangerous radioactive materials.

3. System of Notification, Authorization, Inspection and Enforcement

In accordance with IAEA recommendations and stipulations of the law on radiation protection and radiation safety, an inventory of ionising radiation sources in Republika Srpska has been created. To this date, not all the sources on the territory of Republika Srpska have been entered into this database, but new entries are being added constantly (table 1). The registry of sources contains the following data: serial number of the source, type and number of the device in which the source is used, source, radiation type, production date, initial activity and user. The software for this database was written in the department for protection from ionising radiation. It must be emphasized, that a large number of used sources is in a very poor condition. Many mines and factories simply do not have adequate facilities for temporary storage. Many sources have corroded, and are placed on corroded steel constructions or pipes although the factories or mines have been out of operation for ten years. These sources are relatively easily accessible by unauthorized persons. Lightning rods with still strong sources Eu-152/154 and Co-60 pose a significant risk. There are about two hundred and sixteen such sources on different buildings in Republika Srpska. There is a large number (12000) of radioactive smoke detectors with Am-241 isotope. There is also a number of radioactive sources formerly or still used by the army, which are not accessible to civilian services.

There are sixty institutions in Republika Srpska that use diagnostic radiology with about two hundred and fifty x-ray devices. Sixty seven of those are dental x-ray machines, nine computer tomography scanners and six mammography machines. There is an important fact, which public and media are aware of, and that is the presence of depleted Uranium which got here during the NATO military campaign in the last war. Serious questions arise concerning this issue: How to decontaminate locations that have been hit?, How to store extracted and collected rounds with depleted Uranium? Due to this pressure from the media, a team from UNEP lead by Mr. Pekka Haavisto was here in September last year, to take samples for Uranium analysis. It is estimated that around 10000 depleted Uranium rounds were fired.

There is no radio-therapy, brachy-therapy and treatments with large doses of radio-pharmaceuticals. For the next cycle of technical cooperation in 2003 – 2004 a project: ***'Establishment of a Centre of Radiotherapy at Banja Luka (BOH/6/006)'*** was approved by the board of governors. In the clinical-hospital centre, at the department for nuclear medicine, I-131 and Tc-99m are being used only for diagnostic purposes. Another project has been approved for nuclear medicine in the next cycle: ***'Rehabilitation of Radio Nuclide Therapy (BOH/6/005)'***. Both projects are of great significance for our country, as there is a large number of patients (around one thousand) that require this type of treatment.

4. Occupational Exposure Control

There is a large number of individuals in the country, that require radiation exposure monitoring. Around four hundred people work in radiological diagnostics and in nuclear medicine and around seventy in industrial radiography. Exposure monitoring of these people is accomplished through use of TLD personal dosimeters. However, this control is highly irregular because these dosimeters have to be sent abroad for reading. The department for radiation protection is trying hard to acquire adequate reader so that this type of control could be performed here. There is no possibility of internal contamination control in Republika Srpska, because we do not have a device for that.

5. Medical Exposure Control

Regular annual control in radiological diagnostics is performed on all x-ray machines, mammographs, dental x-ray machines, CT scanners as well as on industrial x-ray machines and gamma devices. In it, the operation quality parameters are controlled, using equipment donated by IAEA as a part of technical cooperation. In the nuclear medicine department, where Tc-99 m and I-131 are used, gamma camera and gamma counter are being used. Equipment is calibrated with a dose calibrator in appropriate time intervals. They were also donated by IAEA as a part of technical cooperation.

6. Public Exposure Control

There is only one gamma station for monitoring air radio activity in Republika Srpska. This station is located in the vicinity of Banja Luka and it is being controlled by Meteorology Institute of Republika Srpska. Radioactive aerosols are not being monitored and there is no environment monitoring either. There is no monitoring of food, water, raw materials, soil. These analysis require expensive equipment, which we do not have, and also highly trained personnel which hasn't been trained yet. We are hoping that these controls will take place after the implementation of the project: ***'Monitoring of Radioactivity in the Environment (BOH/2/002)'***, which has also been confirmed for the next cycle of cooperation.

7. Radioactive Waste Safety

Republika Srpska does not have generators of radioactive waste, excluding used radioactive sources, previously used for different purposes. A small quantity of I-131 and I-125 are being released into the environment without being previously stored until complete deactivation. There are no nuclear reactors in the entity, there are no nuclear power plants, nuclear institutes or laboratories that would extensively use radioactive nuclides. Existing used sources are inadequately stored in facilities where they were used. However, these provisional stores are inadequate, usually non-maintained, wet and insufficiently supervised premises. Only nuclides for measuring levels, flow, density, thickness etc. are kept in such sites. On 8th of October Republika Srpska government made a decision regarding a location for future permanent radioactive waste disposal site. This location is in Kopači, near Goražde, in an underground military base Soča. Sadly, many local organizations have protested in the meantime, demanding that this decision be withdrawn, due to concern that this facility would jeopardize the environment.

8. Emergency Preparedness and Response

Republika Srpska does not have generators of radioactive waste, excluding used radioactive sources, previously used for different purposes. A small quantity of I-131 and I-125 are being released into the environment without being previously stored until complete deactivation. There are no nuclear reactors in the entity, there are no nuclear power plants, nuclear institutes or laboratories that would extensively use radioactive nuclides. Existing used sources are inadequately stored in facilities where they were used. However, these provisional stores are inadequate, usually non-maintained, wet and insufficiently supervised premises. Only nuclides for measuring levels, flow, density, thickness etc. are kept in such sites. On 8th of October Republika Srpska government made a decision regarding a location for future permanent radioactive waste disposal site. This location is in Kopači, near Goražde, in an underground military base Soča. Sadly, many local organizations have protested in the meantime, demanding that this decision be withdrawn, due to concern that this facility would jeopardize the environment.

9. Emergency Preparedness and Response

We do not have a laboratory with calibration standards for neither personal dosimeters nor other equipment for monitoring and measuring quality parameters of x-ray machines. Quality control equipment is calibrated in other countries, and so are personal dosimeters. There is a military equipment factory in Banja Luka with calibration laboratory with three Co-60 sources. However, this factory has been out of operation for several years, and radioactivity of the existing sources has considerably decreased. Should this laboratory be reactivated, it would be necessary to provide new Co-60 sources. This idea was presented to representatives of IAEA that visited Republika Srpska last year. We also do not have any radio analytic laboratories for analysis of radio nuclides in water and food.

10. Metrology, Standardization and Calibration

We do not have a laboratory with calibration standards for neither personal dosimeters nor other equipment for monitoring and measuring quality parameters of x-ray machines. Quality control equipment is calibrated in other countries, and so are personal dosimeters. There is a military equipment factory in Banja Luka with calibration laboratory with three Co-60 sources. However, this factory has been out of operation for several years, and radioactivity of the existing sources has considerably decreased. Should this laboratory be reactivated, it would be necessary to provide new Co-60 sources. This idea was presented to representatives of IAEA that visited Republika Srpska last year. We also do not have any radio analytic laboratories for analysis of radio nuclides in water and food.

11. Expertise and Training

During past two years, our entity has been visited by more experts from IAEA. The visits were started by Mr. Vladimir Tsyplenkov in February of 2001. In his report, he gave an approximate picture of the state of the ionising radiation infrastructure in Republika Srpska. The visits by Mr. Jozef Sabol and Mr. Dmitrij Miklush followed, and they encouraged our Government regarding future aspects of cooperation with IAEA. Further to that, Mr. Sabol, gave us, on several occasions, strong support regarding devising legislation, organising national training course: ***'Regulatory Control of Radiation Sources'***, and a series of educations (around thirty) in the area of nuclear medicine, radiology, protection etc. Then, Mr. Jan Stuller, during his visits, and Mr. Cecil Victor Levin, with his visit, contributed to better understanding of needs for writing and realising projects concerning radiotherapy, environment monitoring, radio-pharmaceutical treatment, and monitoring of border crossings for illicit trafficking of radioactive materials. We expect, in the following period, more visits by experts, related to our projects. We also expect, in the next cycle of technical cooperation, a greater number of training courses and educations. So far, these training courses and educations have shown that our experts have improved their knowledge and skills within their specialties. The language barrier is a difficulty for many young people, so they do not apply for courses and educations in a larger number.

12. Conclusions

[1] We believe that we have not done much regarding the ionising radiation infrastructure here, but we are content that we have started these activities.

[2] Technical assistance, as well as aid in instruments and education has been considerable.

[3] A law on ionising radiation has been created, and regulations are to follow soon.

[4] We are expecting implementation of the projects in the following cycle.

Table I. Inventory of sources in industry in Republika Srpska

No:	Town	Institution	Address	Source	Quantity	Activity	Date supplying
1.	Banja Luka	Rudi Cajevac-MDU	Jovana Ducica 23a	Co-60	1	20 TBq	7.7.1986
				Co-60	1	111 GBq	7.7.1986
				Co-60	1	1,3 GBq	7.7.1986
				Eu-152	1	14,1 GBq	12.5.1987
				Sr-90	6	1,85 GBq	1968
				Sr-90	6	1,85GBq+7,4MBq	1968
				Pm-147	6	37 KBq	Unknown
				Sr-90	167	0,222 GBq	Unknown
				Sr-90	170	0,222 GBq	19.02.1983
				Co-60	1	Unknown	Unknown
				Co-60	1	50 GBq	Unknown
		Jelsingrad	Brace Podgornik 8	Ir-192	2	Unknown	Unknown
				Co-60	1	37 GBq	1973
		IIM	Jasenovackih log 41	Ir-192	1	1480 GBq	Unknown
		UNIS-Ramici	Ramici bb	Am-241	1	3,7 GBq	Unknown
		Factory of tobacco	Kralja Petra 82	Sr-90	2	925 MBq	1982
				Sr-90	2	925 MBq	29.3.2001
		Zavod zast. zdrav.	Jovana Ducica 1	Ni-63	1	370 MBq	1988
		Poljep. Inst.	Knjaza Milosa 19	Ni-63	1	370 MBq	Unknown
		Tehn. fakultet	Bulevar V. Stepe 3	Ni-63	1	370 MBq	Unknown
2.	Srpski Brod	Rafinerija nafte	Svetog Save bb	Ir-192	1	1740 GBq	Unknown
				Cs-137	1	1500 GBq	2000
				Co-60	1	0.3 GBq	2000
3.	Teslic	Tvor.komp. opreme	Zarkovo polje bb	Ir-192	1	1480 GBq	Unknown
4.	Bjeljina	Tvor. Secera	Velika obarska bb	Ir-192	1	Unknown	1980
5.	Bileca	Bilecanka	Peka Pavlovic bb	Am-241	1	Unknown	1982
6.	Srbinje	Maglic	Brod na Drini	Sr-90	1	Unknown	Unknown
7.	Prijedor	Rudnic Ljubija	Jovana Raskovica	Co-60	1	Unknown	1972
		Rudnic Omarska	Jovana Raskovica	Cs-137	1	6,35 TBq	1.06.1982
		Rudnic Omarska	Jovana Raskovica	Cs-137	36	Unknown	Unknown
8.	Milici	Rudnic Boksita	Lukic polje	Neutron.	2	Unknown	Unknown

Actual Situation in Radiation Safety and Radiation Protection in the Republic of Moldova

I. Bahnarel

The Ministry of Health of the Republic of Moldova
Chisinau, Moldova

Abstract. Today in the Republic of Moldova is in storage and exploitation about 6665 ionizing irradiation sources of 142 enterprises, organization and institutions, on the base of which are situated more than 370 nuclear facilities (laboratories, departments, divisions). In the field of Control of public exposure (external exposure, radioactive contamination, discharge of radioactive wastes in the environment and radioactivity in foodstuffs, water, soil, construction materials etc.) – was adopted a national programme for public exposure control. The criteria for the organisation and supervision of public exposure from natural radioactive sources was published, No 06-5.3.35, from Mart 05, 2001. The equivalent effective dose from medical examination was established and the hygienic monitoring was introduced for risk control associated with the radiation sources. The individual dosimetry is carried out centralised on the base of the National Centre for Scientific and Applied Preventive Medicine of the Ministry of Health using the thermoluminescent dosimeters DTG–04 and Harshaw-6600. The scientific investigations revealed increased chromosome mutagenesis in somatic cells in Chernobyl accident consequences clean-up participants and their children, and that gave reasons to classify them among those with the increased risk of probability of the so-called pathology with genetic component.

1. Introduction

Use of ionizing radiation in medicine, industry, agriculture, hydrogeology etc. continues to increase rapidly throughout the world. In some cases the special advantage over other techniques and methods has been clearly demonstrated. In its preamble, the International Basic Safety Standards for Protection against Ionizing radiation and for the Safety of radiation Sources (BSS) /1/ stresses the fact that the acceptance by society of risks associated with radiation is conditional on the benefits to be gained from uses made of radiation.

2. Characteristics of the situation regarding regulatory control of radiation sources in the Republic of Moldova

Radiation situation in the Republic of Moldova during the 2001-2002 years was stabile. The value of the gamma-fond radioactive varied between 8-14 μR/h.

Cases of radioactive contamination of food, drinking water, construction material, medicinal plants, biological probes and other environment probes were not founded.

One local incident of metal product contamination and used filters in the technological process with radionuclide ^{137}Cs was found out. Cases of over irradiation of personnel were not established. The Public Body specialists of regulatory in the radiation protection and nuclear security fields established that the incident took place because of melting of one identified cask with ^{137}Cs, which was transported from other country. The incident was liquidated. The technologic system of the works was decontaminated. The solid radioactive wastes (cinders, slag and contaminated metal) were deposited and storage separated on the works territory in accordance with actual technical and hygienic norms

(SPORO-85 «Санитарные правила обращения с радиоактивными отходами», Moscow, 1985 and Safety guides / 2, 3, 4/ .

The IAEA experts have evaluated the radiation protection situation in the Republic of Moldova and physic protection state of high capacity radioactive sources. 142 organization and institutions, inclusive private organization, which have irradiation ionizing sources have been registered in accordance with the National Register of the Department of Standards and Metrology and National Scientific and Applied Center of Preventive Medicine of the Ministry of Health. 130 organization belong to the Ministry of Health, 12 organization belong to the Academy of Sciences, the Minister of Agricultural and Processing Industry, and the Ministry of Industry. Dosimeter individual monitoring of 1395 persons of A category was effectuated under the strict control.

3. Description of the Law, Regulations, Regulatory Authority and Licensing/inspection system as well as inventory of radiation sources

The "Law on Radiation Protection and nuclear Safety" of the Republic of Moldova», no. 1440-XIII was adopted on December 22, 1997 by the Parliament of Republic of Moldova containing provision for radioactive waste management. The Law delimits the Body Public functions in the field of Radiation Protection and nuclear safety, describes the authority and regulatory control of irradiation ionizing sources.

The Law of the Republic of Moldova "About licensees of some kind if activity", No.451-XY was adopted in July 30, 2001. On the base of this low the Ministry of Health shall authorize all activities of economic agents working with the radioactive sources and the measures of radiation protection.

The Government Resolution "About the Public Bodies in the field of radiation protection regulation and nuclear safety", No. 1225 from December 22, 1998 delimited the inventory and notification of radioactive sources, inspecting system and sanitary function authority.

4. Regulatory Body and Related Authorities

The Republic of Moldova Radiation Safety Regulatory Authorities are:

- Ministry of Health
- Department of Standards and Metrology
- Department of Emergency Situations
- Ministry of Ecology, Construction and Territorial Development

The National Committee of Radiation Protection of Moldova was founded in 1995 which elaborates recommendations in the field of radiation protection and nuclear safety and take the decision in the field of radiation protection and emergency situation. The committee has its work plan in the field of nuclear and radiological Objects control and physic protection of sources.

5. Cytogenetic consequences in children that were born in families of the participants in liquidation of the consequences after the accident at Chernobyl NPS

Of many problems that appeared after Chernobyl accident, the long-term effects of low dose irradiation are among the most important. Assessment of the remote consequences is always more complicated, but not less important, than assessment of the acute irradiation effects. The induced mutagenesis is one of the most remote consequences and is connected with increased frequency of hereditary diseases and diseases with hereditary predisposition. The problems of cancerogenisis conditioned by somatic mutations induced by radiation have direct relation to the present generation.

By the present time in the Republic of Moldova 23 participants in liquidation of the consequences of Chernobyl accident in 1986-1987, males, ages from 30 to 46, and 20 children that were born in families of those who participated in liquidation of the accident have been examined cytogenetically /5, 6/.

It was found that at the present time all the examined groups of people retained increased level of cytogenetic irradiation markers.

The obtained data revealed increased chromosome mutagenesis in somatic cells of the examined people, and that gave reasons to classify them among those with the increased risk of probability of the so-called pathology with genetic component. The results permitted organization of special groups for further cytogenetic control.

6. Control of the Professional Irradiation

The individual dosimetry is carried out centralised on the base of the national centre for scientific and applied preventive medicine of the ministry of health using the thermoluminescent dosimeters DGT–04 and harshaw-6600. At present the system of individual monitoring in the Republic of Moldova is carried out based on tl-dosemetry only for persons working in the field of SII (personnel).

All the forms of radiation supervision are implemented depending on the frequency of the recommended regulating comments of the state regulatory authorities.

The project “Individual monitoring Programme in the RM” is being completed in which the main directions of the development of individual dosimetric control problems and destined to:

— receive the necessary information to optimize the radiation protection;
— exclude the fact that the irradiation of the personnel doesn’t exceed the limits of doses or the supposed doses of irradiation.

The inclusion of personnel and institutions with dosimetric supervision per years is represented in the below table.

Table I. Inclusion of institutions and organizations with Individual Dosimetric Supervision per years

The year	Inclusion (people)	Number of organizations	Of them medical	The number of people that underwent IDS	Out which are medical
1988	305	57	44	305	
1989	1022	68	61	1022	953
1990	1609	101	84	376	364
1991	1721	117	98	1137	1087
1992	1734	122	103	958	919
1993	1762	127	105	1001	935
1994	1793	103	72	1125	1153
1995	1722	102	83	1262	1179
1996	1392	107	85	944	902
1997	1643	122	90	1052	977
1998	1666	125	92	1155	1039
1999	1231	118	85	963	872
2000	1250	148	122	1250	1200
2001	1280	124	125	1280	1205
2002	1395	142	130	1395	1325

7. Any achievements within the framework of the model project with respect to medical and population exposure control as well as emergency response – Medical exposure control

In this field the following measures have been done:

— Inventory and review of sources and practices (updated list of medical sources, updated list of practices (number of departments, number of radiologist, radiographers, technicians, etc).

— Licensing, inspection and enforcement (approval, printing and application of Fundamental radiation protection Norms (FRPN-2000) based on the BSS, specific regulations and procedures related to the evaluation of applications for licenses, specific regulations and procedures related to inspection and enforcement.

— Training – there were organised 4 National Training Courses in the field of Medical Exposure Control, took steps in achieving self-sustainability in training of medical personnel.

— Quality control – complete a comprehensive national programme addressing QC in medicine.

— Patient dose reduction in diagnostic radiology - compared patient doses in different hospitals, prepared guides for good practice, adopted national guidance levels for diagnostic and nuclear medicine examinations.

— Accidental medical exposure - reviewed the present situation, co-ordinated activities related to accidents and overexposures with other national agencies, implemented local procedures and rules in all medical facilities where accidents may lead to overexposure.

8. Public Exposure

In the field of public exposure control (external exposure, radioactive contamination, discharge of radioactive waste in the environment and radioactivity in foodstuff, water, soil, construction materials, etc) – was adopted a national programme for public exposure control. The criteria for the organisation and supervision of public exposure from natural radioactive sources was published, No 06-5.3.35, from Mart 05, 2001. The equivalent effective dose from medical examination was established and the hygienic monitoring was introduced for risk control associated with the radiation sources.

9. Conclusion

Several ministries deal with health and safety issues: the Ministry of Health, the Department of Standards and Metrology, the Department of Emergency Situations, and the Ministry of Ecology, Construction and Territorial Development. The Republic of Moldova now has active control of over 6000 radioactive sources. Studies of Chernobyl victims revealed increased chromosome mutagenesis in somatic cells.

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Present Status in the Implementation of Model Projects RER/9/062 and RER/9/065 in Bosnia and Herzegovina

M. Sirbubalo

Federal Ministry of Health
Federal Administration for Radiation Protection and Safety
Sarajevo, Bosnia and Herzegovina

Abstract. The paper provides some results achieved in the implementation of IAEA Model Projects RER/9/062 and RER/9/065, followed by some general comments on the present radiation protection and safety situation in Bosnia and Herzegovina. Results described in this paper are only for part of Bosnia and Herzegovina – Federation of Bosnia and Herzegovina. The main reason is current specific organization of radiation protection and safety in Bosnia and Herzegovina.

1. Introduction

Bosnia and Herzegovina is one of the countries of central Balcan region. Our neighbours are Croatia and Serbia and Montenegro. Bosnia and Herzegovina population is 4,3 milion (1991) and square of 52 280 km^2. Bosnia and Herzegovina as a state constists of: Two entities, Federation of Bosnia and Herzegovina and Republic of Srpska, and District Brčko (state district).

Unfortunately,Bosnia and Herzegovina has nothing established on national level, regarding to infrastructure of radiation protection and safety. Infrastructure of radiation protection on entities levels and is still being create.By the IAEA assistance, the process of establishing National Regulatory Authority is under way. There are activities in Ministry of Foreign Affairs for establishing National Regulatory Agency for Radiation Protection and Radiation Safety.

2. Implementation of Model Projects in Federation of Bosnia and Herzegovina

Institutions responsible for implementation RER/9/062 are:Ministry of Health of Federation Bosnia and Herzegovina (Federal Administration for Radiation Protection and Safety), including Institution for Public Health of Federation of Bosnia and Herzegovina, as institution autorized by Minister of Health for technical support.

2.1. Law and Regulatory Authority

The new Law on Radiation Protection and Radiation Safety (4), according to BSS (1), is promulgated in the Official Gazette of F B&H 30.April 1999 (No.15/99).The Law established Federal Administration for Radiation Protection and Safety, acting as Regulatory Authority.Federal Administration is not effectively independent, as a part of Ministry of Health ,and has not separate budget for work. Staff employed in Federal Administration are three-full time, one-half time.

2.2. Regulations

Development of regulations is based on the Law and IAEA TECDOC 1067 (2), are under way.
Promulgated:

- Regulation for exemption practices and sources from regulatory control, promulgated in Official Gazette of Federation of Bosnia and Herzegovina,No .13/02 (April 07.2002) (5).

In final draft:

- Regulation for system of notification and authorization of users radiation sources,
- Regulation for radiation protection of patient during medical exposure.

(waiting for change Law for Health Protection regarding to establish a new specialization in medical physics).

In draft:

- Regulation for health surveillance persons occupationally exposed to ionizing radiation,
- Regulation for occupational exposure and dose limits .

Number of specific regulations from former common state is still in force.

2.3. System for Notification, Authorization, Inspection and Enforcement

2.3.1. Inventory of radiation sources

Federal Administration for Radiation Protection and Radiation Safety is responsible for inventory of radiation sources (data enters manually).

(a) Radiotherapy:

- One teletherapy facility in Clinical Centre , Institute for Oncology, Sarajevo
- Three teletherapy units (1 linac and 2 telecobalt units)
- Two Co-60 sources activity 155 TBq and 188 TBq in 2000.
- Linear accelerator SL20: photon energies 6 MV and 18 MV, electron energies 4,6,8,10.12,15,18 and 20 MeV

Brachytherapy:

- total 71 GBq, Cs-137; 2 brachytherapy units (Selectron LDR/MDR and microSelectron LDR)
- 1 superficial radiotherapy X-ray unit (70 kV)
- 1 simulator

(b) Industrial radiography:

- Companies: four
- Type of sources: Ir-192 3 cps.; Se-75 1 pcs. Up to 3.7 TBq initial activity

(c) Diagnostic radiology:

- Number of hospitals: 12. Clinical centres 3
- Number of X-ray mashines : total 229, fixed 195, mobile 20

- Number of CT sceners: 14
- Number of dental X-ray mashines: about 200

(d) Nuclear medicine

- Number of departments: four
- Main radionuclides: Tc-99m and I-131.
- Application: diagnostic and therapy

(e) Industrial applications:

- Nuclear gauges :59

(f) Consumer products:

- radioactive lightning conductors (Eu 152,154): 287
- smoke detectors : Am-241 , total 7624

2.3.2. Notification

Legal person in responsible to notify practice or sources, by Law requirement.Questionnaire for notification of practices and sources is prepared according to IAEA TECDOC 1067.

2.3.3. Authorization

In a draft of Regulation for system of notification and authorization of users , there are list of justified practices with radiation sources. Federal Administration for Radiation Protection and Safety as Regulatory authority, should issue autorizations by registration and licence. Further use a radioactive lightening conductors is forbidden.

2.3.4. Inspection

There is only one inspector responsible for radiation protection and radiation safety. (B.S.Physicist) , employed. Number of inspections performed: 129.Inspector issue permits for transport of radioactive materials on the territory of the Federation of Bosnia and Herzegovina after evaluation of the conditions of the consignor, user and carrier.Total 111 permits are issued , till now.

By the IAEA assistance with equipment, inspector is able to make independent measurements of the radiation levels and contamination, now.

2.3.5. Enforcement

In the Law on the Radiation Protection and Radiation Safety there are stipulated sanctions expressed in three levels for the cases for unauthorized operating with radioactive waste and radiation sources in regard with the life and health protection, as well as environment protection.

2.4. Occupational Exposure Control

General requirements: in a drafts of regulation, there are requirements for classification of areas, local rules and personal protective equipment, according to RS-G-1.1. (3)

Individual monitoring: TLD Harshaw 4500, TLD-100, Institute for Public Health-Center for Radiation Protection, number of persons monitored are 757 (whole body). For internal contamination control, there is no facilities.

Monitoring of workplace: Institute for Public Health responsible for monitoring and perform once a year dose rate measurements on the wokplace in medical and industry applications; dose estimation based on measurements performs,too.

2.5. Medical Exposure Control

In Clinical Centre in Sarajevo, Committee for Radiation Protection is established. Main task is preparing for lincensing of practices according to BSS requirements.

2.5.1. Radiotherapy

Programme for Quality Assurance and Safety of Radioactive Sources was established on Institute of Oncology in August 1999 and it was revised in November 2001. Revision was performed taking into account gained experience during more than 2 years. QA programme includes:

- Physical and technical aspects consisting of: calibration of radiotherapy machines,periodicalQC tests, clinical dosimetry, local rules and supervision, individual monitoring. Head of Department for radiotherapy physics is responsible for mentionned components of QA programme. In the Department are employed in total 3 physicists;
- Clinical aspects consisting of: responsibilities for medical exposure radiotherapy process and possible sources of errors in radiotherapy process, QA for every component of radiotherapy process, and actons for prevention of potential exposure;
- Head of Radiotherapy Department is responsible for clinical aspects of QA programme, and for medical exposure are responsible specialists od radiotherapy (10 employed);
- Procedures for emergancy situations, radiotherapy physicist is radiation protection officer who is responsible for these procedures, as well as for radiation protection and safety of radioactive sources;
- Evidence;
- Surveillance of implementation of QA programme in radiotherapy.

Head of Institute is responsible for implementation of QA programme.QA Committee consisting of 3 specialists of radiotherapy, radiotherapy physicist and radiotherapy technician, evaluates implementation of QA programme and give recommendations to the Head of the Institute for actions needed to improve some component of the programme.

2.5.2. Diagnostic radiology

Program for processing control is started (sensitometry and densitometry), in a five radiology departments in Federation of Bosnia and Herzegovina. Institute for Public Health, Center for Radiation Protection, performed initial measurements regarding to start with implementation TC Project «Quality Assurance Programme in Diagnostic Radiology (BOH/6/004).This TC Project is extened to the end 2003.Specialisation for M.D.is extended to four years (instead of 3).In the department is employed 1 physicist.Guidance levels are not established, yet.

2.5.3. Nuclear Medicine

Regarding to QC programme in Nuclear Medicine departments, there are uniformity of gamma cameras is checked once a week, and check of reproducibility of dose calibrators (per day).

Radionuclides are in use for diagnostic and therapeutic purpose.

For diagnostic purpose: Tc- 99 generator, activity 8,6 to GBq, in vivo use;

I - 131 for whole body scan;

For therapeutic purpose;I - 131, activity to 0,56 GBq, ambulatory

TC Project «Rehabilitation of Radionuclide Therapy » (BOH/6/005) has approved by IAEA, for TC ciclus 2003-2004, for Bosnia and Herzegovina.

2.6. Public Exposure Control

Enviromental monitoring is not established yet. According to the request of the some owners, radiological control of foodstuff and water are performing.

TC Project «Monitoring of Radioactivity in the Environment» (BOH/2/002), has approved by IAEA, for ciclus 2003-2004, for Bosnia and Herzegovina.

Levels for discharge in sewage, from nuclear medicine department is not established yet.

2.7. Radioactive Waste Safety

There is a problem of spent radioactive sources in Federation Bosnia and Herzegovina. Interim storage is built, and activities regarding to building small waste treatment facility, for conditioning of the sealed radioactive sources is started. It shall be necessary to lincencing this facility according to international requirements.

2.8. Emergency Preparedness and Response

By the Law, Federal Administration for a Radiation Protection is responsible for preparedness plan for emergency situation. Plan is not established yet. Local emergency response plans are developed for industrial radiography and radiotherapy practices.

2.9. Metrology, Standardization and Calibration

Calibration facility doesnt, exist.Calibration of the TL reader is performed in 2002.TL dosimetrs are calibrated. Calibration of survey meters is done in 2002.

2.10. Training

Regional training courses and seminars, organized by IAEA were very useful.All participants continue to work in the field. Fellowships were very useful, too.

3. Conclusions

- Some basic requrements from RER/9/062 and RER/9/065 are achieved;
- Main difficulties encountered in the implementation of the Projects mentioned above, were specific political and economic situation in Bosnia and Herzegovina;
- National Regulatory Authority for Radiation Protection and Safety is not established yet;
- We need further IAEA assistance for upgrading national regulatory infrastructure according to BSS, in Bosnia and Herzegovina.

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Status on the National Radiation Protection and Safety Infrastructure

I. Solomonova, M. Drakalski
Ministry of Education and Science
Skopje, Macedonia

Abstract. During the IAEA Project Cycle 2001/2002 significant progress has been achieved regarding the harmonisation of the national radiation protection infrastructure with the requirments from the Basic Safety Standards: promulgation of the new Law on Radiation Protection and Safety, drafting of the basic Regulations to cover the essential features for its implementation, updating of the inventory of radiation sources, occupational exposure control, medical exposure control and training of personnel. Intensive co-ordinated activity for establishing of the new, independent Radiation Protection Directorate, based on the new Law, is underway.

1. Introduction

In July, 2002 the new Law on Radiation Protection and Safety was promulgated by the Parliament of the Republic of Macedonia. The new radiation protection concept was created jointly with the dispatched IAEA expert missions and tailored according to the IAEA reccomendations, taking into account the national specifics.

2. Regulatory Infrastructure in Macedonia

In order to ensure proper implementation of the BSS, the new Law foresees establishing of an independent Radiation Protection Directorate (RPD), headed by a Director, appointed by the Government of the Republic of Macedonia. It shall be entirely responsible for radiaton protection in the country. It shall be enpowered to issue radiation safety regulations, to conduct the entire system of notificaiton, authoristion, inspection and enforcement. An Advisory Commission, consisting of representatives form the relevant ministries and recognised scientific and technical experts shall be appointed. The inspection shall be performed by the existing inspectorates for health, envirnoment and veterinary medicine (for food stuffs), acting in accordance with the requirements set forth by the RPD. The technical services shall be mainly provided by a Radiaiton Protection Center, established within the existing Republic Institute of Public Health, as well as by other competent technical institutions assigned by RPD (Chart on Radiation Protection and Safety Infrastrucutre, attached).

A system of liaison and working procedures will be established, in order to ensure appropriate degree of co-ordination and co-operation.

3. Regulations

In paralel, based on the new Law, the Regulations governing radiation safety, notification and authorisation, excemption from regulatory requirements and supporting guidelines to assist in implementation of these regulations, are in phase of preparation by group of experts, assisted by IAEA. So far, the following drafts have been prepared:

— The Regulations on the Dose Limits, Action and Intervention Levels and other Level of Exposure to Ionising radiation;

— The Regulations on the Conditions for Practices with X-ray Devices and other Devices Generating Ionising Radiation;

— The Regulations on the Conditions for Practices with Radioactive Sources;

— The Regulations on Occupational Exposure

The drafts reached highly finalized form. They cover essential features for implementation of the new Law: dose constraints and limitations, system of authorisation and associated procedures for practices. It is considered that these regulations are indespensebale for the operalisation of the Regulatory Authority.

Continuous expert assistance by IAEA is required for preparation of the remaining regulations and Codes of Conduct in order to cover all relevant components of the BSS, in a way to enable narowwing the scope in order to fit the type and size of the national radiation infrastructure.

4. Inventory of Radioactive Sources

The Inventory of Radiation Sources is kept by the Republic Institute of Public Health applying RAIS provided by the IAEA and is udated on regular basis. According to the Registry the following data is available.

— Medical and stomatology X-ray machines	
(radiography, fluoroscopy, CT scanners)	298
— Radiation therapy Accelerator	
(20MeV for electrons)	1
— Co-60 Radiotherapy unit	1
— Cs-137 Brachiterapy unit (900 mCi total)	10
— Unsealed radioactive sources in medicine	
RIA laboratories	4
— Nuclear Medicine Departments	
(I-131,Tc-99, Cr-51, Tl-205)	2
— Industrial radiography (X-ray, Ir-192, Co-60)	20
(8 not in use)	
— Other industrial applications	50
— Gas chromatography	16
— Radioactive lightening arresters	207
— Radioactive smoke detectors	30.000

5. Occupational Exposure Control

Individual monitoring is provided for total number of 1.200 professionally exposed workers. Two types of personal dosimeters are in use: film badges and TLD.

TLD was introduced in practice in September, 1999. It coveres 400 most exposed workers (2 dosimeters for each). The equipment provided through IAEA includes: TLD Reader BICRON-4400, Computer Compaq with software for TLD Bicron, Printer HP Desk-Jet, Air Generator and 1.000 TLD dosimeters.

The calibration of film dosimeters and TL dosimeters will be done by the Republic Institute of Public Health. Establishment of the new Small National Calibration Laboratory is currently in final phase with IAEA assistance.

Facilities for internal contamination, bioassay measurements and no whole-body counter exist.

Monitoring of working places is conducted on regular bases (once per year). Measurements are performed by the experts and instrumentation of the RIPH and records kept. Regular medical survailance of occupationally exposed workers is conducted by a physician – specialist in occupational medicine employed by RIPH only for that purpose.

6. Medical Exposure Control

Present situation:

— Radiotheraphy - 4 physicists are responsible for QA/QC in radiotheraphy at the University Department of Radiotheraphy and Oncology in Skopje. Extensive training was provided under RER/6/012 on QA/QC in Radiation Oncology.

— Diagnostic Radiology - 1 physicist is co-ordinating the National Project on QA/QC (MAK/6/004) in progress. Routine quality control of X-ray devices is conducted by the RIPH. By strong support from IAEA training of 120 specilists in radiology and radiographers have been conducted and training materials in Macedonian language developed, based on the relevant IAEA TECDOC's.

— Nuclear Medicine – 2 physicists are responsible for QA/QC of diagnostic and therapeutic applications. They were provided extensive training under the IAEA Regional Thematic Programme on Nuclear Medicine (RER/6/011).

Upgrading of the current situation shall require a lot of activities related to establishing of Regulations on radiation protection and quality assurance, criteria for good parctices and further training of personnel.

7. Public Exposure Control

— Environmental monitoring - is performed by the Department of Environmental Monitoring of the RIPH and the Laboratory of the Ministry of Environment on regular basis. Selected locations and sampling of foodstuffs, water, air and soil are permanently monitored.

— Industrial discharge control is conducted both through the internal control of the facilities engaged in use of unsealed radioactive sources and the inspection authority of the Ministry of Environment.

— 10 mobile dose meter devices have been provided under RER/9/065 IAEA to strenghten the capacities of the technical institutions.

8. Radioactive Waste Safety

The Republic of Macedonia is in possessesion only of low radioactive waste temporarily deposited at 2 industrial waste storages. The transport is carried out in accordance with a separate Regulation. Waste management needs general resolving approach and is in competence of the Ministry of Environment. A National Project on Management and Disposal of Low and Intermediate-level Rad Waste (MAK/4/002) is underway aiming at establishing of a countrywide waste management system following international standards. The Project will also address the problem of dismantling and storage of the sealed sources from the lightning arresters.

9. Emergency Preparedness Response

According to the new Law, the overall responsibility related to emergency preparadness and response will be delegated to the new Regulatory Authority, based on a National Action Plan and support by the relevant technical institutions. Further assistance by IAEA will be required in regard to further strengthening of the national preparedness and response to nuclear emergencies.under RER/9/064.

10. Expertise and Training

The participation in the IAEA Regional Projects on Strengthening the National Regulatory Control and Occupational Radiation Protection Programmes (RER/9/062) and Development of Technical Capabilities for Sustainable Radiation and Waste Safety (RER/9/065) made significant contribution to the upgrading of knowledge on different aspects of radiation protection, based on the BSS standards.

Most valuable expert assistance was provided during the process of drafting of the new Law and the Regulations thereof.

Relevant profiles of Macedonian experts were provided total number of 40 fellowships for participation at the training courses and seminars organised under these Projects.

In the frames of these Projects, IAEA also provided expert and financial support to the Republic of Macedonia for organising of national training courses for Radiation Protection Officers in medical and industrial fields (total number of 160 participants).

The Programmes of the Courses were tailored so as to provide substantial knowledge on the BSS, but also to encourage active involvement of the participants in the discussions focused on issues related to the implementation of the BSS in Macedonia and the promulgation of the new legislation. It was strongly recommended that such activities should become regular practice, particularly covering the defficient tasks, such as quality assurance of medical practicies involving ionising radiation sources.

The absence of such training activities in the country for a period of more than 10 years, resulted in great interest for participation at the Courses. In order to address it, the number of the accepted trainees was far bigger than the ordinary standards for such type of training (particularly for diagnostic radiology) and consequently requiring increased national financial contribution.

Considering that this kind of training is also defficient in some of the countries of the sub-region, participants from the neighbouring countries may be accepted for training under the future national training courses.

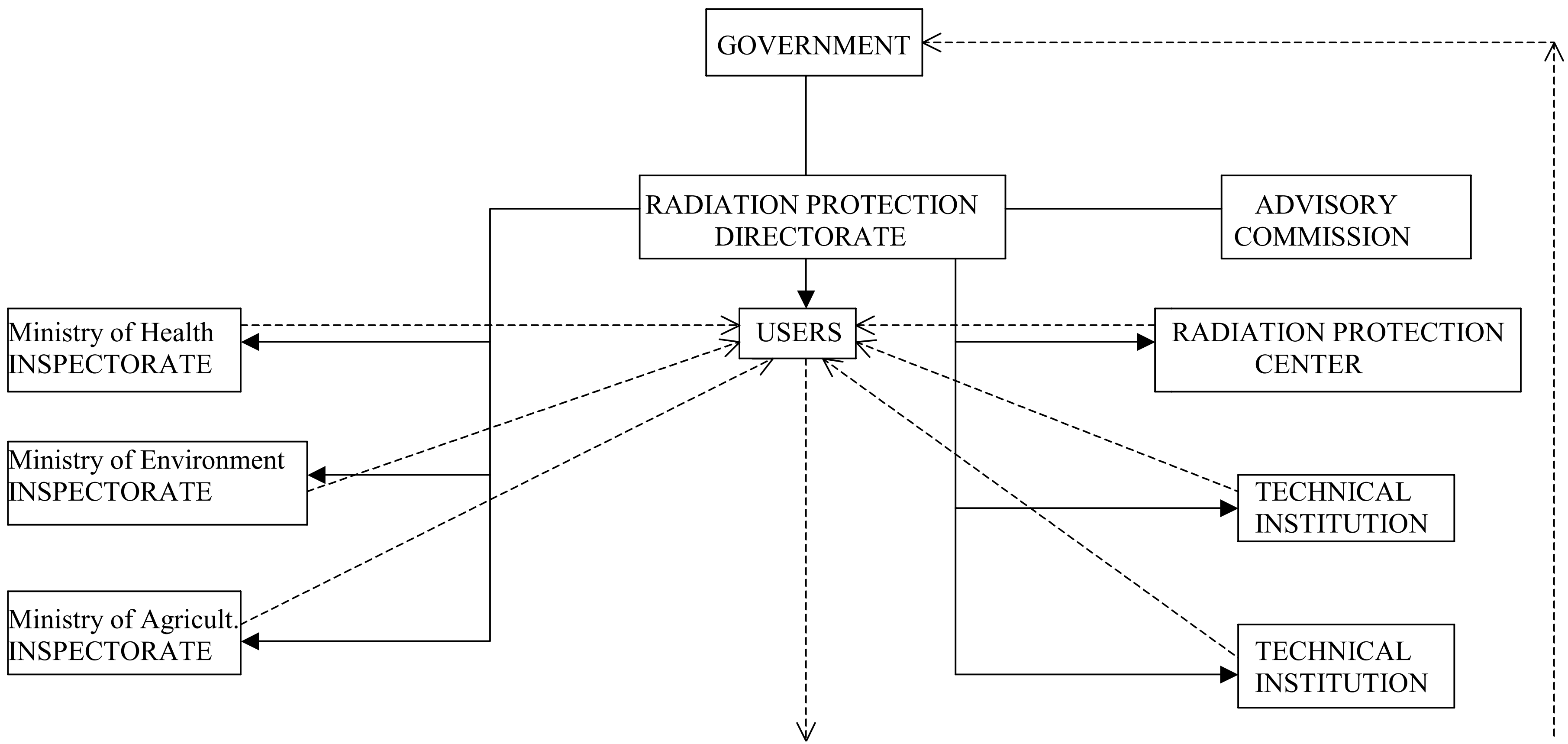
11. Conclusions

The previous Model Project RER/9/056 and the current Projects RER/9/061, RER/9/062 and RER/9/065 were of crucial importance for upgrading of radiation protection in the Republic of Macedonia, particularly regarding the harmonisation of the national legislation with the BSS, occupational exposure control and training of staff. We are very much obliged to the Regional Manager, Mr. J.Sabol for his understanding of the specific circumstances and the difficult phases of the development of the Republic of Macedonia during the last several years, as well as for the IAEA support thereof. On the other hand, we very much appreciate the co-operation established between the countries participating in these Projects and the experience exchanged.

However, additional assitance will be required regarding the enforcement of the new Law, establishing of the Radiation Protection Directorate, management requirements, drafting of the remaining regulations, strengthening of medical and public exposure control, quality assurance, radiactive waste management, emergency intervention, targeted training etc.

REPUBLIC OF MACEDONIA

RADIATION PROTECTION AND SAFETY INFRASTRUCTURE



Implementation of the Model Project in Turkey

A.G. Buyan, N. Guven, B. Okyar, et al.

Turkish Atomic Energy Authority, Ankara, Turkey

Abstract. Abstract. TAEK involved in these utmost important project at the beginning of the 2001 due to the importance of the safety of radiation sources and security of radioactive materials. The main goal of Turkey to involve in this project is to achieve a high and sustainable radiation protection/safety standards in this field. TAEK is the regulatory body of the country and has had its own radiation safety legislation, which is renewed in accordance with the changes in international policies and standards. Many fruitful activities have been realized under Model Project. Revision of the legislation, realization of the several training activities, updated of the inventories, strengthening of the calibration facilities, adaptation of the inspection programmes to the TEC DOC 1113 are some main benefits gained from the project.

1. Introduction

Due to the thousands of radiation sources, geographic location and also national nuclear technology transfer policy of the country, nuclear and radioactive material security and radiation safety are the most important objectives of Turkey. Turkey involved in these project at the beginnig of the 2001 for the purpose of harmonization of the country's practices with Member States, promoting knowledge and experience by information exchange, the upgrading of the radiation safety infrastructure, establishment a regional training center and taking a role in the development of the region.

2. The Progress of the Model Project

2.1. Legal and regulatory framework

In 1937, the Ministry of Health issued the first law related to ionizing radiation in Turkey. The Turkish Atomic Energy Commission was established in 1956. Turkey has been a Member State of the IAEA since 1957. The structure and the name of the Turkish Atomic Energy Commission were changed to the Turkish Atomic Energy Authority in 1982 by the issued Law.

TAEK is the judicial organization for preparing the regulatory framework concerning radiation protection and nuclear safety. The Law covers the establishment, management duties, responsibilities and the authorization of the TAEK.

Radiation Safety Decree was issued in 1985 based on the Act. Radiation Safety Regulations published in 1991 and revised on 24 March 2000 based on BSS 115 of IAEA and 97/43 and 96/29 EURATOM Directives. Besides that there are currently valid several specific regulations.

According to the Legislation, it is an obligation to be issued with a license for all kinds of radiation related activities. These activities are carried out by RSGD. Following preconditioned TAEK license, the working permission for the facilities is given by other related ministries.

Under the model project revising studies of the Decree, Regulations on Transport of Radioactive Material" according to ST-1 and the Discharge of Radioactive Wastes have been completed and sent to the related ministries and authorities to take their suggestions. The preparation of the specific regulations on nuclear medicine, diagnostic radiology and industrial radiography were made ready for taking suggestions from related institutions. For the preparation of the additional necessary legislation, providing IAEA Documents, sample regulations, CD's from IAEA, information exchanges by the experts who visited to the country and also our experts visited to IAEA and other countries and also all type of training programmes have been very beneficial.

2.2. System of Notifications, Authorization, Inspection and Enforcement

According to TAEK legislation all radiation sources and source related activities above the exemption levels must be notified for authorization and get license from the TAEK to keep, use, produce, import and export, purchase, sell, transport, store, maintain, repair, install, dismantle, exchange ext. Additionally a separate permission is required for each import; export and transport of all kinds of radiation sources.

After the Country involved in the Model Project, TAEK control and inspection procedures were compared and adapted to the TECDOC-1113 recommendations and the implementation of this procedures has been started.

2.3. Empowerment of the Authority to enforce requirements

In any case the fact that the violation of the license or the legislation, the license is temporarily or permanently cancelled. According to the legislation, if TAEK decides for the cancellation of the license, the closing procedure of the facility has been realized by the governorship.

2.4. Inventory of radiation sources and facilities

TAEK has a comprehensive inventory which includes sealed and unsealed sources, radiation generators, responsible persons, controlled area workers, radiation monitoring instruments, facility specifications, etc. The TAEK has local software (Client/Server Architecture, ORDBMS, and UNIX) for the administration of the inventory, which is maintained by the Radiological Health and Safety Department of TAEK

3 research and training reactors that are not in operation, two Mo/Tc generator production facilities, two baby cyclotrons (11 MeV CTI, RDS111), two industrial irradiation facilities, 1 central radiopharmaceutical laboratory (Tl-201 & I-131), 136 nuclear medicine and 162 RIA laboratories, 4186 diagnostic radiology laboratories, 38 radiotherapy laboratories, 630 industrial radiography companies, 660 nuclear gauges companies, 30 research and training laboratories, 11.052 lightning rod users, 202 smoke detectors are already exist in the country.

Under Model Project, the inventory has been updated and a separate computer software management division has been established and the program has been made more user friendly and effective. Now, it is certainly possible to follow-up all radiation sources which are kept, used, imported, exported or stored in the country effectively and it is possible to know the place of the all sources in any time by using this system. Additionally on line connection with the Dosimetry Divisions of TAEK was realized. TAEK web page was improved to make it possible to reach information, documents, forms and related issues for radiation users.

2.5. Occupational Exposure Control

The controlled & supervised areas, dose limits, reference levels, working conditions, personal protective equipments are identified in the Radiation Safety Regulation based on BSS-115 of IAEA.

2.6. Individual Monitoring

Individual monitoring for external radiation in Turkey has been carried out by the two Dosimety Divisions of TAEK bimonthly by using films and limited (1%) TLD dosimeters. The total numbers of workers receiving services are around 18.000 per year.

Under the Model Poject, after the expert mission from the IAEA and also scientific visit of the chief of the ANAEM Dosimeter laboratuary to the Check Republic Dosimeter Laboratuvary, necessary calibration sources and devices of these two Dosimetry Divisions and the new procedures were reprogrammed based on the IAEA experts' report. Regarding the report, a new developing time was introduced, present X ray system was modified, and present film dosimeter evaluation algorithm has been revised for the Dosimeter Laboratuvary of the ANAEM. In addition to the existing TLD System which has just been purchased for the ANAEM Dosimeter laboratory two more TLD systems have been purchased for ÇNAEM SSDL and dosimeter laboratory. The project of the establishment of the calibration facility of the ANAEM Dosimeter Laboratory has been approved and the procedures has been initiated and required devices and calibration sources have been purchased. Following that, it is also planned to establish the second SSDL in Ankara in near future.

2.7.Workplace Monitoring

As a part of licensing procedure, depending on the practice, the facilities where the work place monitoring is required have to be equipped with suitable devices for the monitoring of the working places.

Under the Model Poject following the first expert mission, 10 alarmed individual dosimeters and one digital gamma spectrometer in addition to three sintillation dedectors for using during the inspections were provided from the IAEA

2.8. Training

The total number of TAEK Staff is 790 with 468 technical staff, 81 Radiation Safety Officer and 37 Radiation Safety Experts.

The total number of radiation workers in overall the country is around 40 000. There are around 103 medical physicists in radiation oncology (89), nuclear medicine (31) and diagnostic radiology (13).

There are three academic postgraduate medical physicist educational programs in Turkey. This year, the academic postgraduate training programme for radiation safety experts in the Nuclear Science Institute of the University of Hacettepe in Ankara will be initiated.

Two years education programs are going on in the 23 universities for radiology technicians after high schools. Postgraduate nuclear physics programs and graduate/post graduate nuclear energy engineering programs also exist In Turkey.

Besides the academic programs some training courses are given to the radiation protection officers, health professionals, medical physicists, medical practitioners, industrial radiographers, custom officers, polices, radiation workers, by the experts of RSGD and CNAEM for more than 40 years. Between 1999-2002, 30 courses were organized and approximately 1600 workers were trained in different regions of Turkey. Upon requests, TAEK experts also contribute both to the courses at the universities and to the courses organized by the related institutions as lecturers.

NDT courses for level 1, 2 and 3 are being carried out by 3 centers. Informative lectures for the radiation workers of the facilities, during the radiation control for licensing has been carried out.

Training activities are the most beneficial part of the model project. Under the Model Project many of regulatory body officers and radiation workers such as medical physics experts, industrial radiographers, some technicians have had the chance to train and gained lots of valuable knowledge.

55 Turkish participants attended to various regional courses of IAEA. Three regional courses were held in Turkey in last two years. The courses named by “Radiation Protection in Nuclear Medicine” and “Radiation Protection in Radiology” will be held in this year in Ankara. Two national courses on industrial radiography and diagnostic radiology were organized by contribution of the Agency and around 100 persons were trained. 5 fellowship and 4 scientific visit programmes were also realized.

The other main benefit of the project was to provide a wide range training materials such as course notes, brochures, IAEA documents, CD’s. Some of them were translated to Turkish and sent to concerned institutions. Information exchange is one of the major benefits of the project and it has been good opportunity to discuss the differences in practices and systems between the countries.

2.9. Emergency response

According to the legislation, all users, importers and transporters have to prepare an emergency preparedness plan as a part of licensing procedure and this plan has to be approved by TAEK. In 2002, radiological emergency plans of all radiation facilities were updated. The management of radiological accidents is conducted by RSGD, however if the accident causes to a crisis, the management of the crisis would be carried out by the Emergency Center. An Emergency Response Center operated under the President of TAEK with the participation of related Departments with online connections to the national and international information centers such as IAEA, INES and RESA (Radiation Early Warning System of TAEK). There are 66 RESA stations around the country.

3. Conclusion After two years, it is clearly seen that it has been a really fruitful project we have had many benefits to reach high and sustainable protection/safety standards in this field. Additionally, to realize of the work plan in predetermined time stimulated us to reach our main goals. Providing the needed documents makes it possible to carry out our programmed activities in a shorter time. Participation to the training programmes has really motivated our staff. The initiation of the studies for the establishment of a Training Center in the cooperation with IAEA to train large number of radiation workers in Turkey and also share this opportunity with other countries in the region have been the other very important activity under this project.

Beside that, because of the very intensive programme of the project, it was not easy to realize the work plan such as the adaptation of the TEC DOC 1113 to the country practice and to prepare the necessary regulation in the programmed time. It is suggested that it would be more beneficial if fellowships could be carried out in the developed countries which have different radiation safety practices including some oversea countries and IAEA’s laboratories. Additionally, it seems that the standardization of the Peer Review Team and lecturers’ qualification help to the project to be more successful.

Radiation Protection in Qatar

A. J. Al Khatibeh

The Supreme Council for the Environment and Natural Reserves
Doha, Qatar

Abstract. The State of Qatar has become a member State of IAEA since 1974. Later the Department of Industrial Development (DID) because the focal point and the competent authority regarding all aspects of the peaceful application of Nuclear Technology. Very little or no progress was made regarding improving the Radiation Protection Infrastructure during those years. In 1998, DID approached the Supreme Council, then called "Department of Environment" to implement the model project on upgrading radiation protection infrastructure, the council agreed and work commenced immediately. In less than five years, we were able to issue the radiation protection law, draft three set of regulations, namely: Radiation Protection Regulations, Radioactive Waste Management Regulations and the Safe Transport of Radioactive Materials Regulation. A radiation Protection Section, comprising three units was established. We are providing individual exposure monitoring for most of the radiation workers in the public sector and some in the private sector. We have also started proper licensing and inspections procedures, where our inspectors are enforcing the law.

1. Introduction

The Supreme Council for the Environment and Natural Reserves (formerly Department of the Environment) was approached by the Department of Industrial Development, the Ministry of Energy & Industry, on 25 March, 1998 with a proposal to implement the project of upgrading radiation and waste safety infrastructure in Qatar through an IAEA project (RAW/9/006). The Council accepted, and began a research work on the status and uses of radiation sources in the State of Qatar.

Before the implementation of this project, the control of radioactive material handling (import, export, use…etc) was based on a ministerial decree which formed what was called "the working group". The procedures were ineffective, and licensing was purely a routine work. No inspections were performed, except an initial inspection for radioactive material storage pits, which was done by the Department of Civil Defence.

2. Uses of Radiation Sources in Qatar

Radiation Sources are used in the following fields:

2.1. Industry

With a large percentage concentrated in the oil industry (oil and gas logging)

2.2. Medical Practices

Radiation sources and radiation equipment are used in diagnostic radiotherapy and in nuclear medicine.

3. Users of Radiation Sources

There are about (100) users of the different types of radiation sources, divided as follows:

a. About (60) companies and establishments that use radiation sources for research or industrial applications.

b. About (40) clinics (including dental clinics) and hospitals that use radiation sources for diagnostic radiology and nuclear medicine

4. Implementation of the Model Project on Upgrading Radiation and Waste Safety infra structure

The Supreme Council for the Environment and Natural Reserves (SCENR), formerly the Environmental Department, received the proposed plan for the implementation of the above mentioned project in April 1998. The plan was modified and transmitted to the agency after consultations with the concerned parties in Qatar. (Hamad Medical Foundation, the University, the Department of Civil Defence…etc.)

The execution of the plan commenced immediately, and the following actions were initiated.

4.1. Draft radiation and waste safety law was prepared comprising 23 articles

These articles regulate the import, export, utilization and trading with radiation sources. They also regulate licensing, inspection, and registration procedures. There are articles that include penalties for any violations regarding the above subjects. The Law was approved by the Emir on 29 September 2002, which is now called the Decree by law number 31, for year 2002 Concerning the Protection from Radiation. It was published in the official gazette on the 1st of December 2002. The law gave the Council a period of 6 months to issue all regulations related to the implementation of the said law.

4.2. Draft Regulations

A set of regulations was drafted with the assistance of several IAEA experts and based on the Safety Series 115. These regulations include three major parts. These parts are:

4.2.1. Radiation Protection Regulations

These regulations consist of 61 articles which cover the following sections:

4.2.1.1. General Requirements

This section describes the general requirements for radiation protection. It describes the purpose, scope, interpretation, definitions, exclusions, exemptions dose limits and optimization.

4.2.1.2.Administrative Requirements

This section outline basic obligations. It discusses notification, registration and licensing. It also outlines criteria for license withdrawal, cancellation or suspension, and the procedures that a licensee can follow to protest such actions. The section also describes, in general, the different types of licenses that are required by the council.

4.2.1.3.Inspection and control

This section explains the qualifications and training requirements for radiation inspectors. It also describes their duties, responsibilities and their rights. It includes sample forms for different types of inspection reports.

4.2.1.4. Occupational Exposure

This section describes the various permissible dose limits for various areas within a radiation practice. It describes exposure records and estimation of exposures in case of loss of dosimeters (such as TLDs, films… etc). It also describes the different dose measurements that must be performed by radiation protection officers in order to guarantee the safety of radiation workers. The section also includes all the details that should be included in the medical records kept by the registrants and licensees and employers for each radiation worker.

4.2.1.5. Radiation Protection in Medical Applications

This chapter describes different radiation protection aspects applicable to medical practices. The material in this chapter is prepared with the assistance of the IAEA Basic Safety Standards 115.

4.2.1.6. Public Exposure

This section describes the permissible dose limits for general public. It describes the responsibilities of the registrants and licensees towards protecting the general public and the environment.

4.2.2. Radioactive Waste Disposal and Management regulations

These regulations detail with all matters related to radioactive waste disposal. They include classification of wastes, and the clearance levels for wastes which may be dispensed into the environment for solid, liquid or gaseous wastes. The regulations also identify wastes, which must be disposed of as radioactive waste at appropriate sites, and all necessary warning signs, and tags that must be fixed on them.

4.2.3. Transportation Regulations

These regulations deal with all matters related to the transportation of radioactive materials. They are based on the model regulations prepared by IAEA.

4.3. Radiation Protection Section

A Radiation Protection Section was established. The section includes the following units.

4.3.1. Licensing and Inspection Unit

The duties of this unit include the evaluation of each license application, checking the necessary documentation before passing the application on to the Radiation Protection Committee for approval. The duties also include the various types of inspections that must be carried out in order to insure that registrants, licensees and employers are observing adequate radiation protection procedures.

4.3.2. Radiation Monitoring Unit

This unit is responsible for all environmental radioactivity measurements. It is also responsible for setting up a radiological accident early warning network covering the entire country. . This unit is responsible for all matters related to the management and disposal of radioactive wastes and transport of radioactive materials

4.3.3. Technical Services and Projects Unit

This unit is responsible for monitoring the radiation doses for all radiation workers in all the various practices, and make sure that these doses do not exceed permissible levels. The unit is also responsible for introducing new peaceful applications of radioactive and nuclear techniques into the council and other establishments in the country. Its responsibilities also include the follow up and organization of

Technical cooperation projects with IAEA and the national organizations and institutions. It will also be responsible for all matters related to radiation protection training.

4.4. Radiation Protection Committee

The Draft Radiation and Waste Safety Law calls for establishing a radiation protection committee. This committee will be the advisory council on all matters related to radiation protection and waste safety. However, recent developments have necessitated the speeding up of establishing this committee, and we are considering forming such a committee even before approval of the above mentioned law.

5. Implementation of the Model Projects RAW/9/008 and RAW/9/008

In 1999 the council was approached by IAEA to participate in two projects, namely National Regulatory Control and Occupational Radiation Protection Program (RAW/9/008) and Development of Technical Capabilities for Sustainable Radiation Protection Program (RAW/9/009). The council accepted and Mr. Khalid Al- Ali, the Secretary General of the Council, was named as the counter-part for the two projects. Two staff members were assigned to assist Mr. A-Ali; Dr. Ahmad J. Al Khatibeh, the radiation protection consultant, was the assistant for Project RAW/9/008, and Mr. Waleed Al-Emadi, head of Radiation Protection Unit, was the assistant for Project RAW/9/009.

5.1. Current Situation

5.1.1. The law

The law was approved by the Emir on 29 September 2002, and is being implemented.

5.1.2. Regulatory Authority

The law defines the regulatory authority clearly as the Supreme Council for the Environment and Natural Reserves. However, without the law there is a decree that names committee, designated by the Minister of Municipal Affairs and Agriculture assigned to issue the necessary authorizations to various users.

5.1.3. Regulations

A set of regulations has been drafted. They are currently being reviewed by a special committee, which must finalize them before the 1st of July 2003. They are expected to be approved by the chairman of Supreme Council by that date.

5.1.4. Quality Assurance in medical Applications

We have just received two quality assurance kits from the agency. They were handed over to Hamad Medical Corporation, The Department of Radiology. We also recently started a joint work between the Council and the Radiology Department to train their staff on QA in Diagnostic Radiology and Nuclear Medicine.

5.1.5. Exposure Monitoring

We have started monitoring some radiation workers in the medical field and in the University of Qatar. We are going to start monitoring people in the industry very soon (after training the new employees).

5.1.6. Emergency Preparedness

The council has organized a workshop for medical preparedness for radiological Emergencies, in collaboration with the Agency and Hamad Medical Corporation (HMC). About 60 members of the medical staff participated in the course.

After the course we have contacted the Ministry of General Health and HMC in order to establish a radiological emergency response team. HMC has been instructed to formulate the team. Currently it consists of medical staff, however, once our national emergency plan is finalized, a national response team will be established, which will include members from all concerned parties (e.g: SCENR, Civil Defence, Police Force, HMC, Ministries of Interior, health…etc).

5.2. Conclusion -- Future Work

5.2.1. Code of practice

A code of practice is yet to be prepared. It was agreed with the field manager for west Asia that an expert will be assigned by the Agency for this purpose.

5.2.2. Emergency Preparedness

Currently we are working on setting up a National Radiological Emergency Plan, which outlines and defines the duties, responsibilities and actions to be carried out by various organizations within the country in case of a radiological accident. IAEA has agreed to provide an expert to finalize the plan; however, no action has been taken yet.

5.2.3. Environmental Analysis

We found real need for establishing a low level radioactivity measurement laboratory. We have placed a purchase order to buy the necessary equipment. The lab should be ready within the next few weeks.

5.2.4. Medical Exposure Control

One of the areas, which need special attention is medical exposure control. We will work with IAEA experts to address this issue very soon.

5.2.5. Training

The action plan for Qatar also realized the need to organize a workshop on Industrial Radiography. The workshop was planned fro November – December,2002. However, we have contacted the field manager to organize it this year at a date to be decided with IAEA.

Model Projects RAW/9/008 and RAW/9/009 in Kuwait: Implementation experience

S. S. Y. Yousef

Radiation Protection Department,
Ministry of Health, Kuwait

Abstract. The TC Projects, 'RAW/9/008: National Regulatory Control and Occupational Radiation Protection Programmes' & 'RAW/9/009: Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure' were set in motion in Kuwait in the second quarter of 2002 with the Workplan for 2002. This paper presents the progress attained in the workplan and the advantages & disadvantages of the model projects based on the experience gained by the Radiation Protection Department, Kuwait.

1. Introduction

Radiation Protection in Kuwait had a humble beginning in 1960, when the Ministry of Health was authorized by law to supervise and control X-ray departments. In 1973, a committee was appointed by the council of ministers to supervise radiation protection duties. In 1977, Radiation Protection Division was established in the Ministry of Health by the Amiri decree No. 131/1977. During the Chernobyl nuclear accident in 1986, Kuwait became more aware of radiation protection as did the rest of the world and the Radiation Protection Division played an important role in radiation monitoring. In 1993 Radiation Protection Division was upgraded to Department, with additional duties and creation of a new Division for Non-Ionizing Radiation Protection within the Department. However, without the assistance of international agencies, the activities of the department was not well organized. With the commencement of co-operation with IAEA, things changed in a dramatic way. Kuwait signed with IAEA in 2001 the two model projects, RAW/9/008 – National Regulatory Control and Occupational Radiation Protection Programmes & RAW/9/009 – Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure. As part of the above projects and with the technical co-operation of IAEA, our staff are being sent to various world class laboratories for training and fellowship. Kuwaiti staff participated in many regional training courses and we are supported by visits of many experts from IAEA. Radiation Protection Department is now co-operating with other agencies in Kuwait as well. All these helped to improve the standard of radiation protection in Kuwait and the service it provides to the public.

2. Radiation Protection Regulatory and Technical Infrastructure

Increased use of radiation in various fields required a re-arrangement of Radiation Protection Department and accordingly Ministerial Decree 324/2001 was issued. As a result, Radiation Protection Department, at present, consists of four divisions, (i) Environmental Radiation Protection Division (ii) Radiation Techniques Division (iii) Inspection Division and (iv) Non-ionizing Radiation Protection Division. It has a total of 59 staff members, 44 of them technical with vast experience in various fields and 15 administrative staff.

Main activities of the Radiation Protection Department in Kuwait include (a) inspection of medical, industrial and research facilities that use radiation, (b) licencing of personal, place and equipment, (c) monitoring of personnel working in the radiation field, and (d) environmental monitoring including air, water and foodstuff.

Following are the progress made in the workplan:

3. Radiation Protection Law

The existing Amiri law 131 of 1977 (The Control of the Use of Ionizing Radiation and Protection from the Hazards thereof) is to be updated by drafting a new law and empowering Radiation Protection Department (RPD) as an independent body.

4. Radiation Protection Regulations

IAEA provided us with the necessary documentations and the service of an expert. The expert was with us from 20.12.2002 to 2.1.2003 to help us prepare the Radiation Protection Regulations. The draft regulations will be presented to the Radiation Protection Committee, Ministry of Health, for approval. After the approval, it will be signed by the Minister of Health and implemented.

5. Codes of Practice on Radiotherapy, Radio diagnosis, etc.

We are waiting to receive model Code of Practice from IAEA.

6. Radioactive Waste Management Regulations

IAEA provided us with the necessary documentations and the service of an expert. The expert was with us from 20.12.2002 to 2.1.2003 to help us prepare the Radioactive Waste Management Regulations. The draft regulations will be presented to the Radiation Protection Committee, Ministry of Health, for approval. After the approval, it will be signed by the Minister of Health and implemented.

7. Transport Regulations

IAEA provided us with the necessary documentations and the service of an expert. The expert was with us from 20.12.2002 to 2.1.2003 to help us prepare the Transport Regulations. The draft regulations will be presented to the Radiation Protection Committee, Ministry of Health, for approval. After the approval, it will be signed by the Minister of Health and implemented.

8. Regulatory Authority

As per the new regulation to come into force, Radiation Protection Department will be the regulatory authority.

9. Licensing and Inspection System

When the Licensing Department will be merged with RPD as per the new regulations, we will establish the Licensing and Inspection System as per TECDOC 1113 issued by IAEA.

10. Inventory of Radiation Sources and Users

We have a database of all the radioactive sources. Sources could be imported to Kuwait only after the approval of Radiation Protection Department. Our database will be converted into the format of IAEA database.

11. National Individual Monitoring Service (external monitoring)

Right from its inception in 1977, RPD has always tried to upgrade the individual monitoring service, both through latest equipment and by hiring expert staff. We had requested IAEA through TC project to evaluate our system. Accordingly, IAEA expert came to Kuwait on a mission during 7 – 11 September 2002, to 'Upgrade Individual Monitoring Programme in Kuwait'. We are now preparing to switch over to the use of TLD, which we expect to start from the beginning of 2004. This will help us in revaluation and inter comparison with IAEA. One of our staff members is trained on individual monitoring in Syria from 9/2002 to 12/2002.

12. National Individual Monitoring Service (internal monitoring)

One of our staff members attended a training course on internal monitoring and we are going to implement internal monitoring in the near future.

13. National Programme on Radiation Protection in Radio diagnostic, Radiotherapy and Nuclear Medicine

We have distributed the manual to the concerned people for study and proper implementation.

14. Radiation Protection Programme in Industrial Practices

We have distributed the manual to the concerned people for study and proper implementation.

15. Calibration Programme for Radiation Protection Equipment

The building is already constructed and we are awaiting the equipment for the establishment of Secondary Standard Dosimetry Laboratory (SSDL). One of our staff members is now trained in the above programme through a fellowship in Vienna.

16. National & Regional Training Events

Following are some of the training events in which candidates from Kuwait took part:

Three months' training in the field of Radiation Protection (specifically: Control in Diagnostic Radiology) at St. James Hospital, Dublin, Ireland, 21.08.02 – 21.11.02.

Regional Workshop on the Safety of Radiation Sources and Security of Radioactive Materials, Almaty, Kazakhstan, 12.08.02 – 16.08.02.

Regional Training Course on Safety of Radioactive Waste Management (Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure), Damascus, Syrian Arab Republic, 27.10.02 – 31.10.02.

Regional Training Course on Regulatory Authorization and Inspection of Medical Practices, Dubai, UAE, 24.08.02 – 04.09.02.

Regional Training Course on assessment of occupational exposure due to Intake of Radio nuclides, Tehran, Islamic Republic of Iran, 12.10.02 – 23.10.02.

International Conference on Occupational Radiation Protection: Protecting Workers against Exposure to Ionizing Radiation, Geneva, Switzerland, 26.08.02 – 30.08.02.

Kuwait hosted the "Regional Training Course on Radiation Protection and Safety in Diagnostic and Interventional Radiology, Sept. 28 – Oct. 9, 2002". We will again be hosting the same Regional Training Course in Kuwait from 4 – 15 Oct. 2003.

17. Advantages of the Model Project

— From our experience, the model project is very useful and encourages the authorities in Kuwait to upgrade the Radiation Protection Programme within the framework of IAEA guidelines.

— The format of the workplan is helpful to evaluate the present status and to proceed further in a systematic manner.

— The titles in the workplan cover all the aspects of radiation protection.

— IAEA personnel who are in-charge to follow up the workplan are very cooperative, serious and respond fast to our needs.

— National training workshops and regional training events are very helpful for the effective continuation of the project. The candidates who attend the events come back with good experience and knowledge and contribute effectively to the project. We had gained good experience through the regional training course we had hosted.

— The co-ordination meetings held regularly help the member states to know each other and to co-operate together effectively.

— This project helps us to compare ourselves with our neighbours and members of West Asia so as to know where we stand and to improve our standards.

— Through the model project we have developed a close partnership with IAEA which enables us to better understand the agency and its various departments. It also enables us to realize the objectives and goals of IAEA regarding radiation protection and to recognize its priorities.

18. Disadvantages of the Model Project

— The timetable set by IAEA for the model project is insufficient to meet the Basic Safety Standards (BSS), especially when the country has limited budget, lack of experience and also the bureaucracy involved in getting things done.

— Reference Annual Report 2001 of IAEA, page 79, where it states that "........ new technical co-operation projects involving the use of radiation sources would be proposed to the Board of Governors as fully funded projects only after States have attained these two milestones". We feel that implementation of milestones 1 and 2 should not be set as a condition for approval of further TC projects. Since realization of these milestones take considerable amount of time, States would be losing TC projects which would in fact have helped in the implementation of the milestones.

19. Suggestions

— It would be advisable to create a database for the project similar to NEWMDB which could be regularly updated. This would enable each country to know where it stands in comparison with the other participating countries.

— In order to encourage the participating member states, we propose to have a credit system by which credits would be given to each task that is successfully carried out. This will enable each participant to know where one stands and also will build up a healthy competition among the members.

20. Conclusion

The experience Kuwait had gained during the last 25 years in the field of radiation protection has helped us to handle the model projects effectively. Though some of the items of the model projects are yet to be achieved, majority of them are progressing in good shape, which makes radiation protection in Kuwait much better than before. Especially, milestone 1 is difficult to be fully implemented in Kuwait. There are many conflicts of interests and political impacts on the procedures to make Radiation Protection Department an independent body in Kuwait. With the progress in implementation of TLD monitoring system, establishment of Secondary Standard Dosimetry Laboratory (SSDL) and further training of our staff, we are confident that radiation protection in Kuwait will achieve the international standard in the near future.

The workplans for 2003 are implemented accordingly based on the needs and prioritized areas in particular for fulfillment of all requirements of milestones 1 and 2 as well as the other milestones in particular on emergency preparedness and response. The effort put in by IAEA in realising the model projects is highly appreciated. It has motivated the people in radiation protection and the users of ionising radiation to work in a systematic manner and to gain proper experience. Through the projects, radiation protection culture is cultivated among the staff within the guidelines of IAEA. We have already started experiencing the results of the projects in a positive way, and the experience helps us to protect the public, worker and the environment in a better manner. We hope that the progress that is set in will continue till all the objectives of the projects are met.

Development of Radiation Protection Infrastructure in Zambia

D. Muleya, T. Chunga

Radiation Protection Board
Ministry of Health Headquarters
Lusaka, Zambia

Abstract. Radioactive materials have been in use in Zambia for a long time and its applications are non-military and mostly are used in medicine, research, teaching and industry. Radioactive waste management practices have been confined mainly to collection and storage of radioactive wastes in temporal storage facilities or strong rooms. With the proposed establishment of the Radiotherapy Centre, the increase of radioactive materials in the country's hospitals, research centres and industries, the volume and types of radioactive wastes on the whole is expected to increase requiring a well defined radiation infrastructure.

1. Introduction

Work related to radiation protection began early 1970 under joint management of National Council for Scientific and Research (NCSR) now the National Institute for Scientific and Industrial Research (NISIR) and Physics Department of the University of Zambia (UNZA). The management of Radiation Protection Service was moved from NISIR to Ministry of Health in 1986.

2. Legal Framework for Radiation Protection Infrastructure

2.1. Establishment of the Radiation Protection Board

The Radiation Protection Board was established through an Act of Parliament CHAPTER 552 of the Laws of Zambia in 1972. The Act is now recapped CHAPTER 311 of the Laws of Zambia. There are twelve (12) members of the Board drawn from different ministries and stakeholders in the country.

The Board's main objective is to advise the government on radiation matters and allocation of priorities and coordinating activities in order to formulate a cost effective regulatory programme, which achieves safety goals in a manner compatible with national resources and needs.

2.2. Establishment of the Radioisotope Advisory Committee

The Act also established the Radioisotope Advisory Committee whose members are technical people to advise the Board on matters referred to it by the board, on all other matters of technical nature on which the Committee is competent to advise and initiate studies or enquiries concerning the safe use of radioisotopes or devices producing ionising radiation and may recommend measures, including the expenditure of funds in support of such work, to the Board.

2.3. Establishment of Radiation Protection Service

The Act also established the Radiation Protection Service, which is the executing arm of the Radiation Protection Board. Currently the Service has only three (3) technical staff and two (2) auxillary staff. It currently has 124 institutions registered with the service and monitoring about 1000 radiation workers throughout the country.

3. Zambia's Efforts Towards Achieving the Milestones

Zambia joined the Project RAF/9/029 "Development of Technical Capabilities for Sustainable Radiation and Waste Safety" in August 2002 as Zambia had met some of the benchmarks to qualify for this particular project namely: -

3.1. Milestone 1: The Establishment of a Regulatory Framework

3.1.1. Legislation

Following the enactment of the law, the radiation protection and safety infrastructure is operated through a legal framework, which include the regulatory authority, supporting government services and experts. This system has a clear line of authority and responsibility, it requires adequate staffing and training, adequate facilities and equipment. The scope of this legislation includes sources of ionising radiation (radioactive substances and radiation devices) and applies during import/export procedures, transport, possession/use, and disposal.

It is a requirement that any person who intends to introduce any work involving ionising radiation practices in the country to notify the Radiation Protection Board through a prescribed form. After the Board has reviewed the application and having been satisfied with radiation safety features of the practices, the Board will either issue the applicant with a licence or register the applicant. This also applies in the case of importation or exportation of a radiation source or device and disposal of radioactive wastes. In this way the sources/devices that come and leave the country are monitored.

3.1.2. Regulations

There are regulations on radiation protection and are currently in use. The Ionising Radiation Protection Regulations were enacted through Statutory Instrument No. 171 of 1992. The regulations on radioactive waste management have not yet been promulgated and are still in draft form. The Radiation Protection Regulations are not being reviewed side by side with the Radiation Protection Act, but it is envisaged that the regulations by the IAEA shall be adopted.

3.1.3. Enforcement Actions

The Radiation Protection Board is empowered by the Act to suspend or revoke any licence where the holder has failed to comply with the regulatory and safety requirements enshrined in the Act and the subsequent regulations.

3.2. Milestone 2: The Establishment of Occupational Exposure Control

The Radiation Protection Service monitors all radiation workers by the use of TLD badges, which are read on the Harshaw 4000 TLD Reader. It currently monitors about 1000 radiation workers representing about 124 institutions and the badges are changed once every two months. The dose records are kept for a period of about 30 years. The assessment of the health of a worker, both before and during employment is carried out in order to determine whether the health of the worker is compatible with the tasks for which he is employed. A medical examination upon employment, and at intervals during employment, is desirable.

3.3. Milestone 3: The Establishment of Medical Exposure Control

Currently only inspections of diagnostic radiology and nuclear medicine departments are being undertaken by the Radiation Protection Service, but very little has been done in terms of quality assurance and quality control programmes. However, individual departments do carry out routine quality assurance programmes by their technical staff.

3.4. Milestone 4: The Establishment of Public Exposure Control

The regulatory control of waste management practices is the responsibility of the Radiation Protection Board. There is no Radioactive waste Management Centre to manage and process the radioactive waste in the country.

However, the National Institute for Scientific and Industrial Research (NISIR) has been identified to be responsible for managing of radioactive waste produced in the southern part of the country while the Zambia Consolidated Copper Mines (ZCCM) Investment Holdings Limited manage the radioactive waste produced in the northern part of the country. Currently the ZCCM Investment Holdings limited is managing the Interim Storage Facility in Kitwe. The facility houses conditioned radioactive sources including radium sources.

It is now a condition in the license that prior to importation of radioactive sources an agreement must be signed between the importer and the exporter/manufacturer that after the usefulness of the sources, the exporter/manufacturer shall be responsible for its disposal, hence sources must be returned to their places of origin. The Radiation Protection Board keeps a record of all such sources. All importers of radioactive sources seek clearance from Radiation Protection Board prior to importation of sources/devices.

A project on food and environmental monitoring was initiated by IAEA and is a joint project between the Radiation Protection Board and the Radioisotope Research Unit of the National Institute for Scientific and Industrial Research. Environmental samples are analysed by using a high pure germanium detector coupled to a multi channel analyser and computer. So far only building materials (i.e. cement, river sand, roofing material etc) phosphate ores and its products, and coal and copper tailings have since been analysed.

3.5. Milestone 5: The Establishment of Emergency Preparedness and Response Capabilities

No activities have been undertaken under this milestone except Zambia participated at the Regional Training Workshop on Practical Response to Radiological Emergency held in Cairo, Egypt in March 2003.

4. Conclusions

The need to move the regulatory Authority from the Ministry of Health to an independent Authority has been explained by ourselves and IAEA experts to the policy makers and have agreed in principle that this be done to avoid a self regulating system.

A self-regulatory system has its own weaknesses and problems when it comes to enforcing the law as the users and regulators will fall under the same management.

Zambia’s regulatory authority is on the way to be an independent body to enable it execute its functions effectively.

Radiation Protection Infrastructure and Regulatory Control of Radiation Sources in the Philippines

A. M. dela Rosa, A. J. Mateo

Philippine Nuclear Research Institute
Diliman, Philippines

Abstract. The Philippines has been engaged in the peaceful utilization of nuclear energy since 1959 with the passage of the nuclear legislation creating the Philippine Atomic Energy Commission. Radiation sources have found applications in agriculture, medicine, industry and research. The regulatory control over the use of radiation sources is based on a set of laws and regulations implemented by two national regulatory agencies. This paper presents the important elements of the Philippine regulatory infrastructure, the opportunities and the challenges towards greater effectiveness and sustainability in ensuring radiation safety.

1. Historical Perspective of Nuclear Science and Technology in the Philippines

The bilateral agreement between the Philippines and the United States of America which came into force in 1955 marked the advent of nuclear science and technology activities in the Philippines. The United States Government provided a nuclear research reactor while the Philippine Government provided the manpower and the infrastructure for the research reactor facility. This initial activity was followed with the passage by the Philippine Congress in 1958 of Republic Act 2067 creating the Philippine Atomic Energy Commission (PAEC), the precursor of the Philippine Nuclear Research Institute (PNRI). The law mandated the PAEC to promote the peaceful applications of nuclear energy as well as regulate the use of such to protect public health and safety. The Philippines became a member of the International Atomic Energy Agency (IAEA) in 1959. The first set of regulations governing the use of radioactive materials was established by PAEC in 1959. About 10 years later, Republic Act 5207 was passed providing for the licensing of atomic energy facilities.

2. Regulatory Framework

There are two national agencies responsible for the safe utilization of ionizing radiation in the country. The Philippine Nuclear Research Institute (PNRI) of the Department of Science and Technology (DOST) is the national authority responsible for the regulation, licensing and safeguards of radioactive materials and atomic energy facilities. The Bureau of Health Devices and Technology (BHDT) of the Department of Health (DOH) is the national agency in charge of radiation protection and safety of the ionizing and non-ionizing radiation emitted from electrical/electronic devices. For facilities with energies beyond the threshold that could produce radioisotopes, these are under the regulation of the PNRI.

Both regulatory authorities have adopted the IAEA Safety Series 115 or the International Basic Safety Standards, and implement well established licensing, inspection and enforcement systems for radioactive materials, atomic energy facilities and radiation-emitting devices. Periodic conferences of the two agencies are conducted to ensure harmonization of national safety standards. The regulatory authorities are presently addressing the recommendations of the IAEA Peer Review Mission conducted in 2001with the long-term view of evolving a more effective and independent regulatory body for the country.

2.1. PNRI as the Regulatory Authority for Radioactive Materials and Atomic Energy Facilities

Republic Act 2067, as amended, otherwise known as the Science Act of 1958, created the Philippine Atomic Energy Commission (PAEC), the precursor of the Philippine Nuclear Research Institute (PNRI), under the National Science Development Board (NSDB). The PAEC was mandated to promote the peaceful applications of nuclear science and technology. The same legislation gave the PAEC the authority to regulate the use of atomic and nuclear energy for the protection of public health and safety. Republic Act 5207, as amended, also known as Nuclear Liability Act, provided the PAEC the authority to regulate and license atomic energy facilities and radioactive materials including nuclear power plants. Executive Order No. 128 promulgated in 1987, reorganized the government's science and technology sector and created the Department of Science and Technology (DOST). PAEC was re-organized and renamed PNRI which retains the full regulatory powers of the former Commission. The Executive Order defines the clear delineation of the promotional and regulatory functions within the organizational structure of PNRI. The Nuclear Regulations, Licensing and Safeguards Division (NRLSD) is the regulatory arm of the PNRI. In the implementation of the regulatory activities, the NRLSD undertakes the following functions: standards development; licensing, review, and evaluation; inspection and enforcement; safeguards; and radiological impact assessment.

Pursuant to the requirements of RA 2067 and RA 5207, PNRI promulgates rules and regulations collectively defined as Code of PNRI safety Regulations (CPR). The CPR consists of several Parts that describe the license requirements for different categories of use and application of radioactive materials and atomic energy facilities**,** *e.g.*, industrial radiography, medical use of sealed radioactive sources in teletherapy and brachytherapy, medical use of radiopharmaceuticals. The CPR is approved by the PNRI Director and published in the government's Official Gazette. The CPR Parts are periodically updated, revised and/or amended to be in tune with the developments in standards**.** CPR Part 3, Standards for Protection Against Radiation, has been revised upon adoption by the PNRI of the IAEA Safety Series 115. CPR Part 4, Safe Transport of Radioactive Materials in the Philippines, is presently being revised upon adoption of the PNRI of the IAEA ST-1-1996.

2.2. BHDT as Regulatory Authority for Radiation-emitting Devices

Presidential Decree 480 of 1974 created the Radiation Health Services (RHS), the precursor of the Bureau of Health Devices and Technology (BHDT) under the Department of Health (DOH) with responsibilities for regulation of radiation-emitting apparatuses including authorization, inspection and guidance on safe procedures. Standards, rules and regulations formulated by the BHDT are approved by the Secretary of Health, and are issued by the DOH in the form of Administrative Orders.

2.3. Regulation of PNRI-owned Facilities

The laws cited above exempt the PNRI-owned facilities from licensing requirements. To ensure radiation safety in its facilities, the PNRI has a regulatory control program as embodied in its Radiological Health and Safety Policy. The Facility Managers submit their request to undertake radiation activities to the Radiation Safety Committee. After the necessary evaluation is undertaken, the Radiation Safety Committee submits the request to the Nuclear Regulations, Licensing and Safeguards Division (NRLSD) which undertakes the necessary evaluation using the appropriate CPR and IAEA standards and guides as applicable. The NRLSD approves the request and prepares an inspection program for the facility.

3. Radiation Protection Infrastructure

The use of radioisotopes and radiation-emitting devices in the Philippines has increased, both in number and sophistication, in the last twenty years. The establishment of the Gamma Knife Facility, the Medical Cyclotron Facility/PET Facility, the increasing number of application of medical linear accelerators, and the introduction of high-energy electron beam machines for industrial applications give rise to the need to further strengthen the radiation protection regime. Thus, the government, through its two regulatory bodies, sets standards, policies and management schemes to address the radiation protection requirements of the radiation users.

The Philippines has been participating in the Model Projects on Upgrading of Radiation Protection Infrastructure (RAS/9/026 and RAS/9/027) since 2001. These IAEA-coordinated projects have served as catalyst to the Philippine efforts in meeting the radiation protection requirements based on the IAEA Safety Series 115 otherwise known as the International Basic Safety Standards for protection against Ionizing Radiation and for the Safety of Radiation Sources IBSS), specifically a) an effectively independent regulatory authority, b) personal dose monitoring program for occupational exposure control, c) QA and dosimetry program for medical exposure control d) environmental monitoring program and radioactive waste management program for public exposure control , and e) a national system for preparedness and response to radiological emergencies.

3.1. Regulatory Initiatives

To attain the objectives of the Model Projects RAS/9/026 and RAS/9/027, PNRI has undertaken the following steps towards the establishment of an independent regulatory body to oversee the licensing and regulation of the use of radiation sources in all fields of endeavors including the PNRI-owned radiation facilities. PNRI considers a short-term and long-term approach to the problem. Among the short-term initiatives already in place are:

Adoption of the IAEA Basic Safety Standards (IBSS)

— PNRI issued Administrative Order 02, Series of 2001, adopting the BSS. The PNRI has revised its CPR Part 3 entitled “Standards for Protection Against Radiation (SPAR) to conform with the IBSS.

PNRI Radiological Health and Safety Policy

— PNRI issued Administrative Order 01, Series of 2001, promulgating the PNRI Radiological Health and Safety Policy. The Policy established the following:

- PNRI Radiological Health and Safety Manual to conform to the requirements of BSS and will govern the regulatory control of PNRI-owned radiation facilities.
- PNRI Regulatory Control Program for PNRI-owned radiation facilities and radioactive materials by the NRLSD.
- Reconstitution of the Radiation Safety Committee to oversee the safe operation of PNRI-owned radiation facilities, and designation of the Radiation Protection Section of the Nuclear Services and Training Division as the PNRI Radiological Health and Safety Officer (RHSO).

Action Plan on the Safety of Radiation Sources and Security of Radioactive Materials

Following the IBSS and in accordance with the IAEA Action Plan on the Safety of Radiation Sources and Security of Radioactive Materials, a Philippine Action Plan to ensure the safe use of radioactive materials in the country has been formulated. The Plan involves the implementation of the following related activities:

- Establishment of a National Registry of Sealed Radiation Sources to track radiation sources from “cradle to grave”.
- Management and control of sealed radiation sources through the licensing and registration processes.
- Addressing issues on trans-boundary movement of radiation sources particularly in scrap metal export/import.
- Emergency response to abnormal events.
- Nuclear education and training.
- National and international linkages and commitments.

3.2. Nuclear Training

Nuclear science and technology is a knowledge-based discipline. Training and re-training of the regulatory staff is an essential component of a forward-looking radiation protection infrastructure. The IAEA has been an important partner in human resource development. The PNRI offers a wide range of training courses in radiation protection and safety for radiation users. BHDT provides training in quality assurance procedures in diagnostic radiology, dental and industrial x-ray users.

A two-year Master of Science in Medical Physics is offered at the University of Santo Tomas (UST). This was established in 1981 as a joint project of PNRI, BHDT, and the UST Graduate School with technical assistance from the IAEA. A 3-year course for x-ray technologists and 4-year course for radiation technologists are offered in a number of universities and colleges.

3.3. Radiation Protection Services

PNRI provides a range of radiation protection services available to support the mandated regulatory functions of PNRI and BHDT, and for the licensed radiation sources users. These services include:

- Personnel monitoring based on the use of film badge and TLD monitors
- Calibration of radiation monitoring instruments
- Radiation hazards and dose assessments
- Leak testing of sealed radiation sources
- Radioactive wastes disposal and storage
- Cytogenetics
- Environmental radioactivity surveillance
- Radioactive waste management.

3.4. Radioactive Waste Management

The PNRI licensees categorized according to their specific type of application are essentially the waste generators. The PNRI scientists comprise the other major generators of radioactive waste. To ensure the proper and safe management of radioactive waste, the PNRI extends waste management services to these radioactive waste generators. The PNRI operates a Centralized Low Level Radioactive Waste Treatment Facility, and maintains an Interim Storage Facility for conditioned radioactive waste. These facilities were established with the technical assistance of the IAEA and the Philippine Department of Science and Technology.

Regulations on Radioactive Waste

Treatment and disposal of radioactive waste are covered by Chapter VII of the revised CPR Part 3, "Standard for Protection Against Radiation".

Under PNRI regulations, the licensee has several options in waste management, namely: a) transfer of radiation source to another licensee for use at the current activity level; b) storage to allow decay of short-lived radioisotopes, and c) return of spent sealed sources to the original manufacturer or supplier. For large irradiation sources, the PNRI requires the licensee to secure an agreement with the manufacturer for the return of the radiation source to the latter. These options should be exhausted first before a radioactive source can be considered for conditioning and storage at the PNRI Facility.

Decommissioning of Co-60 Teletherapy Units

The country has built the capability to decommission/dismantle Co-60 teletherapy units. A private PNRI licensee provides such service for small radiation facilities, and has decommissioned 10 Co-60 teletherapy units for the past 10 years. The PNRI formed a team to provide service to government hospitals with limited funds to hire the services of a private service provider.

Siting Studies for a Near Surface Disposal Facility

The PNRI operates an Interim Radioactive Waste Storage Facility comprising of engineered trenches. Presently, there is a need to locate a bigger and permanent repository of radioactive waste. Under the auspices of the Nuclear Power Steering Committee, an interagency committee conducted siting studies for a near surface disposal facility. Based on predetermined criteria, the preliminary results indicate that about 90% of the country will be eliminated from being suitable radioactive waste disposal sites. The Philippines is presently undertaking a national Technical Cooperation project on the site selection and conceptual design of a near surface disposal facility.

4. Conclusion --Challenges and Opportunities for the Regulatory Body

The ultimate end of Milestones 1 and 2 of the Model Projects is to achieve effective independence of the regulatory body. For PNRI, this translates into a restructuring of the PNRI organization resulting to the separation of the regulatory function from the promotional function. The present enabling law of PNRI exempts it from the requirement of a license for the conduct of its activities. Thus, the nuclear facilities and radioactive materials owned and operated by the PNRI are not covered by a license.

The PNRI proposed the following steps to be undertaken so that the Philippines can comply with the requirement for effective regulatory independence:

— Short-term: Establish a self-regulation system
— Medium-term: Work for an organizational structure that will provide more focus on regulation by the creation of a deputy director post for regulation; a deputy director post for promotion (research and development)
— Long-term: Work for the creation of two separate agencies under the Department of Science and Technology: one for regulation and another for research and development.

With regards to the establishment of a self-regulation system, the PNRI has established a Radiological Health and Safety Policy (approved in August 2001) that provides for the regulatory control of all nuclear facilities and radioactive materials of the PNRI by the Nuclear Regulations, Licensing and Safeguards Division. The operationalization of the self-regulation system is ongoing. The creation of one more deputy director post in the PNRI is seen as an interim action while working a legislative agenda for the creation of two separate agencies under the DOST.

United Arab Emirates National Infrastructures for Radiation *Safety towards effective and sustainable system*

A. M. Al Mutawwa, S. Shaheen

Radiation Protection and Control
Dubai, United Arab Emirates

Abstract. The Ministry of Electricity and Water is the formed national counterpart for Agency Technical Coordination Programme matters. Radiation has a wide range of application in UAE (such as training and research, industry, agriculture and medical). The Federal Law No. 1 / 2002 was the first successful step in developping and establishing the national infrastructure for radiation protection in UAE. Under this law, a Radiation Protection Committee has been formed, basic Radiation Protection Regulations are finalized and the three steps system is established. The drafts of waste management and safe transport of radioactive materials regulations have been prepared for finalization and expected to be finished soon.

1. Introduction

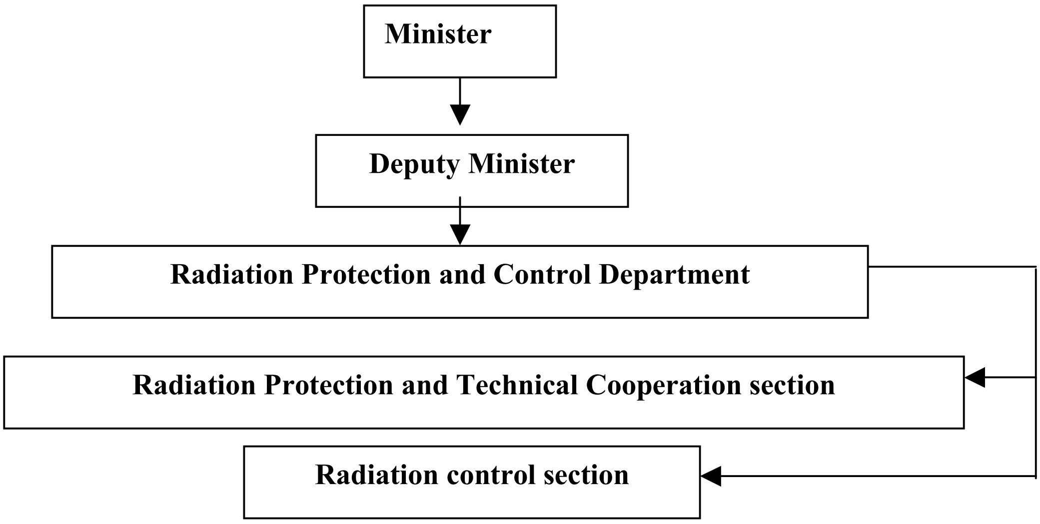
The UAE became a member state of IAEA in 1976. Over the years, ten national Technical Cooperation Projects have been completed.(**a-** UAE9002, Radiation Protection, started 1988, closed 1993. **b-** UAE6003 Quality Control in Diagnostic Nuclear Medicine, first year 1995, date completed 1998.**c-** UAE9004, Radiation Protection –phase-II, first year 1993, date completed 1995).

The UAE is one of the participant member states in the model projects on radiation protection (RAW/9/008 and RAW/9/009 for upgrading radiation protection infrastructure), and UAE takes an active interest in the agency's regional activities in West Asia. The UAE has promulgated the radiation protection law (Federal law No. 1 of 2002, regarding the Regulation and Control the use of radiation sources and protection against their Hazard) in the first of January 2002 and subsequently established a regulatory authority, the Radiation Protection and Control Department under the Ministry of E&W.

2. Organization Chart

In compliance with the law, the Radiation Protection and Control Department was established under the ministry. This department is supervired by the Deputy Minister directly, and consists of tow main sections, the first is radiation control section and the second is radiation protection and technical cooperation section as below.

The department has been provided with qualified technical staff (physicists, radiation protection officers ...) and a library which especially interest for subjects related to radiation and its regulations.



3. Nuclear Regulations

- The competent authority is completely independent (resources, administration).
- Radiation Protection Committee (RPC) has been Formed (24 persons cover all concerned parties in the state) and the Deputy Minister is the head of this committee.
- Basic Radiation Protection Regulations (BRPR) are finalized in compliance with the requirements of the BSS, and (approved by RPC).
- The three steps system (Notification, registration, License) is established (all formats are ready for use), and draft of check lists inspection for activities involved radiation sources has been prepared.
- The agreement between the UAE and the IAEA for application of safeguard in connection with the treaty on the non-prolifection of nuclear weapons has been signed on 15 December 2002 including the additional protocol.
- The draft of emergency planning and preparedness for accidents involving radioactive materials, draft of waste management and safe transport of radioactive materials have been prepared for finalization.

The following are considered as priority areas for technical co-operation between IAEA and UAE:

- Further up gradation of the national radiation protection infrastructure in manner that is compatible with the level of use of radiation and radiation sources in UAE.
- Utilization of nuclear techniques in human health.
- Application of isotope hydrology techniques for water resources management.
- Use of nuclear techniques in agriculture.

4. International Projects Model Project

4.1. The two projects RAW/9/009 and RAW/9/008

4.1.1.Scope: as requirements to development the radiation protection and infrastructure in UAE for implementation, the Model Project (code RAW/009/006) was divided to the following projects: RAW/9/008 and RAW/9/009.

4.1.2. Activities under model project befor separable (workshop, scientific visit, courses).

No.	Title	Place	Period
1	Group Training Course on the safe Transport of Radioactive Materials	Syria	22 Nov-1 Dec 1999
2	Group Training on the Assessment of the Legislative and Regulatory infrastructure	Czech	17-21 July 2000
3	Group Training on Radiation Protection, Waste Management and Quality Assurance in Nuclear Medicine	Sweden	14-25 August 2000
4	Group Training on Radiation and Waste Safety in the Oil and Gas Industry	Syria	8-12 Oct 2000
5	Post Graduate Regional Training Course on Radiation Protection and Safety on Radiation Service	Syria	16/9/2000 27/6/2001

4.1.3. Activities under model project befor separable (Experts Visits)

No	Expert Name	Project code	Duties	Period
1	Mr. R. Dale	RAW/9/006-35	Visiting to Government Hospitals	28/1/-2/2-2002
2	Dr. I. Othman	RAW/9/006-31	Visiting to MOH	31-7/4/2000
3	Mr. A. M. Sharif	RAW/9/006-31	Visiting to MOEW	14-25-1/2001

4.1.4. Activities under model project befor separable (Documentation and instruments) special regulatory documentation related with the law of radiation protection was received and, Ministry of Interior received some equipment and documentation related with this project.

4.2. Activities on project code RAW/9/009: (workshop, science visit, courses)

No	Title	Place	Period
1	IAEA Regional workshop on Developing a national Capability for Response to Radiological Emergents	Vienna	11-15/6/2001
2	First meeting of the Representation Of National computer A	Vienna	18-22/Jun 2001
3	RAW/9/009-001 Regional past Graduate Training Course on Radiation Protection and Safety of Radiation Sources	Syria	16/9/2001 1/7/2002
4	RAW/9/009-002 Regional Training Course on Radiation Protection and Quality Assurance in Radiotherapy	Jordan	4-13 Nov 2001

4.3. Activities on project code RAW/9/008: (workshop, science visit, courses)

No	Title	Place	Period
1	RAW/9/008-001 Regional Training Course on Assessment of Occupational Exposure due to external Radiation Sources	Syria	4-8 Nov 2001
2	RAW/9/008-002 Regional Training Course on the safe Transport of Radioactive material	Lebanon	5-16 Nov 2001
3	RAW/9/009-003 Regional Training Course on the organization and implementation of national Regulatory programmer for the Control Radiation Sources.	Iran	3-14 Nov 2001
4	RAW/9/008-9001	Bahrain	19-21/3/2001

4.3.1 Activities on project code RAW/9/008 (Electrons Documentation) CD on training package for a national workshop on Radiation protection in Hospitals.

5. Activities on International projects during 2002

The following table is summaried all activites related with the subjects runing in UAE:

<table>
<tr><th>No.</th><th>Title</th><th>Location</th><th>Period</th><th>Institution</th><th></th><th>Project No.</th></tr>
<tr><td>7</td><td>Safety of Radioactive Waste Management</td><td>Syria</td><td>27-31/Oct./2002</td><td>MOH</td><td>RTC</td><td rowspan="4">RAW/9/009</td></tr>
<tr><td>8</td><td>Radiation Protection and Safety in Diagnostic and Interventional Radiology</td><td>Iran</td><td>28/9-31/10/2002</td><td>General Authority for Health Services</td><td>RTC</td></tr>
<tr><td>9</td><td>Regional Post-graduate Training course on Radiation Protection and Safety of Radiation Sources</td><td>Syria</td><td>13/Sep./2002
2/July/2003</td><td>--------</td><td>RTC</td></tr>
<tr><td>10</td><td>Radiation Training course on Safety of Radioactive Waste Management</td><td>Syria</td><td>27-31/Oct/2002</td><td>MOH
MOI</td><td>RTC</td></tr>
<tr><td>11</td><td>Assessment of Occupational Exposure due to Intakes of Radionuclides</td><td>Iran</td><td>12-23/Oct./2002</td><td>MOH</td><td>RTC</td><td rowspan="3">RAW/9/008</td></tr>
<tr><td>12</td><td>Calibration of Radiation Measuring Instruments at Radiation Protection Level</td><td>Jordan</td><td>9-13/Dec./2002</td><td>MOH</td><td>RTWS</td></tr>
<tr><td>13</td><td>Regulatory Authorization and Inspection of Radiation Sources in Medical Practices</td><td>UAE</td><td>24/Aug–4/Sep./2002</td><td>MOEW
MOH.
MOI
Dept. of Health and Medical Services</td><td>TC</td></tr>
<tr><td>14</td><td>West Asia Regional Meetings on Safety of Radiation Sources and Installations</td><td>Vienna, Austria</td><td>27-31/May/2002</td><td>MOEW</td><td>RM</td><td>RAW/9/009
RAW/9/008</td></tr>
</table>

2- Emergency Incidents: three cases were detected:

- Missing of radiography projector, No. 2701 on the road between Dubai and Sharjah (the source was Iridium-192,its activity 42.5 Ci, the source was found in scrap yard at industrial area in Sharjah, due to the cooperation between Regulatory authority , civil defense and police)
- The moisture meter involved Am241-Be (neutron source, 50mCi) was found in scrap yard at industrial area in Sharjah due to the cooperation between Regulatory authority , civil defense and police.
- Am241 source was found at the main store of Ministry Finance, it was classified as a scrap.

6. Civil Defense

Federal Law No. 3 for 1979 gave permission to Directorate of civil defense to carry out the following duties:

- Monitoring of import, export, transport and storage of radiation sources.
- Monitoring the safety use to keep workers and public against radiation sources.
- Licenses are issued according to IAEA's regulatory (cooperative with ---Municipalities)
- Qualification of workers through training course on radiation protection
- Emergency plan against radiation accidents.
- The Co-ordinate between Civil Defense and other agencies inside state to control the radiation contamination and waste radiation substances.
- Directorate of Civil Defense has special car to transport radioactive substance inside state.

All companies and hospitals were registered using RAIS programme since 1/09/1999 as all types of radiation sources.

Statistical information about radiation sources through 1996-1999 (as an example in Dubai Emirate) is shown in the following tables.

#	Year	Import	export
1	1996	108	101
2	1997	110	97
3	1998	268	161
4	1999	214	105

i. Facilities were used radiation source in Dubai as follows:

Facilities = Medical use + Industrial use
47 = 20 + 27

ii. 249 radiation sources were used in Dubai and the percentage as follows:

44% Cs-137
32% Ir-192
16% Am-241-Be
Other 8%

7. Conclusion

Recently, under the law all workers handling with radiation shell be controlled through the occupational national programe, and this service is running very well at all hospital government additional to some companies in private sector. UAE will establish fixed satation in borders to monitor radioactive and nuclear materials with coopreration beteewn local authorities and IAEA. Inventory of radiation sources and/or any devices produce or using radiation will be obtain through the distribute the sepceial questioner for that purpose and the system for licence and inspection also will be run. And finaly the following are considered as priority areas for technical co-operation between IAEA and UAE:

— Further up gradation of the national radiation protection infrastructure in manner that is compatible with the level of use of radiation and radiation sources in UAE.
— Utilization of nuclear techniques in human health.
— Application of isotope hydrology techniques for water resources management.
— Use of nuclear techniques in agriculture.

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National Radiation Safety Infrastructure: The case of the Great Jamahiria

B. H. Fawaris

Tajoura Nuclear Research Center
Tripoli-Libya, The Great Jamahiria

Abstract. This paper intend to highlight the steps that has been taken for building infrastructure of radiation safety within The Great Jamahiria in accordance with Act No.2 of 1982, IAEA BSS, the country national work plane, and radiation protection and quality control ' five milestone proposed in model project RAF/ 09/ 029". It will also numerate and explain the different activities, which lead to the present situation of radiation safety services and control the use of radioactive sources within the Jamahiria. After the promulgation of the legislative Act No 2 of 1982 by the general people congress. It also reflect the status and progress in radiation protection services that were carried out within different institutions and organizations utilizing radioisotopes in their activities for twenty years in the Great Jamahiria, for 20 years.

1. An overview (1973-1983)

Before the establishment of Libyan Atomic Energy commission on 1973, radiation safety was conducted only for worker within the two main governmental radiography departments, namely Tripoli Central Hospital and Benghazi Hawwary Hospital by the World Health Organization (WHO) office in Libya. Such services were used for providing some statistical information about the radiological services that were given in the form of assistance to developing countries by UNDP and WHO. The main use of such statistics is to be included in the yearly report produced and prepared by UNDP office in Tripoli. The data includes average values of dose received by few worker in the two hospitals, and no follow-up or recommendations about occupational exposure to competent authority or worker were given. The obtained information usually on a small scale but never the less it gives some information about radiation exposure at least for few radiation workers during that time.

In 1983 department of radiation protection and health physics established within Libyan Atomic Energy commission, when it include radiation control inside and outside TNRC. Additionally all measurements related to Chernobyl impact were also assigned to this organization. On 1988, however; the IAEA started a national project aiming for establishment of Secondary Standard Dosimetry Laboratory (SSDL) which is functioning fully after complition of the training of its technical staff. Thus many activities were conducted as a result of cooperation with the IAEA, including technical training, development of man power, supply of some equipments, and provision of technical documents and some reference materials (IAEA Publications). Many expert mission from IAEA were also conducted aiming for upgrading infrastructure of radiation safety including the establishment of special emergency team within Tajoura Nuclear Research Center (TNRC), which will be included within the national emergency team in the Jamahiria.

2. Jamahiria Experience in Radiation Protection Services

2.1. Regulatory aspects of radiation protection

The regulatory framework for radiation protection that exist in Jamahiria (Libya) since 1982, as there were two regulations that have direct impact on radiation protection:

— Low on regulation of the use ionising radiation and protection against its hazard, (Act No 2, Promulgated on February 15 1982).
— Low on protection of the environment (Act No 7, Promulgated on July 1982).
— National Commission formed on 1983 to work as a policy maker for all aspects and matters related to utilisation and implimentation of radioactive sources in the Jamaheria.

2.2. Role of Radiation Protection and Health Physics Department in Safety Programme

As the assigned commission has no executive body to manage day-to-day work, the department of radiation protection and health physics at TNRC was nominated to execute all programmes related to utilisation of radioactive isotopes and radioactive material within the Jamahiria such as, licensing, Inspection, and monitoring of workers and working places. Those activities include personal monitoring (to determine occupational exposure of both public and worker as a result of handling sources of ionising radiation). Environmental monitoring as well as transport of radioactive material were also included.

Part of Radiation protection and Health Physics duties were deviated to training of personnel responsible for radiation safety at different institutes (Those will act in future as Radiation Safety Officers). The main task however, was to perform all work related to Division of Nuclear Safety or Regulatory body which was not existing at that time (between 1983-2000). The work that has been carried out due to the initiative of radiation protection staff at the national levels were:

— National register of all X-rays apparatus (1125 units in more than 175 hospitals and polyclinic) has been established.

— A personnel dosimetry using film badge has been established for about 1600 employees. The average dose of external exposure per individual at the start of monitoring (1983) was about **100 mrem/year** which then steadily decreased to less than **20 mrem/Year** in (2002).

— All hospitals where the individual average dose exceeded **50 mrem/year** were inspected by the inspection team in order to improve the radiation protection status, and advices and recommendation were given about (sheilding, working procedures and code of practis). After three months, the same hospital will be reinspected untill results were found satisfactory.

— For control of inport export of different sources of ionizing radiation such as X-ray apparatus or any radioactive source, agreement has been reached between Radiation Protection and Health physics and the Customs Authorities in the Jamahiria with the aim to not allow any source of ionizing radiation to inter the jamaheriyia without a written permition and approval of the Radiation Protection National Committee. In this regard a national register of all radioactive sealed sources was established.

2.3. Radiation Protection Activities at Tajoura Nuclear Research Center

The Radiation Protection and Health Physics Department within TNRC performed and supervises all activities leading to the use and utalization of radioactive substances and machines producing ionizing radiation. It also provides TNRC personnel with dosimeters, as well as survey meters to ensure safe handling of radioactive materials within different laboratory of TNRC. In this regard the department is carring the following duties:

— Perform all kind of personnel dosimetry service that include monitoring, calibration, and reading of TLD dosimetrs for all radiation workers.
— Monitoring of environmental radioactivities in the vicinity of TNRC and performing a large number of gamma Spectrometry measurments for imported food material after Chernobyl accedent on 1986.
— Perform training and assistance in case of any radiological accidents.

2.4. Radiation Protection Activities at Hospitals

The activities that were performed in the operating hospitals includes:

- X-ray apparatus registery.
- Personnel dosimetry (workers).
- Calibrations and inspection of all existing X-ray used within diagnostic radiography centers.
- Revission of all X-ray laboratories designe and shielding materials.

2.5. Radiation Protection in the Industrial Sector

For the time being radiation protection practice in the industrial sector were limited to the regestared companies that using radioactive sorces in quality control application such as NDT. For control, each company must open a file at the Department of Radiation Protection and Health Physics at TNRC. This file must containe all activities of such company particularly activities related to use or utilization of radioactive materials or sourses of ionizing radiation. This file will also containe the personnel history (CV) and experience of all workers dealing with sources of ionizing radiation in that companies. The file should contain a table with all records that involved radiation bank of operator or workers.

2.6. Radiation Protection in Oil Fields (Exposure to ionising radiation from NORM)

Radiation Protection and Health Physics department performed a nation wide survey for detection of any radioactive contamination in the Libyan sahara as a result of oil production and explorations which might present (in the form of NORM). which might be generated as a result of mining and/or petrolium exploration activities. The survey covered all working oil companies fields that operating during 2001-2002. The survey pointed out that there were some spots contain some naturally occured radioactivity which were sampled and analysed. Results show there were no direct contamination to worker however, some pips and crude oil separators contain some scales contain some radioactive material such as Ra-226 and Ra-224 in addition to some other naturally occuring radioactive materials. Determined concentrations, however; does not cause any danger to oil worker. Written advise were given to workers not to recycle or handel all/or any of the contaminated pipes by any means and must be kept at a secured and isolated area. The other group of worker in the oil field particularly those performing quality control testes such as NDT, and X-ray radiography inspecting teams. On April 5th a seminar was held at National Oil Companies (NOC) for increasing the awareness of workers and to establish Radiation Safety Officers (RSO) committee at oil sector in the country. Additionally a small booklet contain general information about NORMS, its formation, way of handling, and temporary disposal (storage of raidioactive contaminated scales) was prepaired and will be distriputed to all campanies.

2.7. Radiation Emergency Planning and Prepardness

Radiation Emergency within territory of The Great Jamahiria were expected from the following:

- Fall-out from foreigen or national nuclear reactor accident.
- Radiation accident involving a radiotherapy or industrial radiography source.
- Upgrading and reviewing of all code of practices that exist in the Jamahirya and deal with utilization of radioactive sources.
- Loss of radioactive source.
- Leak or flow of radioactive waste treatment system in Tripoli Medical Center (TMC) and Bengazi Medical Center (BMC).
- Any other hazard as a result of radioactive sources utalization or handling within The Great Jamahiria.

2.8. Role played by the IAEA - TC Department (IAEA input)

The IAEA provided many assistance to make radiation protection survecies in the Jamahiria at its level of to day, such assistances were in many forms. The most important ones were summarized as follow:

- Long term training (many fellowships between 1977-2003).
- Short term training (fellowships for three to six months).
- Radiation Protection Advisary team (RAPAT) mission on 1990
- Workshops related to the upgrading of infrastructure of radiation safety.
- Provission of some equipments such as TLD dosimeters and their axcessories which were essential for radiation safety.
- Providing equipments of SSDL, which was a joint project between IAEA TC divission and The Great Jamahiria.
- International Experts as a part of TC assistant to provide either local training or to provide advices and guidance for some problems.
- Providing Scientific visits to many of local staff.
- Assistance in emergency team training (Special Expert mission).
- Provission of necessary literature materials, which include all IAEA publications such as TEC-DOC, Proceedings, and other electronic publications.
- Provission of Quality control kits to diagnostic x-ray and CT.

2.9. Results Achieved in the area of Radiation Protection in Jamahiria

The most important achivements in the area of radiation protection and radiation safety were as the following:

- Continous monitoring of radiation workers as a part of determination of occupational exposure.
- Determination of Gamma Background radiation around TNRC.
- Revission of all X-ray labratories in the Jamahiria from designe, specifications, and operating procedures.
- Determination of hot spots in the oil fields as a part of Naturally occuring Radioactive Materials (NORM).
- Establishment of a Data base for all companies and private sectors utilizing or importing radioactive materials for NDT.
- Perform all kind of works related to control of radioactive sources in the country, such as (National regestry, Licencing, Inspection, provide training, and Calibrations) for all institutions utalizing radioactive sources in the Jamahiria.
- Increasing the awairness of workers as well as of the competant authorities.
- Establishment of National Non Distractive Testing Sociaty (NDTS).
- Establishment of Regulatory office for control of nuclear material (new, 2002).
- Establishment of Quality control group in the Great Jamahiria (New, 2002).
- Establishment of Emergency team at TNRC, to work as a working radiation emergency team within the country.

3. Conclusion

Regardless of some little problems, and presence of few qualified staff the work in the area of radiation Protection and safety of radioactive materials is satisfactory and start to cover all fields of application including research institutions, and Health sector. Thus the general performance of the different working groups within the Radiation Protection and Safety Department in Jamahiria has fulfilled several components of The first and second milestones of the radiation safety infrastructure as defined in GOV/1999/67 and GOV/2001/48, and in accordance with the cabapilities of Radiation protection and Health Physics Department organigom. During years 2001,2002, and 2003 the authorities diviate a highest priorities to activities, assistance and efforts on capacity bulding in the areas of environmental monitoring, medical exposure control, planning and prepardness to radiological and nuclear emergencies. In the same time aimed to meet the principal requirements of the country safety act No. 2 of 1982 which was in accordance with the IAEA BSS to set up operational system for notification, inspection, autherisation, and enforcement for the control of radiation sources in the Great Jamahiria.

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Table I. calculated dose in man m Sv received by the two working group as external occupational exposure .

Year	TNRC working staff			Operating Hospital w. staff		
	No. Workers	Total Dose	Average Dose	No. workers	Total Dose	Average Dose
83	176	312.8	1.78	366	8854.5	24.19
84	203	736.3	3.63	344	8686.5	25.25
85	213	3291	15.45	280	5605.5	20.02
86	176	1289	7.32	294	4152.8	14.13
87	219	871.3	3.98	290	1252	4.31
88	143	706.8	4.94	192	774.3	4.03
89	139	292.3	2.1	174	676.5	3.89
90	181	207.5	1.15	166	832.5	5.01
91	141	163.5	1.15	320	710.3	2.22
92	124	52.3	0.42	284	617	2.17
93	107	131	1.22	260	630	2.42
94	112	153	1.37	304	620	2.34
95	142	300.4	2.13	305	674	2.21
96	210	612.2	2.91	381	904.4	2.41
97	98	134.1	1.46	344	729.3	2.12
98	104	68.4	0.56	322	708.6	2.2
99	108	41.2	0.38	320	686.8	2.15
00	102	44.8	0.48	366	768.6	2.12
01	122	43.9	0.36	460	964.1	2.1
02	96	40.4	0.42	382	816.8	2.4

Topical Session 4

RESOURCES AND SERVICES (SYSTEMATIC APPROACH), QUALITY ASSURANCE, INTERNATIONAL SUPPORT OF SERVICES

Radiation Protection Infrastructure and Role of the Competent Authority in Iran

M. Ghiassi-Nejad[a,b], **M. M. Beitollahi**[a], **N. Fallahian**[a]

[a]National Radiation Protection Department
Iranian Nuclear Regulatory Authority
Tehran, Iran

[b]Department of Biophysics
Tarbiat Modaress University
Tehran, Iran

Abstract. Based on Radiation Protection Act of Iran (RPAI), which was ratified in 1989, the National Radiation Protection Department (NRPD) has an authority to regulate and to control radiation protection activities over the entire range of ionizing and non-ionizing source applications in Iran. For this purpose, about 100 scientific experts, technical and administrative staff members are involved in research, training and administrative activities through seven main Divisions and three Committees in this Department to protect radiation workers, members of the public, the environment and future generations against the harmful effects of radiation. Considering the increasing applications of radiation sources in different fields such as industry and medicine, as well as operation of Bushehr nuclear power plant in near future, further developments are needed for the upcoming radiation protection programmes in Iran.

1. Introduction

Radiation Protection activities in Iran were started with the establishment of the Tehran University Nuclear Centre (TUNC) in 1957 and developed after the operation of the 5 MW research reactor of the Atomic Energy Organization of Iran (AEOI) in 1967 [1]. The national radiation protection infrastructure was formally established, when the Atomic Energy Act of Iran was legislated and ratified in 1974 [2]. Three years after the Chernobyl accident, in 1989, with regard to existing situations and to fulfill regulatory provisions in the country, the Radiation Protection Act of Iran (RPAI) was ratified [3]. The RPAI empowered the AEOI and in turn its National Radiation Protection Department (NRPD) with authority to regulate and to control radiation protection activities over the entire range of ionizing and non-ionizing source applications. The Radiation Protection Regulations of the 1989 Act were drawn up by the NRPD and approved by the Government in 1990. In the exercise of the RPAI and its regulations, the Basic Radiation Safety Standards (BRSS), approved in 1999, specify the other basic requirements for the protection of human beings, their progeny and the environment against the harmful effects of ionizing radiation [4]. In accordance with the suggestion of the International Atomic Energy Agency (IAEA), and regarding to this fact that the “Authority” should be separated from the “Utility Sections”, the Safe and Peaceful Utilization of Nuclear Energy in Iran, was drafted in 2002. One of the main purposes of this draft is to establish an individual State Competent Authority (not in connection with the AEOI) for the regulatory supervision and control of regulated activities and facilities.

2. Infrastructure and Main Activities of the NRPD

More than 100 scientific experts, technical and administrative specialists, in the form of specialized working groups are engaged in different fields of research, training and administration at the NRPD. Figure 1 shows the organizational chart of this Department.

The general policies of NRPD are: implementing radiation protection regulations, approved by the Parliament, in all centres dealing with radiation; supervision, control and quality assurance of the proper use of radiation; and finally, prevention of hazardous effects on the environment and human health. More than 20,000 radiation workers are involved in 3760 radiation centres.

The main activities of NRPD are performed through an administrative section, seven Divisions and three Committees as follows:

(a) Ionizing Radiation Control and Inspection Division

- Regulatory control including inspection from total of 3760 radiation centres in the country and supervision of radiation sources and practices in different fields such as industry, research, training and medicine.
- Operation of special "Gate Guards" at some border customs across the country for control of radiation sources and imported metal scraps. It should be mentioned that total of 102 radioactive materials including orphan sources and radioactive sources such as ^{137}Cs, ^{90}Sr and ^{60}Co, as well as materials containing or contaminated with radioactive substances have been found in metal scraps during the past 5 years.
- Implementing comprehensive quality control projects, as well as promoting radiation safety culture.

(b) Environmental Radiological Control Division

- Measurement of natural and artificial radionuclides in environmental samples (water, soil, plant) and foodstuffs using radioanalytical techniques and different counting instruments such as alpha and gamma spectrometers, α / β proportional and liquid scintillation counters.
- Establishment of Early Warning Environmental Radiological Monitoring Systems (EWERMS) in 10 stations around the country for the prediction of atmospheric releases of radionuclides due to nuclear accidents in neighbouring countries.
- Setting up a High Volume Air Sampler (800 m^3 h^{-1}) in Capital for detecting radioactive releases in air from nuclear installations or other sources of radiation.
- Measurement of natural radionuclides such as ^{40}K, ^{226}Ra and ^{232}Th in imported mineral substances.
- Radiological inspection of underground mines for the assessment of occupational exposure of the miners due to radon, its progeny and other natural radionuclides.
- Study on High Level Natural Radiation Areas (HLNRAs) in Iran.

(c) Radiation Dosimetry Division

- Occupational radiation protection and control of more than 20,000 radiation workers in about 3760 radiation centres throughout the country by special dosimetric services using:

  i) Film Badge dosimetres for more than 19,000 workers in medical, educational and research centres;
  ii) Thermo Luminescence Dosimeters (TLDs) for about 1120 industrial radiographers; and
  iii) Neutron dosimetres (Neutr Iran) for 121 radiation workers.

- Performing dosimetre irradiation and measurement of radiation.

(d) Medical and Radiobiology Division

- Carry out biological and cytogenetical dosimetry tests and special hematological and medical examinations.
- Radionuclide analysis on biological, fecal and urinary specimens.
- Thyroid gland counting and measurement of radioactive materials in the whole body.

(e) Non-ionizing Radiation Control and Inspection Division

- Measuring the radiation level of different lamps, microwave ovens, cordless telecommunication devices and other instruments, in which radio-frequency radiations are used.

(f) Regulations and Standards Division

- Codification and drafting of laws, rules, regulations and codes of practice on radiation protection, for applying to all radiation centres throughout the country. Some of these documents are as follows:

  i) Basic Radiation Safety Standards (BRSS) [4];
  ii) Radiation Protection Criteria for Bushehr Nuclear Power Plant (BNPP-1) [5];
  iv) Intervention Levels and Operational Intervention Levels for Off-site Radiation Emergency (2001); and
  v) Regulations for Radioactive Waste Management; Safe Transport of Radioactive Materials; and Emergency Intervention (2003).

(g) Evaluation and Licensing Division

- Notification, registration and licensing of radiation sources and practices in different fields of industry, medicine and nuclear installations.

(h) Technical Support Unit

- Repairing, equipping and support servicing of the electronic and nuclear instruments.
- Establishment of computer data base information systems.

(i) Education and Training Committee

- Holding about 187 training courses on radiation protection methods in industry, health care and dentistry fields, to improve and upgrade the general and technical knowledge of all personnel dealing with radioactive sources or radiogenic devices.

(j) Radiological Emergency Committee

- Provision of all radiation protection services and also medical or radiobiological tests performed on those exposed to radiation, to provide complete readiness to cope with possible accidents.
- The administrative section and Expert Committee of the NRPD are also responsible for supporting activities.

3. NRPD International activities

This Department has participated in different IAEA Technical Co-operation Projects including meetings, national and regional training courses, the most important of which can be summarized as follows:

- Acting as the IAEA contact point for the emergency preparedness in the country.
- Participating in Analytical Laboratory for Measurement of Environmental Radioactivity (ALMERA), Proficiency Tests (AQCS), etc.
- Hosting two IAEA Regional Training Courses under the titles of "Assessment of Occupational Exposure due to Intakes of Radionuclides" and "The Organization and Implementation of a National Regulatory Programme for the Control of Radiation Sources", in Tehran (RAW/9/008-003 & 004).
- Establishment of National Training Workshop on the IAEA guidance on developing an effective emergency capability and plan for nuclear or radiation emergency (RER/9/050).
- Holding an International Conference on high levels of natural radiation areas in Ramsar, 1990.
- Participating in International Conferences, IAEA Regional Training Courses and Scientific Visits.
- Publication of several papers in International Journals.

4. Results and Discussion

Considering the number of radiation workers and increasing utilization of ionizing and non-ionizing radiation in diverse fields in Iran, such as industry, medicine, agriculture, health services, training and research as well as operation of Bushehr Nuclear Power Plant in near future and existence of 130 underground mines throughout the country, the NRPD as an authorized and scientifically capable organization, has an important role to regulate the procedures, establishment of rules, regulations, standards, codes of practice and instructions for inspection, supervision and control at all levels of distribution, application and waste management of radiation sources; as well as performing radiological monitoring of the environment and providing dosimetry services and medical examinations for radiation workers. For this reason, the NRPD needs more technical instruments and scientific experts with special trainings to perform above-mentioned tasks.

In this regard, following items seem to be considered for further development of national radiation protection programmes in the country:

- Establishment of a mobile and marine laboratory for environmental monitoring in emergency and normal situations.
- Increasing the EWERMS to 50 stations throughout the country.
- Carry out radon measurements, with regard to number of underground mines and miners in the country.
- Regarding the main responsibilities of NRPD as the only Competent Authority for inspection, control and supervision of radioactive materials or radiogenic devices in the country, some of the administrative activities such as dosimetry services should be performed separately from this Department.

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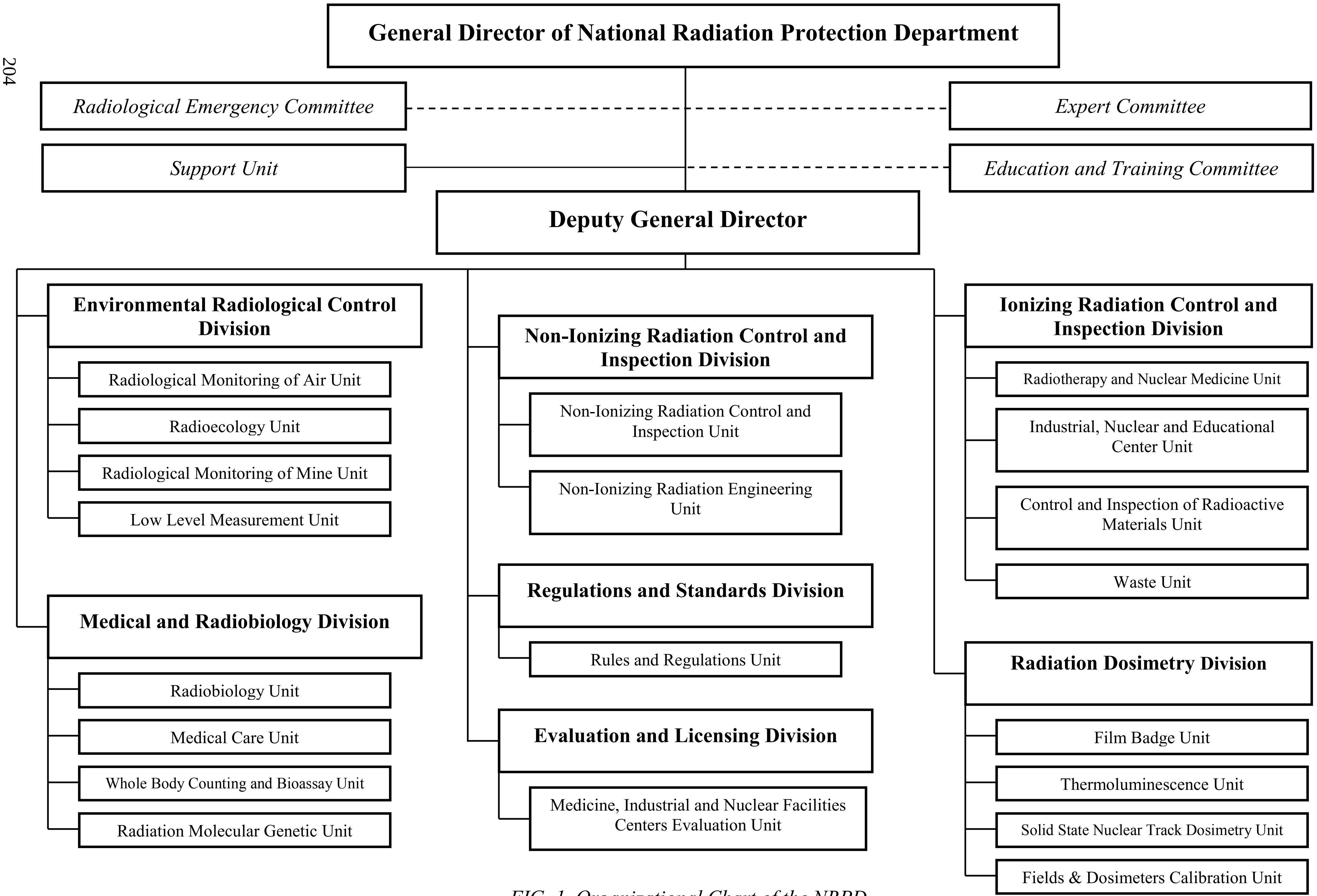

FIG. 1. Organizational Chart of the NRPD.

Implementation of a Quality System based on ISO 9001 Requirement in Malaysia National Dosimetry Services for Monitoring External Exposure

M. A. Noriah

Secondary Standard Dosimetry Laboratory (SSDL)
Malaysian Institute for Nuclear Technology Research (MINT)
Bangi, 43000 Kajang, Selangor Darul Ehsan, Malaysia

Abstract. Long term radiation protection activities in Malaysia has resulted in great efforts to improve mechanisms for controlling and monitoring of external radiation exposure. The requirements for the personal monitoring of Category A workers and of the area known as Personal Dosimetry Services is managed by the Secondary Standard Dosimetry Laboratory of Malaysian Institute for Nuclear Technology Research, SSDL-MINT. SSDL-MINT is expanding into a new frontier in ensuring good quality personal dosimetry services for about 11,000 radiation workers from 1500 different workplaces throughout the country. Recent emphasis on the ISO requirements presents a new challenge to the existing system and offers global measurement harmonization for the radiation protection community. The essential elements of the certification for the SSDL-MINT Personal Dosimetry System are described. This paper provides an insight on the efforts of SSDL-MINT to provide a model national laboratory with emphasis on quality as the valuable and regular features of the activities.

1. Introduction

Radiation protection in Malaysia dated back to the 1970's, when MINT (formerly known as Tun Ismail Atomic Research Center, PUSPATI, and later as Nuclear Energy Unit, NEU) was established. The radiation protection program achieved a broader scope when the activities of using ionizing radiation increased throughout the country. This is evident from the large number of radiation workers in Malaysia, around 11,000 in 2002 [1]. Enforcement of the legal requirements under Malaysia Atomic Energy Act, Act 304, to ensure workers protection, requires the users of radiation sources to implement occupational exposure monitoring on their workers. This requirement is applicable to workers of Categories A and B, according to occupational exposures (respectively in controlled and supervised areas) [2]. It is also in accordance to the Basic Safety Standard [3], where the occupational exposures of these workers ought to be assessed based on individual monitoring or other appropriate information.

Occupational exposures monitoring in Malaysia is carried out by the Personal Dosimetry Service of the SSDL-MINT. The service began in 1985, where SSDL-MINT has been entrusted to issue personal monitoring devices for assessing dose resulting from occupational exposure to ionizing radiation. A total of 133,604 dosimeters were issued in 2002, comprising 119,543 film badges, 7046 TLD's and 7015 chips (5% of the total number were used for area monitoring). The main tasks and capabilities of SSDL-MINT includes the supply and processing of dosimeter systems, as well as evaluation of the dosimeters and issuing of occupational dose reports (Figure 1 and 2). The monitoring of individual workers is carried out on monthly basis and dosimeter readings will serve to ensure compliance with legal dose limits and assure employers that radiation exposure in their premises are kept as low as reasonably achievable. Normal processing and reporting turnaround time is within 4 weeks upon receipt of the dosimeters. Same day emergency processing is also available.

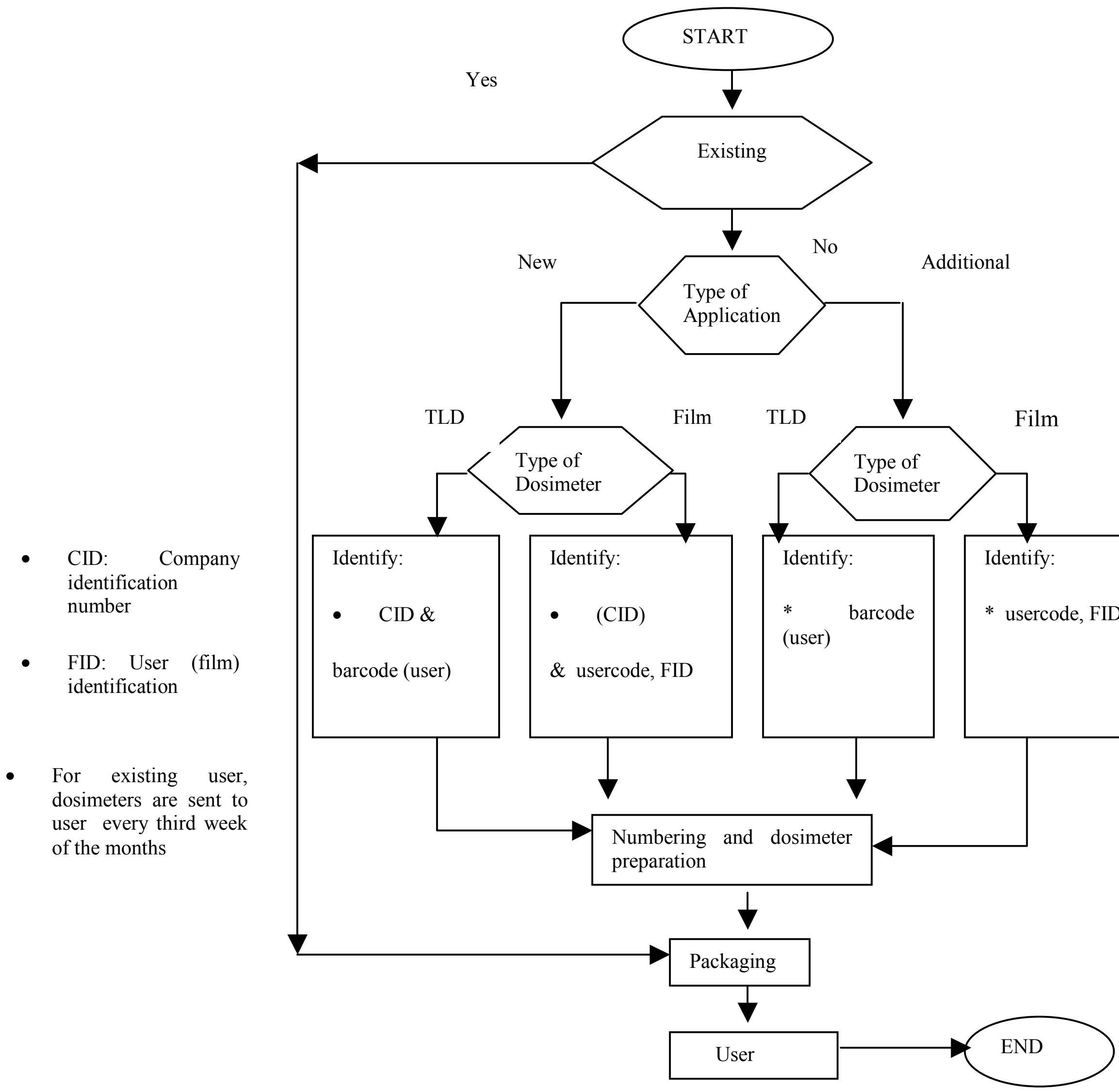

FIG. 1.Issuance of Personal Dosimeter

The routine and systematic collection of data on individual and collective occupational doses categorized by work activity is a key tool to give information on conditions in the workplace. The information is useful in helping the regulating body (Atomic Energy Licensing Board, AELB) and the employer to establishing whether the general conditions in the workplace are satisfactorily under control, and whether operational changes have improved or worsened the working conditions.

In all cases where single dose levels are high (> 20 mSv), or where accumulative doses approach or exceed the limit (50 $mSv.year^{-1}$), the AELB or Ministry of Health will be informed. This will then be followed by an enquiry by the AELB or Ministry of Health and advice on appropriate remedial action (Figure 3). A national dose registry is created at SSDL-MINT, which contains radiation doses for all workers and are stored in perpetuity and maintained throughout until the worker cease to be a radiation worker. This is in accordance with the objective of radiation protection program laid through Act 304, 1984 to ensure the safe use of atomic energy in Malaysia.

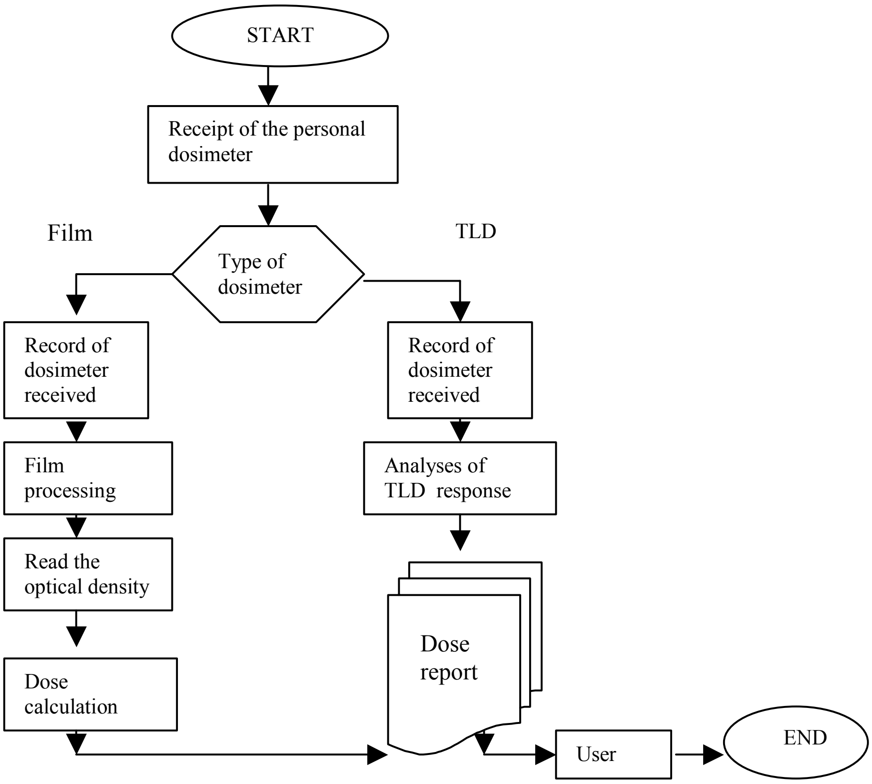

FIG. 2. Evaluation of Personal Dosimeter

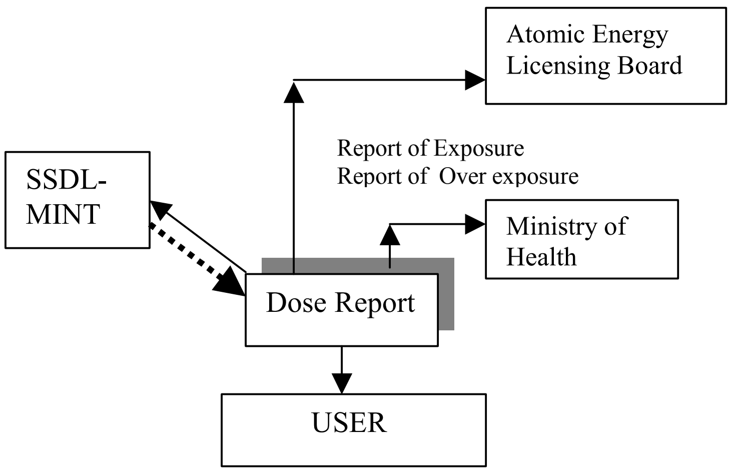

FIG. 3. Communication Network of Personal Monitoring System in Malaysia

2. Individual Monitoring Quality Assurance System

The objective of individual monitoring is normally limited to the measurement of doses delivered to individuals, but its functions are much more extensive; it must demonstrate that the limits of exposure have not been exceeded and that there has not been any unexpected deterioration of the working conditions. Several strategies has been laid down in SSDL-MINT practice, which includes planned and systematic actions that are necessary to provide adequate confidence in the results of a monitoring program. One of the main approach of SSDL-MINT is the integration into a Quality Assurance Management System (QAMS), which is developed with the objective of obtaining the ISO 9002 certification.

It started with a compilation of necessary documents which had been initiated in early 2001. The system is outlined in a stand alone quality assurance documentations structured on two levels; namely strategic and tactical (Figure 4). "Strategy" is pertaining policy, organization and management, whereas "Tactics" concerns the methods adopted to implement them. This illustration represents a logical program structure; other formats may also be acceptable provided that the information meets the following criteria:

(i) Communicates specifications efficiently;

(ii) Demonstrates that all aspects which required control are indeed in control; and

(iii) Permits regular assessment of program effectiveness by the licensee, the operator and the regulatory body.

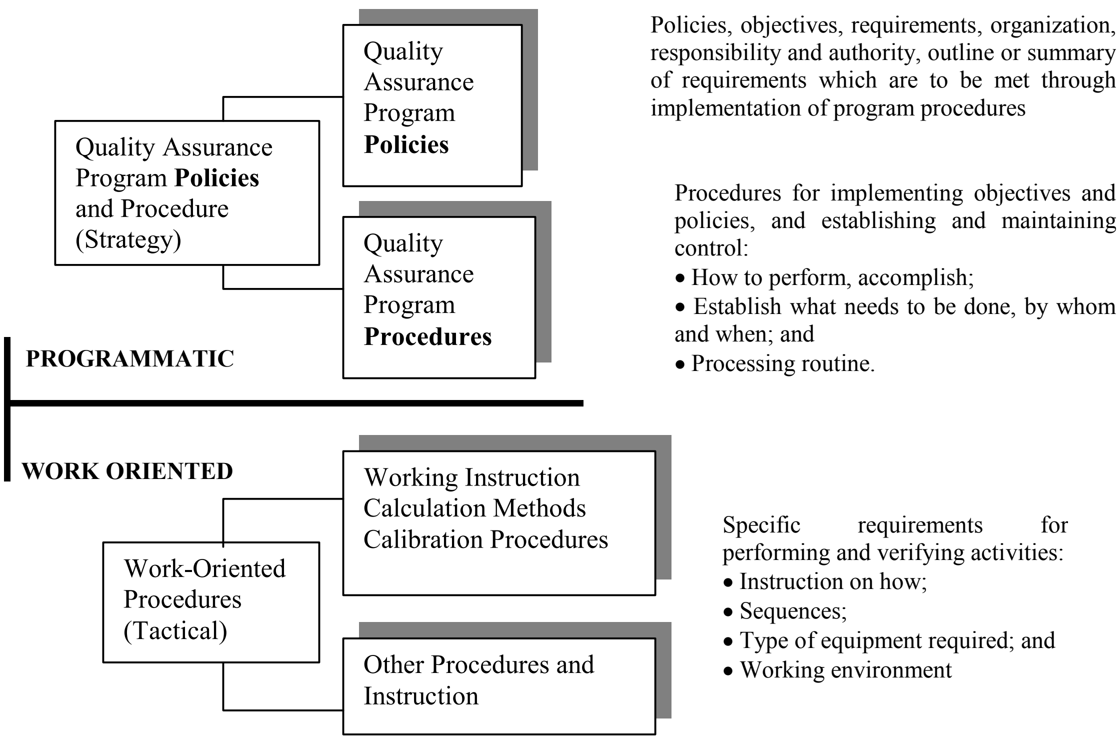

FIG.4. Structured two levels of quality assurance documentation (ISO requirements)

All work is now based on the policy and procedures as documented in the Quality Manual and Quality Procedures. Work instructions are written in layman's terms, easy to be understood by process operators and supervisors; hence, it is also easier to integrate as part of the day-to-day operations. The system documentation is controlled, with each document containing a history of revisions, a distribution list and a signature page duly signed by relevant SSDL-MINT authorities.

Great efforts are also extended in the training of staff to familiarize themselves with the ISO 9002 requirement. Several audits had been performed to continuously review the critical process points, corrective action and outcomes. Third party audit for the purpose of registration was held in early January 2002 and certification obtained by February 2002. This certification will re-affirm the high quality of measurements performed by the SSDL-MINT and instill confidence among its customers on the work that it carries out.

The sufficiently high quality service offered by the SSDL-MINT based on the ISO 9002 certification are as follows:

(i) A sufficiently accurate and reliable dosimetry system which is regularly calibrated and routinely checked;

(ii) Well-trained and experienced dosimetric service personnel;

(iii) On-time delivery of dosimeters to the customers, including information about the results and information to the competent authorities;

(iv) Safe and sufficiently comprehensive storage of dosimetric results for long periods (i.e. 30 years); and

(v) Effective internal quality systems and administration.

The quality management developed and implemented by the SSDL-MINT facilitates the monitoring and consistency of performance (systematic and human resources) relative to the policy, its key principal and the selected and detailed objectives. After one year of being certified to the ISO 9002, the SSDL-MINT is now reshaping the quality based on the ISO 9001 (version 2000), which is a process-oriented structured and are focus for continual improvement of the management system. The model of the complete Quality Management System process is capable of demonstrating the interaction between the processes (Figure 5).

The model recognizes the fact that the customers and other interested parties play a significant role during the process of defining input requirements. Process management is then implemented for all the processes required to realize the required product and/or service and the process outputs are verified. Customer satisfaction assessment, and satisfaction evaluation of other relevant interested parties, are used as a feedback to evaluate and validate whether customer requirements have been achieved.

3. Emphasis on the Certification of the Process

SSDL-MINT is giving more and more attention to the formal institutionalization of Quality Assurance/Quality Management practices for the regular functions. This is owing to, for example the variety and complexity of the activities performed. The commitment of the SSDL-MINT is expressed in a Policy Statement. This commitment is further expressed, which is stipulated by the involvement of management into a Management Review process. This encompasses the review and approval of documentation, internal audits and regular operational reviews involving management and site personnel. The process control of individual monitoring strategy differentiates issuance and evaluation of dosimeter. The overall individual monitoring strategy is supported by various mechanisms to ensure proper assignment, storage, preparation and transportation of personal dosimeters and the traceability of data. Scheduled audits are also planned, since it serves as a guide to correct unnoticeable problem. It gives great boost of confidence to attain a high degree of accuracy in the quality system.

Personnel in the SSDL are trained on various disciplines for the issuance and processing of the dosimeters. Basic training is carried out in a systematic manner to enable worker to adopt the techniques required to obtain a quality personal dosimetry services, as appropriate to the duties. It is provided to every new worker before starting work. The aim is to increase worker awareness and understanding on the specific job-related activities. Supervisor training is also essential to further integrate dosimetry service procedures and work practices into the day-to-day staff activities. The ability to complete the tasks specified are recorded in the Practical Assessment form and are kept at the Quality Assurance Section.

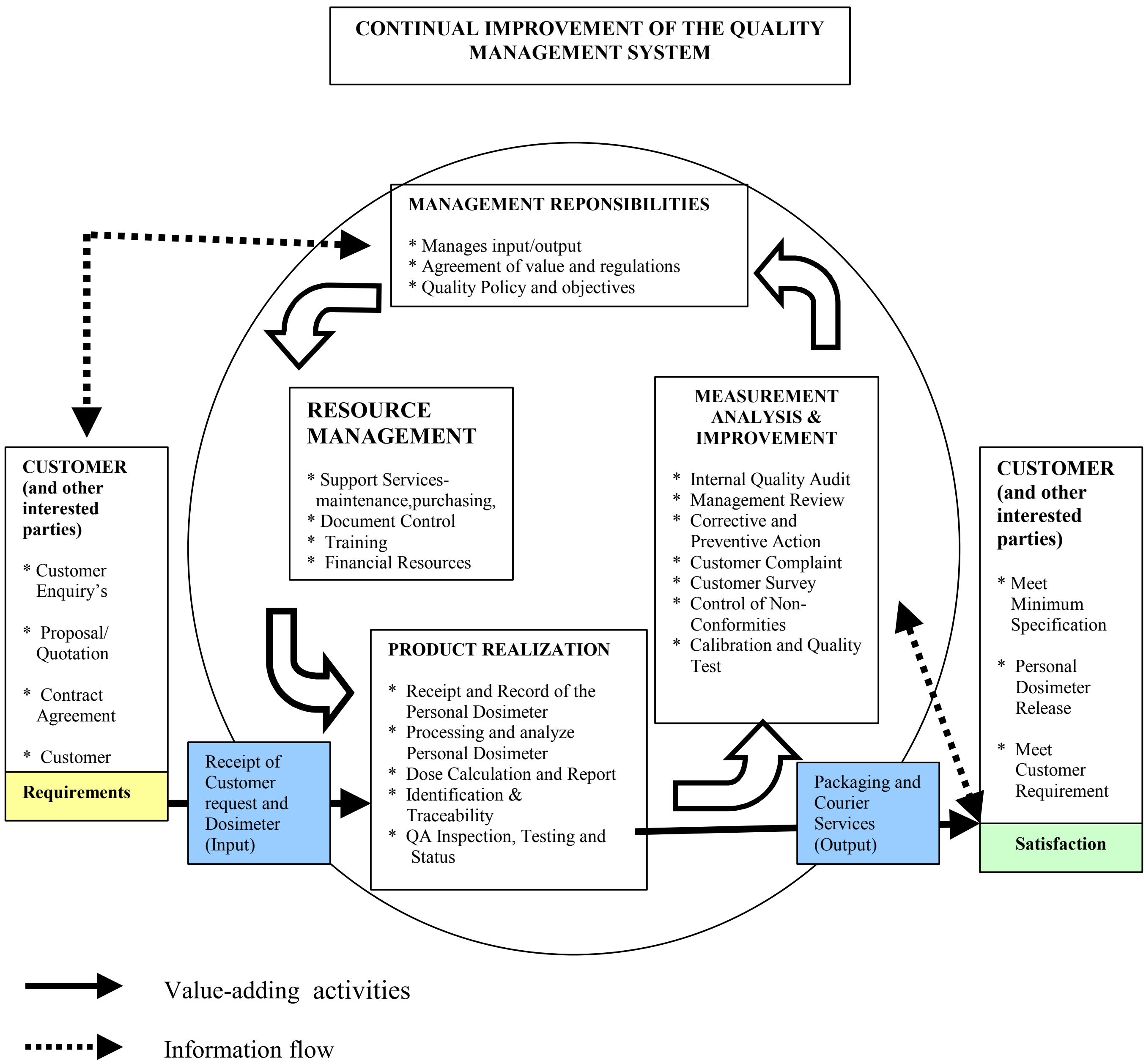

FIG.5. Ilustration of a Prosess-Based Quality Management System at Personal Dosimetry Service, SSDL-MINT

A formal Change of Management process is implemented to handle changes to the system (i.e. procedures, work instructions, equipment etc.). This process puts an emphasis on the facility critical systems. A formal process for identifying, correcting and documenting Non-Conformities is also implemented. Records, Assessment, Report and Communications are key milestones for the continued success of the SSDL-MINT Personal Dosimetry Service. Regular meeting and reports on various Personal Dosimetry aspects involve a wide spectrum of staff, from process operators and supervisor to Section Managers. These meetings and reports have been instituted at an early stage of operation, and include frequent interactions with other divisions in MINT. Besides these meeting and reports, communication with regulatory body and customer on items requiring follow-up actions are tracked in a proper record. Complaints from customers are recorded, analyzed and resolved.

Customer satisfaction is recognized as one of the driving criteria for the sustainability of the process. A nationwide survey had been conducted on the Personal Dosimetry customers in early 2003. From the responses received, more than 90 % of the respondents were satisfied with the services provided. Improvements are also been made by identifying and addressing issues and other concerns from time to time.

4. Summary

A Quality Assurance Management based on the ISO 9001 requirements was successfully developed, implemented and is currently optimized for the Personal Dosimetry Services, SSDL-MINT. It is a complex task that requires long-term commitment, consisting planned and systematic action to provide confidence in the results of a monitoring program. The ISO certification for the Personal Dosimetry of SSDL-MINT marks the continual improvement to properly discharge of the responsibilities and efficiently perform the regulatory activities. It will provide a solid foundation for the SSDL-MINT to earn strong status in strengthening and maintaining public confidence in the radiation protection framework of the country.

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Specific Role of the Service in the Country with Deficient Regulatory Resources

M. Novakovic

EKOTEH dosimetry radiation protection Co.
Zagreb, Croatia

Abstract. The system of radiation protection against ionizing radiation that has been gradually set up in Croatia is based on international standards. As in many countries, in Croatia, the National Regulatory Authority (NRA) is lacking resources and is not fully able to fulfill its legislative mandate pertaining to radiation protection and safety. Especially the NRA is not self-sufficient in specialist expertise. To overcome this deficiency expert supervision of compliance and adherence to prescribed regulations can be carried out by technical services accredited by NRA. Technical services can provide expert technical assistance to supplement both the NRA and radiation user capabilities.

1. Introduction

In recent years the extensive development of worldwide harmonized system for protection against ionizing radiation reached its culmination. That development has reflected in national legislatures and radiation safety infrastructures. The similarity of approach to solving problems of radiation safety in legal acts of the majority of countries originates in international recommendations, especially the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS) published in 1996 as IAEA Safety Series No. 115) [1].

Based on these recommendations, after establishment as an independent country, Croatia has built system for protection against ionizing radiation taking into account new circumstances, but respecting the national legal tradition, inherited allocation of responsibilities and past experience in this field.

2. Radiation Protection Infrastructure and Resources

Radiation protection against ionizing radiation in Croatia today is governed by the Law on protection against ionizing radiation (Official Gazette No. 27/99) [2] and number of regulations based on this Law issued in 1999 and 2000.

The system of radiation protection that has been built to protect the public and workers is extensive and complex, addressing various radiological protection challenges, to name only few: environmental radiological monitoring, medical exposure, occupational exposure control, response to emergency situations, radioactive waste management, transport of radioactive sources etc. The system can be viewed as overly demanding of resources especially in countries encountered with other development priorities. In order to fully comply with the BSS, Croatian authorities made considerable efforts to establish and upgrade a lot of elements of a radiation infrastructure appropriate to its level of usage of radiation sources.

Ministry of Health is the National Regulatory Authority (NRA) in Croatia for protection against ionizing radiation. This allocation of authority is legal and administrative tradition since 1950`s and is very difficult to be changed despite of repeated objections of the IAEA experts that this solution is not adequate. But, although, failed to achieve administrative independence of NRA, experts in Croatia have made considerable efforts to establish a highly efficient radiation safety infrastructure. In this infrastructure provision and role of the competent technical services is crucial.

Ministry of Health as the NRA issues the regulations, exercises the administrative aspects of registration and authorization of practices, users, workers and radiation sources and maintains relevant records in this field. Health inspectors of the Ministry of Health are responsible for field inspections and enforcement of the Law and regulations. Their role is very important in the case of breaching the regulations and in case of poor commitment of the licensee to fulfill radiation protection obligations.

Despite their commitment to address an ever-increasing number of fairly diverse and complex radiological problems, the number of inspectors is never sufficient enough. Very often their background and technical knowledge is deficient to encounter complex radiological problems. It can be improved by additional training of inspectors and by employment of new inspectors but it is often not the prime option of authorities because of the chronic lack of human and financial resources.

The simplest possible solution in order to strengthen and upgrade radiation infrastructure in the country is to accredit competent technical services to exercise a part of the normal inspection procedure. Every country shall provide for essential technical services within the state: dosimetry services, laboratory services, calibration services, radioactive waste management facilities, medical services, training services and expert technical assistance services.

Competent cadre and technical equipment are the key preconditions for granting accreditation to the service of the kind. Of course, the NRA for authorization procedure of the service should establish the criteria. If the service can fully met the criteria the accreditation can be granted. Part of these criteria could be ISO 17025:2000 or similar standards.

In Croatia, we have only one inspector for hundreds of licensees and thousands sources, but there are three accredited technical services and they render their services as a part of the authorization or inspection procedures prescribed by NRA.

The legal obligations of the licensees that they shall to comply with are those described in BSS and many other IAEA technical documents transferred into Croatian regulations. It is the too demanding task even for big organizations-licensees and they seek for outer help and advice.

Again, technical service can deploy its resources as an advisory body to the licensee. Showing its other face (like ancient god Janus) as a specialized competent organization for rendering services in the field of radiation protection, technical service with the same resources and skill used for participation in inspections, can provide its partners-licensees with the best available service addressing their obligations concerning organization, measurement, remedy actions, planning and response to comply with legal requirements. Accredited technical services could be contracted to the licensees to give the best support in fulfilling their obligations pursuant to the Law and regulations.

The comprehensive report on the findings, measurements, safety assessments and overall evaluation of the radiation protection status of the licensee, technical service shall submit not only to the licensee as a client, but to the NRA as well. Of course, it should be available to the inspector. Ultimate judgment about the compliance with the law and regulations is reserved for the NRA or inspector. They are in possession of the legal power to order remedy action or to revoke license.

Not to mention that any technical service can have contract with a licensee and provide him with services, but the NRA would rcognize only reports by the accredited technical service.

Real value of this arrangement is optimal and rational using of limited resources available in the country for radiation protection and financial savings as well.

3. Conclusion

Principles of radiation protection and safety are now well known and being put into legislation and practice, leading to a degree of international harmonization in safety standards. The user sees standards, both international and national, as an external requirement and not as an aspect of conduct that will help the organization to succeed on the market. Safety is seen very much as a technical issue. There is little awareness of behavioural and attitudinal aspects of safety performance, and no willingness to go beyond mere compliance with rules and regulations. Regulatory inspection and enforcement are essential tools for monitoring radiation protection and safety. Prime responsibility for radiation protection and safety rests with the holder of the license for the operation of a given radiation source or facility, but regulators can either help or hinder the process of managing safety. In the regime of compliance-based regulations, for example in Croatia, inspection and enforcement are largely a matter of verifying compliance the rules and penalizing non-compliance. In this regime, the role of the expert technical service is the key one to assist both NRA staff and user. Regular peer reviews conducted by technical service are an important way of avoiding insular thinking on radiation protection and safety matters within an organization. When NRA exists but has not the necessary resources at its disposal, the competent accredited technical service can provide for the critical examination and improvement of safety performance, and to ensure that line management is effective in monitoring operational safety performance and tasks timely corrective actions to improve performance.

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The European Radiation Dosimetry Group (EURADOS)

C. Wernli

EURADOS Council
Paul Scherrer Institute
Villigen, Switzerland

Abstract. EURADOS is an international non-profit making organization with the objective to advance the scientific understanding and the technical development of the dosimetry of ionising radiation in the fields of radiation protection, radiobiology, radiation therapy and medical diagnosis by the stimulation of collaboration between European laboratories. The executive arm of the Society is embodied by a General Assembly representing EURADOS voting members. EURADOS is governed by a Council elected by the General Assembly. Voting members (currently 47) are selected European laboratories involved in performing or promoting scientific research in radiation dosimetry.

1. Introduction

The European Radiation Dosimetry Group (EURADOS) carries out projects and network activities to advance the scientific understanding of the dosimetry of ionizing radiation, promote the technical development of dosimetric methods and instruments and their implementation in routine dosimetry, and ensure consistency of the dosimetric procedures used within the European Union and compliance with international guidelines. EURADOS was founded in 1981 as a successor organization of the earlier committee on Collection and Evaluation of Neutron Dosimetry Data (CENDOS). The operation of EURADOS was supported since its founding by the Radiation Protection Programme of the European Commission and starting in 1992 under contracts of the 3rd, 4th and 5th Framework Programmes.

2. Membership

The EURADOS General Assembly consists of:

— 47 voting members (status February 2003), i.e. selected European laboratories involved in performing or promoting scientific research in radiation dosimetry, and

— about 130 associate members, who contribute to the activities as individual scientists from European countries.

EURADOS is governed by a Council of currently 12 members elected by the General Assembly.

3. EURADOS Activities

Dosimetry research in radiation protection, radiobiology, radiotherapy and radiology involves investigations in very wide-ranging and very different areas of science and technology such as:

— instrumentation

— computational physics

— various branches of radiation science.

A few examples of activities are:

- **Search for suitable sensors for personal dosemeters**: Investigation of the responses of small, radiation sensitive, probes to various types of radiation
- **Properties of radiation protection instruments**: Investigation of the dosimetric properties and operational characteristics of new or improved personal dosemeter designs and survey instruments
- **Improved dosimetric techniques**: Techniques with potential to provide improved dosimetric information, such as microdosimetry and spectrometry, need to be understood and their performance optimised
- **Characteristics of radiation fields**: The energy and direction characteristics of both workplace fields and areas of public access where enhanced dose rates occur need to be investigated
- **Internal dosimetry**: Spectrometry techniques widely used in internal dosimetry may benefit of the emergence of modern semi-conductor technologies. The results however need traceability to standards and, in some configurations like whole body counting, numerical methods can contribute to improve calibration and therefore the accuracy of the measurement.

Combinations of experimental investigations and calculations are performed for

- the determination of conversion coefficients from fluence, or kerma, to dose equivalent
- retrospective dosimetry
- dosemeter, instrument and shielding design studies
- development of procedures and systems for the characterization of dosemeters and instruments
- determining the constituents of cosmic-ray fields.

4. EURADOS Working Groups

The present working groups are:

- WG1: Facilities for dosimetry research
- WG2: Harmonisation of individual monitoring in Europe
- WG3: Environmental radiation monitoring
- WG4: Numerical dosimetry
- WG5: Aircrew exposure
- WG7: Neutron spectrometry

EURADOS working groups are sometimes asked by the European Commission for expert advice (e.g. WG 5).

5. EURADOS' Contribution to European Radiation Protection Education and Training (ERPET) programmes

The following training courses have been organized by EURADOS since 1992:

- *Training course on the use of MCNP in radiation protection and dosimetry*, organised by EC-EURADOS-AMCG Imperial College, London, September 28 - 1 October, 1998.
- *Dosimetry for Radiobiology*, organised by EC-TNO-EURADOS-EULEP, Leiden, May 10-15, 1998.
- *Assessment of Doses from Occupational Intakes of Radionuclides*, organised by EC-SCK/CEN-EURADOS in collaboration with NRPB, Mol, October 6-10, 1997.

- *Training Course on the Use of MCNP in radiation protection and dosimetry*, organised by EC-EURADOS-ENEA, sponsored by OECD, Bologna, May 13-16, 1996.
- *Advanced methods in radiation measurement and dosimetry*, organised by EC-GSF/IARR-EURADOS, Bad Honnef, April 24-28, 1995.
- *Assessment of Doses from Occupational Intakes of Radionuclides*, organised by CE-IPSN-EURADOS, in collaboration with AEA and NRPB, Cadarache, October 6-10, 1994.
- *Applications of modern methods in radiation measurement and dosimetry*, organised by EC-GSF/IARR-EURADOS, Neuherberg, September 12-16 1994.
- *Modern Methods in Radiation Measurement and Dosimetry*, organised by EC-GSF/IARR-EURADOS,
  Bad Honnef (Germany), 23-26 November 1992.

6. International Intercomparisons organised under EURADOS auspices

- 3rd European intercomparison exercise on internal dosimetry. (1998)
- Trial performance tests in individual monitoring of external radiation. (1998)
- Results of a large scale neutron spectrometry and dosimetry comparison exercise at the Cadarache moderator assembly (1997)
- European intercomparisons of methods used for the assessment of intakes of internally deposited radionuclides. 2nd Exercise (1994)
- Determination of the neutron and photon dose equivalent at workplaces in nuclear facilities of Sweden. A joint SSI-EURADOS comparison exercise. (1994)
- An international intercomparison of criticality accident dosimetry systems at the Silene reactor. (1993)
- Fast and high energy neutron detection with nuclear track detectors: results of the European joint experiments. (1992/93)
- European intercomparisons of methods used for the assessment of intakes of internally deposited radionuclides. 1st Exercise. (1992)
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8. European Research in Radiological Sciences Newsletter

This Newsletter is disseminating the information of the activities carried out and the progress achieved within the specific programme EURATOM "Research and training in the field of nuclear energy", in particular within the key action nuclear fission and the generic research and development on radiological sciences. It is published twice yearly by the European Late Effects Project Group (EULEP) and EURADOS for support of their networking activities in partnership with the European Commission. Further information is given in: http://www.euradnews.org.

9. Conclusion

EURADOS is a regional organisation that has shown a special ability to contribute to the transfer of research and development issues and of scientific knowledge to a wide range of stakeholders in the use of ionising radiation and in radiation protection.

10. Contacts

Detailed information about EURADOS and its actual and past activities can be found on: "www.eurados.org". For comments or questions to EURADOS, contact the Chairman, Dr. Pascal Pihet, at "pascal.pihet@irsn.fr".

UAE National Occupational and Environmental Dose Assessment

M. M. Fikree, F. M. El-Assaly, N. K. Boor, et al.

Radiation Protection Department
Ministry of Health, UAE

Abstract. Radiation safety guidelines and federal regulations require that radiation workers should be monitored in order to maintain the exposure as low as reasonably achievable. Due to the peaceful applications of ionizing radiation in different fields in UAE, there are certain risks which can be restricted and controlled through successful implementation such as occupational and environmental dose assessment. External and internal dose assessment for radiation workers needs to establish monitoring programmes with appropriate dosimetry to be used for individual, workplace and environmental monitoring. Radiation protection department implement the TLD system for external dose assessment and gamma spectrometer for internal dose assessment. Results of applications of both external and internal dose assessment are present.

1. Introduction

United Arab Emirates has been using ionizing radiation for more than 30 years in peaceful application such as medicine, industry, agriculture, oil and ground water logging, and research in order to achieve social economic development. The impact of ionizing radiation as a tool in medicine has been very spectacular specially in Diagnostic Radiology, Radiotherapy and Nuclear Medicine. As in any other human activity, use of radiation sources and equipments has its attendant risks. The associated risks shall be restricted and controlled through successful implementation. Therefore regulatory Controls are necessary to ensure that these risks are kept as Law as reasonably achievable [1]. The regulation should ensure that no sources or practice is permitted without the approval of the competent Authority.

2. Legislation

The Federal Law has been approved by the President of the UAE, since Jan, 2002. Ministry of Electricity and water is the Regulatory Authority.

3. Ministry of Health

Ministry of Health (MOH) sharing the responsibility for the following items in medical field as a Competent Authority:

- Occupational exposure control
- Medical exposure control
- Development of a calibration program for medical applications (SSDL).
- Radioactive waste management for medical sources.
- Sharing emergency response and preparedness plan for UAE.

4. Occupational Dose Assessment

Occupational exposure to radiation can occur as a result of various human activities. Hence for any worker who is normally employed in these fields and may receive significant occupational exposure shall be assessed on the basis of the results of monitoring of the workplace and the individual monitoring. Where individual monitoring of workers is required, an approved monitoring service should be selected. This service should be capable of providing adequate dosimeter systems for the estimation of Hp(10) and Hp(0.07), as appropriate [2,3]. Central Laboratory for Radiation Protection (CLRP), MOH, service is responsible for the performance of the dosimeter and the reliability of the service also be able to evaluate dosimeters within a short time if an overexposure is indicated or expected. [4]

5. Materials and Equipments in CLRP

— Two TLD Reader Systems: Model Harshaw 6600 E & CCD Readers and Model Harshaw 4000 Reader;
— Irradiator: Model Harshaw 6610 Irradiator (100 mCi Cs-l37 source);
— Dosimeters: *Whole body dosimeters* (consist of two LiF TLD-100 element cards), *Environmental dosimeters* (consist of two LiF TLD-100 and two CaF_2 TLD-200 element cards), *Neutron-γ mixed field dosimeters* (consist of four LiF: two TLD-600 and two TLD-700 element cards), *EXT-RAD extremity dosimeters* (Chipstrates) mounted in carrier cards, and *DXT-RAD extremity dosimeters* (Ringlets) mounted in carrier cards;
— Software: *WinREMS* (Windows Radiation Evaluation & Management System) and *HPRS* (Health Physics Record System);

6. Calibration of the System

The system was calibrated by GSF Secondary Standard Dosimeter Laboratory (SSDL) in Germany, for: X-ray (N80), □-ray (Cs-137), □-ray (Co-60), Extremities, Environmental measurements, & Mixed Field (n, □). The Cs-137 reference source (100 mCi) has been calibrated by applying the calibration used by GSF and IAEA (SSDL) secondary standard dosimeter laboratory.

7. Occupational Exposure Record Keeping

The BSS require that employers, registrants and licensees shall maintain exposure records for each worker for whom assessment of occupational exposure is required. Record keeping is an essential part of the individual monitoring process which include external and internal doses as:

— Measurement of external dose and method of assessment as: Personal dose equivalent Hp(10)
— Measurement of internal dose as: Committed effective dose E(20)

The Health Physics Record System

The Health Physics Record System (HPRS) is the most updated software that records and reports radiation exposure (internal and external) information as health physics records. The computer software operates on a computer station different from the readers control. The creation of this central office to archive dosimetric situations and provide epidemiological data for MOH to ensure the management of dosimetric situations and the durability of the files over long terms at least 30 years. This system also offers:

— Receive dose data for individuals and groups
— Produce radiation dose reports for company or government
— Maintain updated and historical files for health physics records

8. Occupational Exposure Control

MOH radiation workers are monitored by CLRP since 1997 by personal dosimetry for external dose assessment using TLD cards. In medical practices the radiation fields consists of □, X-rays, & □-rays. The annual doses of these workers for the years from 1997 to 2001 are shown in Table I and Figure l.

9. Environmental Dosimeter Calibration

The Central Laboratory for Radiation Protection – Ministry of Health sharing in the EML 12th International Intercomparison of Environmental Dosimeters using Harshaw Bicron 8807 TLD Model. These TLD dosimeters contain LiF (TLD-100) and CaF_2 (TLD-200) have been exposed to a certain dose from EML and Measured at CLRP-MOH, UAE. The performance tests pass for the TLD dosimeters

Table I. Annual Radiation Doses for Occupational Workers of MOH – UAE

Dose Range (mSv)	Number of Workers									
	1997		1998		1999		2000		2001	
	Deep	9.1.1.1. hallow	Deep	9.1.1.2. S hallow	Deep	9.1.1.3. S hallow	Deep	9.1.1.4. hallow	Deep	9.1.1.5. S hallow
< 0.50	207	203	251	255	270	277	245	219	421	415
0.51-1.0	39	40	103	93	229	211	184	204	90	100
1.01-1.5	4	4	17	23	18	24	8	14	14	10
1.51-2.0	0	2	3	2	5	4	4	2	4	4
2.01-10	0	1	5	6	15	20	12	14	11	11
10.01-20	0	0	1	1	2	2	0	0	0	0
> 20	0	0	1	1	1	2	0	0	0	0

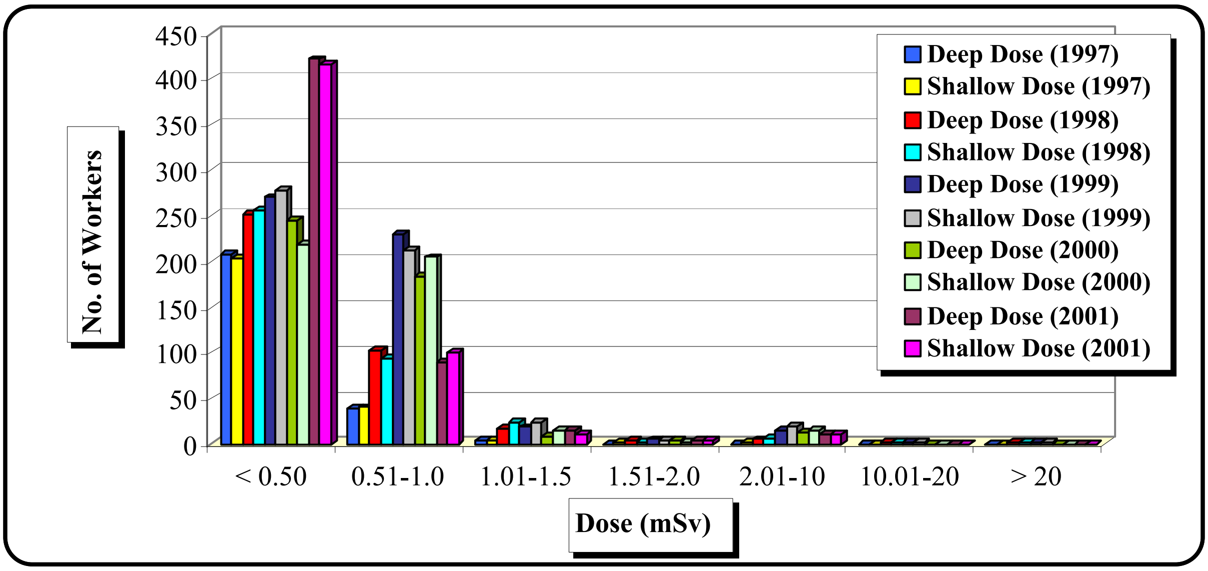

FIG. 1. Annual Radiation Doses for Occupational Workers of MOH - UAE

10. Radiation Doses from Natural Sources

Natural background radiation represents a substantial fraction of the total radiation exposure for most of the population. Hence information about the doses due to the natural background radiation can be considered as basis for UAE population. Investigation of high levels of natural background exposures in some areas might pose a risk for some population living in such areas which may require some remedial actions to reduce health hazards. This may initiate national survey programs for monitoring, assessment and probably some action to mitigate the dose level associated with such places. This kind of program may be linked with some epidemiological survey programs which might help in establishing direct evidence on the risk of radiation exposure at low dose rates by comparing the frequency of cancer or genetic abnormalities in each area. Positive results from such surveys would be very important in terms of radiation protection for the general population. Long term measurements of the dose rates due to ionizing component of gamma rays and gamma from terrestrial sources have been determined by using TLD dosimeters. Two environmental TLD cards were used for 4 periods in a whole year. Direct measurements of absorbed dose rate in air have been carried out in years 2000 & 2001 for 24 locations in UAE. TLD-700 dosimeters were also used in similar measurements during year1993. THE UAE outdoor external exposure rates from environmental gamma radiation was measured during the year 2000 and is indicated in Figure 2. The average dose rate for years 1993, 2000 & 2001 were compared with world population average dose rate. Also the annual effective dose due to natural radiation sources were determined and compared with the annual global per caput effective dose.

11. Assessment of Incorporated Radioactivity

Occupational exposure due to radioactive materials can occur as a result of intakes of radionuclides via a number of pathways as inhalation, ingestion, absorption through the input skin and through wounds. The assessment of doses to workers routinely or potentially exposed to radiation through intakes of radioactive material constitutes an integral part of radiation protection program and helps to ensure acceptably safe and satisfactory radiological conditions in the work. Typical methods of individual monitoring for intake are direct method as whole body counting, organ counting and indirect method as the analysis of the samples of excreta as 24 hours urine. [5, 6]

12. Determination of Gamma Emitters in Urine Samples

The radiation protection department, MOH, participate in IAEA 2000 intercomparison for Determination of Gamma Emitters in Urine Samples [7]. This calibration can be used for radiological measurements, monitoring purposes and assessment of radiation doses to workers and public. The measurements carried out by using Hyper pure Germanium detector, multichannel analyzer with software as Gamma Spectrometer.

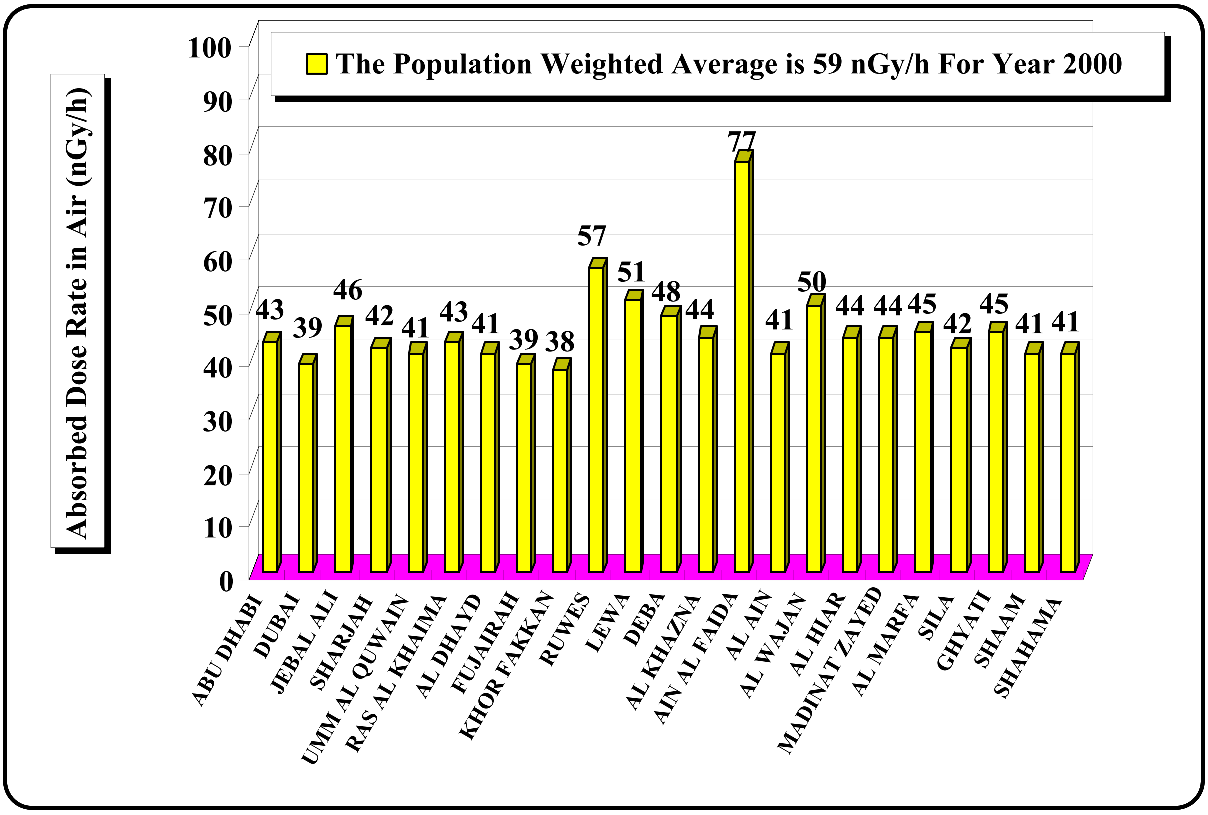

FIG. 2. UAE Outdoor External Exposure Rates from Environmental Gamma Radiation During Year 2000

Physical characteristics of the Gamma Spectrometer such as linearity, resolution, efficiency and minimum detectable activity have been performed with mixed source Marinelli beaker. The minimum testing level is 2 BqL^{-1} which recommended by ISO standard 12790-1. The results of the findings spikes 54Mn, 137Cs, and 60Co for samples B, C are determined with the range of accuracy from 97% to 99%. Measurements have been carried out to:

— The urine of the staff of nuclear medicine departments.

— Urine of workers for interm storage of Mo-99 generators contaminated with Sb-125.

— Medical waste of Ash samples from hospital incinerators.

The results of urine analysis indicate no significant contamination to the nuclear medicine staff and to Mo-99 the interm storage workers. While the ash of medical waste indicates the presence of isotopes used in nuclear medicine and radiotherapy but with low activity.

13. Conclusion

The UAE authorities are working to ensure accurate environmental and occupational dose assessment. A record keeping system is operational. Successful monitoring has been accomplished using TLD dosimeters and gamma spectrometers.

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Individual Dose Monitoring of Workers in Tunisia

L. Ben Omrane, F. Chehimi, M. Nouioui, et al.

Centre National de Radio-Protection (CNRP)
Tunis, Tunisia

Abstract. One of the charges of the "Centre National de Radio-Protection, CNRP" is the evaluation of external radiation dosimetry. The CNRP's dosimetry laboratory monitor approximately 3000 workers periodically. 70% of the dosimeters used are film dosimeters, the remaining thermoluminescent dosimeters. The operational quantities Hp(10) and Hp(0.07) are usually used in practice. Hp(3) is provided for TLD measurements. Our perspective are now towards the establishment of performance tests, harmonisation and quality assurance program. Also, a committee of expert directed by the ministry of health is now actively working to accommodate the national legislation to the new basic safety standards.

1. Introduction

Occupational exposure to radiation in Tunisia is a result of various human activities : these include work associated with the use of radioactive sources and x-ray machines in medicine, industry, agriculture and scientific research.

In order to control this exposure, it is necessary:

— To have legislation and regulation in place. These ones were implemented by the law of 1981 [1] and the decree of 1986 [2] on the radiation protection and the safety of radiation sources.

— To have a radiation safety programme represented by the Centre National de Radio-Protection (CNRP), which has in charge to assess the magnitude of the doses involved, since 1982 [3].

2. Objectives

The individual monitoring programme for external radiation exposure is intended to:

— Optimize protection by demonstrating that the workers exposure has not exceeded any dose limit in a given situation.

— Assess, record and archive individual doses of workers

— estimate accidental exposures.

— Informe on protective actions in the case of an emergency exposure situation especially for workers undertaking interventions.

3. Operational Quantities and Dosimeters for Individual Monitoring

The CNRP's dosimetry service is providing the operational dosimetric quantities: Hp(10), Hp(0.07) and Hp(3) in some cases, for nearly 3000 workers.

Two types of dosimeters are used to measure these quantities:

— Thermoluminescent dosimeters (TLD) with the Harshaw 6600 reader, for 860 workers located around Tunis.

— And photographic film dosimeters for 1900 workers in the rest of the country. This kind of dosimeters is provided and measured by the IRSN (Institut de Radioprotection et de Sureté Nucléaire) in France.

All the workers are monitored for photons, around 12% for neutrons.

A calibrating programme in accordance with the ISO4037 [4, 5] recommendations is established in the Secondary Standard Dosimetry Laboratory (SSDL) of the CNRP for the periodic calibration of the equipment. This SSDL is equipped with a Caesium 137 source and an X-ray installation which provide six narrow irradiating beam for the different calibration purposes in radiation protection domain. Particularly, calibration is performed at laboratory of the IAEA for neutron dosimetry.

4. Results of the Occupational Monitoring Programme

4.1. Dosimeters distribution

In 2002, the CNRP's dosimetry service provided 12835 dosimeters (5181 TLD and 7654 photographic films) for 368 institutions (180 private and 188 public).

These dosimeters were distributed on four specific occupational categories derived from the main activities encountered with ionizing radiations : medical, industrial, scientific research and miscellaneous (Fig. 1). 80% of the monitored workers are in the medical field.

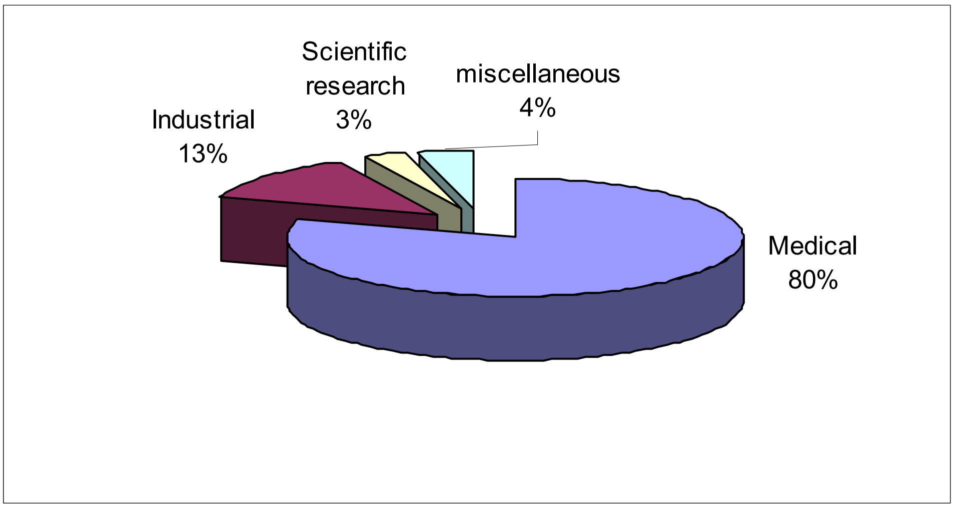

FIG. 1. specific occupational categories for the monitored workers in Tunisia

4.2. Dose assessment

The table 1 shows the number of workers and their average effective dose effective dose in the various specific categories monitored in the year 2002. The recorded annual average doses are too low, with the highest values attributed to the nuclear medicine staff. However, considering the large number of workers in conventional radiology, this activity contributes by 38% of the occupational collective effective dose in Tunisia.

4.3. Special studies

Results of exposure monitoring shows that nuclear medicine, interventional radiology and biomedical research are the most irradiative activities in Tunisia. To evaluate these techniques, a study on dose assessment was carefully conducted for the staff of:

Table I. Dose assessment for monitored workers in the various occupational groups for the year 2002.

Occupational group	Number of monitored workers	Annual average effective dose (mSv)	Annual total effective dose (man Sv)
Medical			
Conventional radiology	1893	0.14	0.26
Interventional radiology	384	0.49	0.19
Nuclear Medicine	55	0.81	0.04
Radiotherapy	53	0.1	0.01
Biomedical maintenance	28	0.1	0.00
Veterinary medicine	10	0.1	0.00
Industrial	337	0.15	0.05
Scientific research			
Biomedical research	27	0.5	0.13
Educational establishments	74	0.14	0.01
Miscellaneous	101	0.1	0.01
Total	**2962**		**0.69**

- Nuclear medicine with the evaluation of doses to extremities by thermoluminescent dosimetry.
- Neuro-radiology service in Tunis with the measurement of absorbed doses at different points by thermoluminescent dosimeters, for technicians, nurses and for the physicists.

4.4. Accidental exposures

Accidental exposures are treated in emergency. They are often related to:

- Women in ignorance of their pregnancy.
- Industrial sources locked out of their protective shielding (three records > 50 mSv since 1990 and only one about 140 mSv in 1994)
- High doses from some workplace dosimeters.

5. Perspective and Difficulties

- TLD generalization becomes a priority for the CNRP with a major difficulty in the cost of the dosimeters especially with a nearly high percentage of lost dosimeters.
- Maintenance service for Harshaw is a an handicap with the absence of a competent manufacture representative in place.

— Upgrading to the new dosimetric limits
— Implementation of a quality assurance programme and harmonisation.
— Training on the performance of dosimetric service and especially exchanging experience with other countries.

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Control of Personal Exposure to Ionizing Radiation in the Republic of Croatia

D. Kubelka, N. Sviličić, I. Kralik Markovinović

Croatian Radiation Protection Institute
Zagreb, Croatia

Abstract. Legal authority for radiation protection in the Republic of Croatia is the Ministry of Health (MH). According to the provisions of the Radiation Protection Act and related regulations, the MH has three institutions to perform activities related to the measurement of the ionizing radiation. The Croatian Radiation Protection Institute has been entrusted to build and manage a central national registry of radiation sources, persons working with the sources and the doses that they receive during their work. Based on the data collected, we were able to analyze the distribution of the doses received by the employees in various institutions. The degree of professional exposure in the Republic of Croatia is relatively low. Most of the workers, over 83.5 %, receive annual doses less than 0.1 mSv. Only 0.1 % of workers receive the dose of 10 mSv. The structure of dosimetry control and records management that has been built gives expected results. Planned changes of the regulatory structure, in accordance with BSS, under the Model Project RER/9/062 should transfer the main regulatory authority prerogatives to the CRPI and give it more power in solving the problems stated.

1. Introduction

Main purpose of systematic personal exposure measurement is to control that measurements of workplaces are carried out in compliance with current regulations and that prescribed protective measures have been undertaken to minimize irradiation of persons working in ionizing radiation zones. Based on the measurements, individual exposure to external radiation is estimated and compared with effective dose limits prescribed by the law. The limits may only be exceeded in cases defined by the law, provided the prescribed conditions are strictly obeyed. Furthermore, the data acquired in that way are important for development of new protective techniques necessary when working with the sources of ionizing radiation.

To be able to control the degree of professional exposure to the ionizing radiation of individuals and groups, it is necessary to have institutions qualified for rendering the dose measurement services (i.e. dosimetry services). Every such institution has to satisfy conditions prescribed by the law and to obey good practices of the trade. The measurement results must be collected systematically and kept in a proper way. They must be easily accessible and in a form that facilitates their comparison and analysis.

To achieve that, the Ministry of Health, which is responsible for ionizing radiation protection and enforcement of regulatory provisions, has authorized three institutions for personal doses measurement. Those institutions had to prove that they satisfy conditions prescribed by the law in terms of equipment, organization, and employees' qualification.

To put together personal data and measurement results, the Croatian Radiation Protection Institute (CRPI) has been entrusted to build and manage a central national registry of classified workers and doses that they receive while working in a controlled area.

This paper presents the methods of data acquisition, management, and exchange among the dosimetry services, the CRPI and end users. Also, the data collected during the year 2002 are analyzed.

2. Organization of Dosimetry Control in the Republic of Croatia

Under current regulations, all workers that work in a controlled area, either a supervised area or an area of special control have to wear personal dosimeters.

Legal authority for radiation protection in the Republic of Croatia is the Ministry of Health (MH). Based on the provisions of the Radiation Protection Act and related regulations, the MH has authorized the Ekoteh Dosimetry Ltd., the Institute for Medical Research and Occupational Medicine and the Ruđer Bošković Institute to perform activities related to the measurement of the ionizing radiation exposure of persons working in controlled areas.

According to the Radiation Protection Act, the Croatian Radiation Protection Institute keeps a central national registry of radiation sources, persons working with the sources and the doses that they receive during their work.

A software system has been developed which enables data acquisition and exchange among dosimetry services, CRPI and the MH using Internet. To ensure data accuracy, responsibilities of individual entities have been redefined.

Workers are registered for dosimetry control at the CRPI. The registration application includes:

— A registration form containing personal data, the data about workplace and the data about sources the person is going to work with

— A certificate of qualification to work with radiation sources and knowledge of radiation protection measures

— A medical certificate for work in controlled areas.

After the registration application is received, the data are entered into the central registry of the persons who work in controlled areas. The registry contains the following three groups of data:

— Data required for identification of a person, i.e. personal identification number assigned by the CRPI, name, gender, title and occupation.

— Data about dosimetry control registration, i.e. personal identification number, institution identification number, registration date, registration document file number, cancellation date, cancellation document file number, dosimetry service identification code, dosimeter type to be used

— Data about issued/returned dosimeters and the doses received, i.e. personal identification number, year, measurement period, dosimeters identification (number), status (dosimeter not returned, returned, destroyed), dose, used dosimeter types, dosimetry service identification code and record of the last status change/ date of dose entry into the database.

All the data listed above are entered at the CRPI, based on the documents prescribed by the regulations and following the prescribed procedures.

Once a month, data about persons working in the controlled areas are sent through the Internet, by electronic mail, to the dosimetry services. Based on those data, using a program designed for that purpose, the services print dispatch lists for the dosimeters. For each worker, the lists contain name and dosimeter identification (number).

Year has been divided into 12 measurement periods coincident with calendar months. Together with the dispatch lists, reports on the doses received during previous measurement period are delivered. For each person, the report contains: dosimeter identification (number), name, effective dose for the measurement period, total dose for current year, total dose for current control period (5 years) and total dose from the 1st of January 2000, i.e. from the date when the dosimetry data gathering in CRPI started.

Institutions return used dosimeters to the dosimetry services before the prescribed date. The services process the dosimeters, record doses and send the data to the CRPI by electronic mail, once a month. The CRPI processes the data, updates the registry and returns the data back in the aforementioned form to the services to let them print and dispatch the reports.

3. Results

Based on the data collected, we were able to analyze the distribution of the doses received by the employees in various institutions. For that purpose, the institutions were grouped into four categories: medicine, industry, veterinary medicine and science. To obtain a clear picture about exposure of the employees, we grouped them into classes defined by the annual effective dose.

The obtained results are shown in the tables I - V.

Table I: Number of employees in medical institutions and collective doses by dose received during the year 2002.

Dose range (mSv)	Persons	Collective dose
< 0.1	3306	19.5
0.1 - 0.99	555	177.7
1.0 - 1.99	62	89.9
2.0 - 2.99	29	69.3
3.0 - 3.99	15	52.9
4.0 - 4.99	9	39.2
5.0 - 9.99	21	147.0
10.0 -14.99	4	48.6
Total:	4001	644.1

Table II. Number of employees in veterinary medicine and collective doses by dose received during the year 2002.

Dose range (mSv)	Persons	Collective dose
< 0.1	35	0.0
0.1 - 0.99	16	6.3
1.0 - 1.99	2	2.7
Total:	53	9.0

Table III: Number of employees in industry and collective doses by dose received during the year 2002.

Dose range (mSv)	Persons	Collective dose
< 0.1	516	1.5
0.1 - 0.99	54	19.9
1.0 - 1.99	2	3.3
2.0 - 2.99	2	4.4
5.0 - 9.99	3	26.0
10.0 -14.99	1	12.6
Total:	578	67.6

Table IV. Number of employees in scientific institutions and collective doses by dose received during the year 2002

Dose range (mSv)	Persons	Collective dose
< 0.1	147	2.3
0.1 - 0.99	13	2.0
1.0 - 1.99	1	2.0
Total:	161	6.3

Table V. Number of employees in all institutions and collective doses by dose received during the year 2002

Dose range (mSv)	Persons	Collective dose
< 0.1	4004	23.2
0.1 - 0.99	638	205.9
1.0 - 1.99	67	97.8
2.0 - 2.99	31	73.7
3.0 - 3.99	15	52.9
4.0 - 4.99	9	39.2
5.0 - 9.99	24	173.0
10.0 - 14.99	5	61.3
Total:	4793	727.0

As the given data indicate, most of the doses fall into the range from 0.0 to 0.99 mSv in all categories (health care, veterinary medicine, industry and science). It has to be specially emphasized that within that range 86.2 % of workers have received doses less than 0.1 mSv, which is 83.5 % of total number of workers who work in the ionizing radiation zones. As expected, the greatest collective dose is received in the medical institutions, and the smallest in the scientific institutions, as they have the least number of employees.

The dates of the dosimeter return to the dosimetry services are recorded in the CRPI database. The data for each measurement period, including the total number of issued dosimeters, percentage of dosimeters returned on time or 1, 2 or 3 months late, are given in the table VI. The last column contains the percentage of the dosimeters that have not been returned even after three months. The late dosimeters returned within three months are processed. The dosimeters returned by the institution after that time limit are not processed and the status 'not returned' is recorded. That event is reported to the sanitary inspector of the Ministry of Health, who institutes legal proceedings based on an assumption that the person was not under dosimetry control. From the data collected during previous years, the percentage of non-returned dosimeters varied, depending on the measurement period, from 11.1 % to 18.4 % in the year 2000, 6.2 % to 17.0 % in the year 2001 and from 5.9 % to 10.0 % for the first nine periods of the year 2002.

Table VI. Overview of returning of dosimeters during the year 2002

Period	Dosimeters	On time (%)	1 month late (%)	2 months late (%)	3 months late (%)	Destr.	Never returned (%)
1	4659	76.6	9.9	2.8	0.7	4	10.0
2	4645	79.4	12.6	1.4	0.6	9	6.0
3	4655	79.9	11.6	1.4	0.8	5	6.3
4	4665	80.7	10.9	0.3	2.1	5	6.0
5	4686	80.9	1.9	10.0	1.3	6	5.9
6	4691	11.5	76.0	5.6	1.0	3	5.9
7	4721	57.6	30.0	3.7	2.5	2	6.2
8	4733	75.8	11.4	3.9	0.7	4	8.2
9	4738	75.8	15.3	1.7	0.9	2	6.3

4. Conclusion

The described organization of data acquisition and recording ensures timely reporting to responsible authorities on any exceeded dose limits and easy detection of certain irregularities in implementation of dosimetry control.

Regardless of the fact that there are several dosimetry services, all the data are collected in one place and can be easily analyzed. There is no data loss or discontinuity of control in the cases when a service stops operation or when a user, for any reason, changes one dosimetry service by another.

The system is organized so that the database managed in the CRPI is an inevitable part of the process of dosimetry control, which ensures regular data updating and verification.

The degree of professional exposure in the Republic of Croatia is relatively low. Most of the workers, over 83.5 %, receive annual doses less than 0.1 mSv. Only 0.1 % of workers receive the dose of 10 mSv. Contrary to these results, which indicate that the dosimetry control system is relatively good, worries the number of dosimeters not returned on time, especially the number of dosimeters that are not returned within three measurement periods. However, certain improvement is obvious compared to the previous years. This improvement can be attributed to better organization of education in the radiation protection field, which now includes relatively large number of workers. Another factor is the activity of the Croatian Radiation Protection Institute, which regularly warns the institutions about noticed deficiencies. Finally, it can be concluded that legal prerequisites for dosimetry control are well constituted, with adequate dosimetry services. The structure of dosimetry control and records management that has been built gives expected results. Contrary to that, the attitude of workers does not satisfy. It is, therefore, necessary to insist on sufficient education of the workers and more efficient inspection of radiation protection measures implementation. Planned changes of the regulatory structure, in accordance with BSS, under the Model Project RER/9/062 should transfer the main regulatory authority prerogatives to the CRPI and give it more power in solving the problems stated.

The Democratic Republic of Congo (DRC) Experience in Radiation Protection and Safety Infrastructures

F. Lumu Badimbayi-Matu, C. Mulumba Luapeta,
A. Kondi Tamba, et al.
Commissariat Général à l'Energie Atomique (CGEA)
Kinshasa, Democratic Republic of Congo

Abstract. In this report we present "the DRC experience and perspective in the radiation protection safety infrastructures. Briefly, it covers the status of the Radiation Protection and safety infrastructures including the promulgated National Act of Nuclear Law 017-2002. Furthermore, it highlights the challenges and difficulties encountered and some experimental results achieved on the personnel dosimetry and the corrosion of reactor tank repairing.

1. Introduction

Peaceful applications of the atomic energy in DRC started since 1959 with the commissioning of the first African Research Triga MK I Rector.

14 years later, in 1972, the Triga MKI Reactor, has been decommissioned for its replacement by the actual more effective Research Triga MKII Reactor which has been diverging since 1974 with the CEN Mol/Belgium appraisal.

Since the starting of nuclear activities, The CGEA has been acting as the National Regulation Authority through its Radiation Protection Department with following duties: occupational exposure monitoring to external radiation, handling of safety procedures of the reactor codes of good practices before and during reactor operation or during radiological emergency. Since 1978 the radiation protection activities have been expanded over the country, especially in hospitals and in industries[1]. All of these activities have been carried out without a legal regulation act. As in other countries involved in nuclear programmes, the regulation needs have been expressed for a convenient protection of radiation exposed workers and population against the radiation effects.

This paper covers the past and the present of the DRC experience in radiation protection and safety infrastructures.

As established in the International Basic Safety Standards and recommended in the Model Project, major requirements to comply with by each Government with regard to the Legal National Infrastructure for radiation protection and safety are: legislation and regulations, independent Regulatory Authority empowered to authorize and inspect regulated practices and to enforce legislation provisions. Further, as set out in the Act 017-2002, the Regulatory Body must be able of registering and inspecting all the authorized practices over the country with respect to radiation protection and safety. Regulatory Authority should have sufficient financial resources, qualified human resources and adequate equipment's and facilities.

Since 2002, the CNPRI (National Council for Radiation Protection and safety) has been promulgated as the National Regulatory Authority. It has to set mechanisms for inventorying all radiation sources in existence and those that will be introduced in the country in the future. This is the famous system of notification and authorization by registration or licensing. With regard to that, the database RAIS software is helping us in implementing such mechanisms, even its use is still partial. The aim of this paper is to establish basis for introducing infrastructure for safety in DRC and to give indication on what our radiation protection and safety program and activities look like with regard to the International Basic safety Standard requirements and the Model Project development. This paper also highlights the challenge and difficulties encountered on the way to achieve these strategic goals.

2. Radiation Protection Safety Guides

The CGEA/Radiation Protection Department offers its assistance to Registrants, Licensees and any moral and physical person intending to practice radiological activities in the country and it facilitates them an effective implementation of the regulation provisions.

In order to achieve the effective implementation of technical regulations for the safety use of radiation:

— The CGEA/R.P. Department has developed guidelines (codes of good practice) based upon the IAEA standards.
— It ensures the compliance monitoring, the personal monitoring, the inspection and safety assessment of x-ray facilities, the occupational radiation protection, the quality assurance through hospitals and industries.
— It deals with the qualification and certification of radiation workers; the notification and authorization by registration or licensing procedures; the exemption and exclusions procedures;

These guideline documents will be gradually completed by other more specific in order to make technical regulations more comprehensive to end-users.

3. Radiation Protection Infrastructures

3.1. The human resources

The Radiation protection Department of the CGEA is working with 8 staff members whose 7 are trained through the IARA Technical projects, Training and Workshop Courses in the field of radiation protection, personal dosimetry, waste management and nuclear legislation and regulations to achieve all safety procedures during the normal and emergency operation Triga MKII research Reactor and to ensure compliance monitoring with standard for medical and industrial practices through the country.

3.2. Laboratory facilities and safety activities

The radiation Control Department of the CGEA is the executive organ for all the radiation control activities in the country. It is running with 4 main scientific laboratories, namely:

1. The Environmental monitoring laboratory: risponsible for the control of radioactive contamination in food and general environment and the control of radioactive waste management practices.

2. The Radiation Protection Laboratory: responsible for workplace and occupational personnel workplace monitoring in services exposed to ionizing radiation and safety assessment of radiation facilities and sources of ionizing radiation. It achieves these activities with following materials:

    — Dose rate meters and radiation monitors for workplace monitoring., a PC pocket Spectrometers and some contamination meters and A quality assurance Kit RMI for compliance monitoring to control of X-ray facilities in the hospitals. Its conducts the intervention in radiological emergency.

Reactor tank repairing for corrosion

In 1988 the CGEA was faced to a serious problem of the reactor tank corrosion. Local appraisal from the reactor and radiation protection staff has been required to carry out the reactor repairing in highly dangerous radiological conditions.

Work strategy consisted to 5 steps :

1. Reactor shutting down from March, 21th 1988 to 24th March 1989 for removing short and medium lived radioactivity decay.

2. Set up an intervention planning, preparedness: - collection of all necessary provisions of radiation protection measurement and for intervention such as Tele detector, bricks in concrete, helmets for transport of fuel rods and auxiliary tank with water for the storage of radioactive fuel rods and acquisition of special work clothes, overshoes, gas masks, individual TLD and alarm dosimeters card and other logistical materials from IAEA

3. Disassembly of the reactor compounds

Based upon an intervention executable plan :

— Water and Air radioactivity measurements.
— Calculation of maximal exposure time and number of involved persons during transfer operation of radioactive compounds (such as fuel rods, Lazy Suzan, instrumentation rods, and so on) from reactor tank to auxiliary tank.

4. Corrosion tank repairing

Radiation level measurements at each repairing step and decision making for reactor tank washing; identification of corrosion spots and resin plugging.

5. Assembly of the reactor compounds : Radiation level measurements and reinstallation of reactor compounds inverse order. The mean collective equivalent dose records during interventions are given in Table 1. It is shown that work has been safely carried out. No complaints have been recorded in course of time.

Table I Mean collective equivalent dose during reactor repairing

	MEAN EQUIVALENT DOSE (10-5Sv)														
Services	Preparedness			Disassembly			Repairing			Reinstallation			Combined oper.		
	H	S	H*	H	S	H*	H	S	H*	H	S	H*	H	S	H*
S1	14	48	12	345	1313	219	84	174	29	307	830	166	676	2365	107
S2	15	45	9	282	460	153	41	81	27	190	352	176	528	938	91
S3	-	-	-	220	430	215	48	92	46	237	458	229	505	980	163
S4	-	-	-	51	132	33	34	48	16	2	2	2	51	182	17
Col.	15	93	11	345	2335	155	84	395	30	307	1642	143	676	4465	95

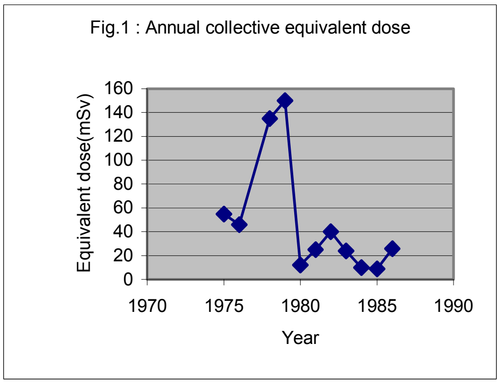
Legends: S1. Reactor service. S2: Radiotion Protection Service, S3: Mechanic Service, S4: Other
H, S and H* Individual, collective mean equivalent dose

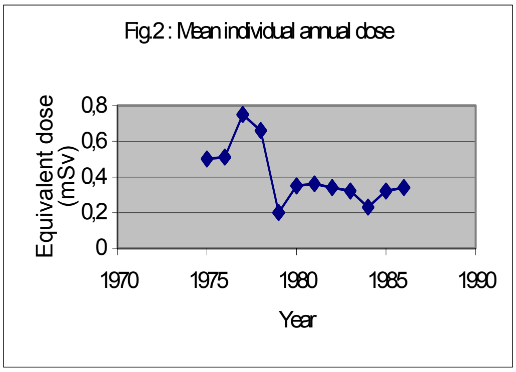
6. The Personal Dosimetry Laboratory : is responsible for

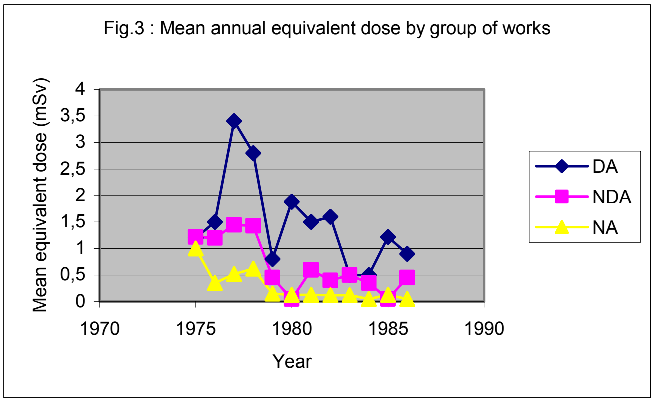
— estimation of the individual radiation exposure dose of workers to demonstrate compliance with prescribed limits and the DRC legal requirements and for occupational workplace exposure control;

— individual dose database registry and record keeping for individual monitoring in CRENK installations, Triga MK II research reactor, industries, hospitals and so on. These activities are carried out with automatic computerized Harsh 4500 TLD Reader system handled by the WINREM Software and Two elements TLD-100 cards for measuring β and γ radiation dose and four elements TLD-700 and TLD-600 for neutron measurements and SYGEDI database software.

Presently about 1000 workers throughout the country are covered by the Personnel Dosimetry service using TLD methodology.







Legend : *DA The workers category A, directly exposed to radiation (Reactor, Radiation protection staff, Activation analysis, RIA and Production Laboratories), NDA No directly exposed (other laboratories) ; NA no exposed to radiation.*

These three figures shows that DA category was more exposed to radiation than NDA and NA. They display the evolution of the improvement of radiation protection safety infrastructure on occupational workplace and in worker skill what drags the collective annual dose decay.

Fig. 1-3 present the personal dose data, using photometric methodology, for CGEA workers over the period 1974 to 1986.

7. The Whole Body Counter Laboratory : for internal contamination assessment, especially for those professionally exposed persons to radiation

8. Radiation Metrology Laboratory : for the calibration of surveymeters, radiation monitors and direct reading dosimeters.

Actually it is used for temporal storage of wastes and unused sources like Ra-226 needles and spent sealed sources which were in use in research laboratories.

4. National Regulatory Framework

1. Law n°017-2002 of 16th October 2002

The protection against radiation Act of the Nuclear Law 017-2002 was promulgated in October, 16th 2002. It gives the requirements for the radiation protection and safety of radiation sources in the DRC. This legal instrument establishes the CNPRI (Comité National de Protection contre les rayonnements Ionisants) as the National competent Authority body for regulatory control of peaceful uses of ionizing radiation in accordance to the IAEA standards.

2. Innovation of the new legislation

- The CNPRI will be effectively independent from the Congo Atomic Energy Commission,
- The creation of a technical organ INRP (Institut National de Radioprotection) depend on the CNPRI,
- The appointment of an advisory Committee, CONAPRO (Commission National de Radiation protection).

5. Funding and Stakeholder Involvements

Main financial sources available to achieve these activities are:

- The Governmental budget for salaries
- Receipts from rendered services to hospitals and industries
- Supports from IAEA under technical projects such as the Regional Model Projects RAF/9/027on Radiation protection and RAF/9/029 on Development of Technical capabilities for a sustainable infrastructure for radiation protection and waste safety and fellowships.

6. Conclusion

Most of major facilities available in these laboratories were provided through the technical Assistance and Co-operation (TC) Projects.

Capabilities in reactor tank repairing have been demonstrated and this experience may been shared with other African countries involved in nuclear reactor operation.

With the WHO supports, 300 radiological facilities have been inventoried in hospitals and industries throughout the country. About 1.000 workers involved in this activity are under our control.

With the promulgation of the nuclear legislation, it is expected the reinforcement of the IAEA technical cooperation for the improvement in the achievement of radiation protection safety duties, including equipment, personnel training, expert missions.

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National Radiation Protection Programme for Occupational Exposure

N. E. Mantilla, S. J. Moreno

Radiation Safety Department
Ecuadorian Atomic Energy Commission
Quito - Ecuador

Abstract. Radiation Protection in Ecuador, as an important part of the whole context of protection against occupational health damage, since 1979 has become a relevant aspect in our government´s concerns and policy. Programs have been developed in order to register machines, sources, activities and ionizing radiation users in all fields throughout the country. Plans have been implemented to improve workers safety from occupational exposure: personal thermoluminescense dosimetry, training courses, technical studies to get the best protection in working places, coordination with health institutions to make tests and evaluations to control occupational health, personal and institutional licensing and others. We also have supplied advice on Radiation Protection in the use of radiodiagnosis and radiotherapy, nuclear medicine, radionmunoassay and in industrial, educational and research applications, mainly in matters of shielding, technical meetings, and design of personal protections and safety procedures.

1. Basic Scheme

Ecuadorian Legislation has an importat tool to regulate the use and application of ionizing radiation sources, the National Radiological Safety Regulation, which is a national law of general application of ionizing radiation in different fields. This Regulation is under study in order to improve and update it. The New National Legal Scheme in the near future will be formed by: first, the law that permits to act as a National Regulatory Authority on the subject of atomic energy to the Comisión Ecuatoriana de Energía Atómica (CEEA); second, the New National Radiological Safety Regulation in order to be prepare for emergencies; and third, a thirteen standard document for specific applications in each of the fields of radiological activities: medicine, odontology, veterinary medicine, dose limiting, inspections and licensing, radiation safety officers, import and distribution of radioactive sources, safe transport of radioactive materials, uranium minig, radioactive waste management, dosimetry, research and educational purposes, industrial and engineering applications, and miscellaneous exposure sources.

2. Personal and Institutional Licensing

An extensive personal licensing program has been implemented throughout the country in order to achieve occupationally exposed workers getting a license from the CEEA, which permits them to work with ionizing radiation equipment and sources. Nowadays, we are making great efforts to reach the whole national occupational exposed population in all application fields.

To obtain a "Personal Radiological Protection License" it is necessay for the user to fulfil several requeriments such as having knowledge on radiological protection, which must be evaluated by a CEEA Radiological Safety Official; have an updated health test and any kind of certified personal dosimetry, be working in a related area, and others. The CEEA also grants an "Institutional Radiological Protection License" to medicial, research and industrial institutions which work with ionizing radiations. This license is given after all their exposed workers have their own personal licenses.

The National Radiological Safety Regulation states that occupationally exposed people cannot work with radiations without a license. In the case of medical or odontological offices and other facilities that use radiations, the single fact that the professional in charge of the radiological service has no license is enough to shut it down until he/she observes the law.

3. Radiological Protection Training Courses

Most of the professional careers in our country have no courses related to radiological protection into their subjects framework. For this reason, the CEEA frecuently organizes specific training courses to improve the knowledge of occupational exposed people. Another kind of teaching consists of "trainig on the job", work which includes practical exercises, review of emergency plans, development of accident simulatioms and radiometric measuments.

4. Technical Inspections

All facilities that work with a radioactive sources or ionizing radiation generating machines, must be previously submitted to a technical inspection, before starting, in order to warrant their safety. Until now it has not been neceesary to carry out decommissionig work in relevant instalations in our country, but we have developped a complete program of inspections.

Industrial gammagraphy is one of our main concerns, because of the increasing use of this technology during the construction of the current oil pipeline. Inspectors are visiting these users at least once a year, and checking different radiological protection parameters in order to warrant the security and safety of sources and verify that exposed people are working under safe conditions.

5. Import and Transport Control of Radiation Machines and Sources

Whenever an importer brings x-ray equipment or any radioactive source to our country, have to fulfil several legal requirements: have a corresponding radiological protection license and importing permission authorized by CEEA; submit enough information about the customer and importing purposes, sell only to an authorized person or institution, have own transportation and qualified personnel to store and move imported goods safely, arrange convenient substructure to store and deal with these kinds of products, count with emergency plans and adequate monitoring detectors and procedures to minimize risks and avoid further accidents.

6. Personal Dosimetry

As an important legal requirment for occupationally exposed people in Ecuador; personal dosimetry has been implemented in all radiological working areas. Nowadays, thermoluminescense, film and some pocket personal dosimeters are used by occupationally exposed workers in medical, odontological, industrial, research, teaching, and engineering applications.

Personal dosimetry is a previous requirement to obtain radiological protection license in whichever fiel. Besides, it is essential for relevant radiological installations, principally in therapy and research fields, to count with any kind of environmental dosimetry system, to warrant their safety and efficiency of their methods.

CEEA provides a personal TLD service for everybody who requires it. At present, we are reaching a great percentage of users in medical, odontological, teaching and engineering applications. We collect, change and process dosimeters every two months, and then we send the readings to our users. Besides, there are three other institutions that offer personal TLD or film dosimetry services in our country.

7. Current Situation

1. For radioprotection purposes, Ecuador is divided in three zones, with headquarters located in three of the biggest cities of the country. However, policy and operational plans are coordinated from Central headquarter situated in Quito, capital of Ecuador. Nowadays, we have 14 inspectors for the whole country. This number could seem enough to control a small country like Ecuador, but the inspector´s staff is always changing mainly because of low salaries. This leakage of expertise has stopped more than once the radiation safety programm performed by our Institution. In the Project Model framework, inspectors will be trained to control the practices all over our country. Of course, the trainees will transmit their knowledge to new inspectors inside the Department.

2. However, since this Regulation was issued in 1979, it have not been updated or revised to control new practices. On the other hand, the Regulation does not contain a specific and strong enough sanction chapter. Furthermore, some situations are not even considered.. The modification and updating of this Regulation is a priority in the context of the Project model RLA/9/041.

3. A very important step to comply with this objective was the signing of an agreetment, last january, with the Health Ministry in order to not allow to any medical facility to get their operating authorization without previously obtaining the Radiation Protection License issued by the Regulatory Authority.Regarding this, the implementation of RAIS has been very useful to improve control of the licensed facilities.

Because of the economical situation of our country, as a government policy, all institutions are forced to implement selfinancing activities. As a consecuence, the Ecuadorian Atomic Energy Commission had to put a tag price to all services, including control activities. This situation has delayed the inspection programme.

Thanks to the generation of our own financial resources, 80 thousand USD has been allocated to buy inspection equipment, to increase and update the tools for the control activities.

8. Conclusion

Within our training plan and as part of the Project Model activities, regional workshops were held in the regional headquarters, to attend Radiological Emergencies, aimed mainly to Disaster Attention personnel. As a consecuence, we finally will count with a National Emergency Plan that will be presented in the next future, in a National Training Course to be held in Quito with the IAEA participation and sponsorship.

Besides, the Ecuadorian Atomic Energy Commission qualified personnel trained by the IAEA are interested in the radiactive waste management, despite the first option is the reexportation of spent sources back to the original country.

Development of the Infrastructure for Radiation Safety in El Salvador

R. E. Torres Gomez

Unit of Regulation and Control of Ionizing Radiation (UNREC)
Ministery of Health
San Salvador, El Salvador

Abstract. The paper in wich you describe the implementation process of infrastructure for radiation safety in the Health Ministery. The problems during the process of training of the personnel and the application of a nonagreed legislation to the international norms (BSS 115). The elaboration of a Regulation of protection and radiological security that gives necessary to the legal force for the control and controls it to the different ones you practice and applications, the diffusion of the culture of the security mainly in the medic applications. The importance of working framed in a project model of which the technic and technological aid is obtained necessary, like the experience that other regulating authorities have compiled in the time.

1. Introduction

The practices with radioactive sources and generating equipment of ionizing radiations are very spread in El Salvador, specially in medicine and the industry. The need to count on an effective regulating infrastructure, supported of an agreed juristic frame with the international norm is impresindible for the country with ascending technological development. Ministerial resolution 001/98 gives origin to the Regulating and Advisory Unit of Ionizing Radiations, like a necessity that the Health Ministery must be able to develop to the attributions and functions established in the Health Code. The International Atomic Energy Organism through Project Model, continuous beingan important piece for the development of the regulating and supervised activities of the ionizing radiations in the country.

2. Description

Used strategies:

(a) Visits to the establishments to make the census of generating equipment, the exposed sources in use and disuses, as well as workers and number of facilities;

(b) Agreements of interinstitutional cooperation:

- Superior Advice of Health
- Together of Monitoring of the Medical Profession
- Together of Monitoring of the Odontological Profession
- Ministery of Outer Relations
- Main directorate of Rent of Customs
- Ministery of Work
- Research center and Nuclear Applications of the Faculty of Engineering and Architecture of the El Salvador University.

(c) Diffusion of the Security Culture, through qualifications to technical personnel, operators and to the people in charge of the facilities.

(d) Qualification of the personnel of the Regulating Authority in inspection and licensing.

(e) Diffusion of the existence of a Regulating Authority in the matter of Protection and Radiological Security.

(f) Use of lists of control for the accomplishment of them inspection.

(g) Calibration of the equipment detectors to make radiometrics rises.

(h) Visits from an expert from the country to enable the personnel of the Regulating Authority.

(i) Elaboration of the Special Regulation of Protection and Radiological Security.

(j) Application of the Regulation.

(k) Elaboration of Norms and Guides for you to practice.

(l) Beginning of the authorization processes.

(m) Processes of coercion by breach to the legislation.

3. Conclusions

The attendance of the IAEA, through qualifications, document provision that has been used for the elaboration as the legal frame and provision as equipment, to be fundamental in the development of the radiological safety in our country. The hiring of personnel from different professions related to practice and applications to have good impact, mainly at level of practices it medicaly.

The agreements obtained in the institutions that some how have relation with the control on the facilities, practice, personnel and sources. Elaboration of an agreed legal frame to the International Norms of Protection and Radiological Security (BSS 115). The diversity of professions of the technical personnel facilitate the delegation of responsibilities, granting to each one practices specifies of prudent a to its capacity.

The delegation to make services to the National University, such as dosimetry personnel, maintenance and calibration of radiological protective equipment, dosimetry environmental and consultant's office in the elaboration of the technical documentation to obtain authorization.

To stimulate to the creation of companies that sell services such as: Control of Quality to x-rays equipment, technical document elaboration for licensing. Implementation of the lending companies of services such as maintenance and control of quality. Qualification and motivation from the personnel of customs to demand the permissions to concern sources emitted by the Health Ministry.

Motivation of the national authorities to modernize the braquitherapy and to increase to the patients, this brings with the substitution of the needles of radio 226, for its later inmobilization. Rating of deposit of radioactive remainders, to be used like an organization centralized in the management.

Elaboration of technical documents for the different ones practice to facilitated the regulating work, as well as to be an instrument for the elaboration of the technical documentation of the users. From year 2001 at the beginning of the 2003, 83 authorizations have been emitted for practice such as: construction, operation, import and export.

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Challenges Affecting the Development of Radiation Safety Infrastructure in Zambia

E. Malikana

Ministry of Health
Lusaka, Zambia

Abstract. This brief presentation gives some of the highlights of the activities that the government of the Republic of Zambia undertook from 1972 to date in its effort to ensure the development of a national radiation protection infrastructure. The paper also discusses some of the challenges that have to be addressed. The final section discusses some of the policy options and recommendations that should be undertaken in order to ensure that the Zambian government has a clear direction for the development of radiation safety infrastructure. The issue of national emergency plan and response in the event of a radiological accident is also discussed.

1. Introduction

The development of the relevant components of a national radiation safety infrastructure requires that an enabling environment should exist that allows all key stakeholders to play their respective roles.

At an international level, concerted efforts have been made which have resulted in significant progress being achieved in ensuring that appropriate radiation safety standards are developed and also resources are mobilized and expert services are provided to assist in the establishment and/or upgrading of relevant components of national radiation safety infrastructure in many countries.

However, at a national level a lot needs to be done in order to ensure full compliance with the internationally accepted basic safety standards. Like other developing countries, the Zambian government took full cognizant of the importance of the application of nuclear science and technology in national development by establishing a regulatory framework through the enactment in 1972 of the Ionizing Radiation Act, Chapter 311 of the Laws of Zambia. Through this Act, the Radiation Protection Board (RPB) was established. In addition, regulations that provide for additional technical requirements for the control of occupational, public and medical exposure were put in place (though not comprehensive).

Apart from the establishment of the regulatory authority (RPB), which is one of the non-autonomous statutory boards in the Ministry of Health (MOH), the Zambian government through MOH has further shown its commitment towards the promotion of the application of nuclear science and technology by supporting financially the operations of the RPB from inception.

However, in 1990, the Zambian government developed a radical and reforming policy for the future direction of health services delivery by moving from a centralized to a decentralized management system, which became the major plank of the health reforms. Decentralization can bring benefits as well as difficulties. However, one of the principal potential benefits is to allow the MOH to be released from administrative responsibilities and tasks of an operational nature in order to concentrate on policy formulation and strategic planning functions.

Decentralization in the health sector in the Zambian context should address a number of issues and these should be acknowledged and adequate attention paid to them. The following issues are of particular importance (a) the status of the non-autonomous regulatory boards such in the MOH such as the RPB, and (b) the financing and workforce of these statutory non-autonomous boards in the restructured MOH.

There is a strong international consensus that each government should play a pivotal role and responsibility of providing among others adequate radiation protection and safety for all its citizens. In this regard, the government of Zambia through the restructured Ministry of Health has the following major function of providing direction for health services, set policies and to translate these policies into strategies and priorities.

However, in the Zambian case, there are many factors that have slowed down the progress in the development of the national radiation protection safety infrastructure. Apart from lack of resources (human and financial) and the ever-increasing disease burden, the other major constraint to the effective development of the national radiation protection infrastructure has been to a very greater extent the lack of a clear national radiation protection policy to provide guidelines for the development of the national radiation safety infrastructure.

The need for such a document at a national level which should provide a purposive course of direction to address matters of concerns and/or identify set of challenges and responsible persons to undertake certain actions which are aimed at ensuring that all activities related to the improvement of radiation protection infrastructure are implemented in a more coordinated manner can not be over-emphasized.

2. Challenges in the Development of Radiation Safety Infrastructure in Zambia

2.1. Internal and external environmental analysis

In order to adequately address important and relevant issues affecting the development of a national radiation safety infrastructure, there is need for the restructured MOH through the Directorate of Health Policy to have a clear understanding and appreciation of the dynamic socio-economic and political environment in which it operates. This should be followed by the identification of internal environmental factors, in the form of strengths and weaknesses, and the external factors in the form of opportunities and threats in order to ensure efficient and effective operations of the MOH in as far as policy formulation related to radiation protection is concerned and also for the overall enforcement of the provisions of the Ionizing Radiation Act by the Radiation Protection Board.

2.2. Resource mobilization

The development of the radiation protection infrastructure in Zambia demands financial, technical, and human resources. Often these resources are inaccessible (allocated to someone else's budget), unavailable (assigned to other priorities and programs), or nonexistent (no appropriately skilled staff). Getting off to a good start requires accumulating a sufficient supply of these resources. Successful development of a national radiation protection infrastructure demands an ongoing flow of these resources. Given this challenge, the need to lobby for these resources effectively cannot be over-emphasized.

2.3. Inadequacies in the Ionizing Radiation Act and the subsidiary legislation

There is need to establish an independent regulatory authority with sufficient powers to discharge effectively its functions, recruit and determine conditions of service so as to ensure the retention of employees and there is need to have in place a financing arrangement approved by Parliament. This challenge demands that the legal framework pertaining to radiation protection should be reviewed so as to harmonize it with other national pieces of legislation and most importantly to make it compatible with the requirements of the internationally accepted basic safety standards for the protection of people against effects of ionizing radiation.

2.4. Establishment of national emergency preparedness and response capabilities

At a national level, there exists a national disaster management plan which deals with human induced disasters such as epidemics, famine drought, influx of refugees, fires, deforestation, industrial and transportational accidents. The disaster management plan also covers natural disaster such as floods, droughts, pest infestation and livestock diseases and water hyacinth (weed). However, there is no specific provision in the plan to deal with radiological accidents at the national level.

2.5. Establishment of occupational, public, and medical exposure control

The technical base that is required to effectively control the occupational, public and medical exposures are not well developed. There is need for physical structures such as laboratories that are purposely built for measurements of radionuclides in foodstuffs, environment and personnel dosimetry measurements. Radiation measuring equipment is not sufficient and the equipment reliability test is not always done on time, as there is no calibration facility. The urgent need for staff to be trained in nuclear analytical techniques cannot be overemphasized.

3. Policy options and Recommendations

3.1. Development of the National Radiation Protection and waste Management Policy

Over the years, it has become increasingly clear that there exist major challenges in the development of the national radiation safety infrastructure. As long as there is no statement by the Zambian government setting out clear direction or guidelines for the development of the radiation safety infrastructure key issues might not be addressed in a more coordinated manner. In this regard, it is proposed that a National Radiation Protection and Waste Management Policy should be developed and adopted by Cabinet so that adequate resources are provide for its implementation. This proposed national policy on radiation protection and waste management should among others provide a vision, policy objectives and measures that the government of Zambia through the restructured Ministry of Health should undertake in order to address the following key issues: (a) planning, management and training aspects of radiation protection personnel (b) resource mobilization and financing of radiation protection programmes (c) infrastructure development. In order to ensure that policy objectives are met in practice, there is need to have an effective monitoring and evaluation system in place. The IAEA is requested to participate in the development of a National Radiation Protection and waste Management Policy for Zambia through the provision of expert service and training and also in the development of performance indicators for the implementation of the policy.

3.2. National emergency plan and response for radiological accidents

In Zambia, only the Republican President can declare an event a national disaster after receiving advice, information and recommendation from the National Disaster Management Committee which is the supreme policy making body for disaster management. The secretariat is established in the Office of the Vice President and there exist a Trust Fund for disaster management. In order to effectively optimize the meager resources and avoid duplication of efforts in disaster management and mitigation at a national level, it is recommended that the National Disaster Management Action Plan (NDMAP) should have a chapter to deal with radiological accident since NDMAP is a national document initiated by the Zambian government in light of the persistent recurrence of disasters in the country.

3.3. Conclusion

The development and management of a complex national infrastructure such as that for radiation safety requires a lot of commitment from all key stakeholders. However, for meaningful results to be achieved at a national level in the development of national infrastructure for radiation safety, there is need to have the following: vision, skills, incentives, adequate resources, and an action plan. Lack of any of the aforementioned components could lead to false starts, frustration, gradual change, anxiety and confusion. In this regard, the need for the development of a national radiation protection and waste management policy cannot be overemphasized. The policy document should identify key issues in the development and/or upgrading of a national radiation safety infrastructure and provide strategies to address the main challenges. A monitoring and evaluation system should be put in place to ensure the smooth implementation of the national radiation protection policy.

Current status of Dosimetric Monitoring in Ukraine and Development of the United System for Monitoring and Recording of Individual Doses

V. Chumak[a], A. Boguslavskaya[b], A. Musijachenko[a]

[a] Radiation Protection Institute ATS Ukraine
Kiev, Ukraine

[b] Ministry of Health of Ukraine,
Kiev, Ukraine

Abstract. About 38,000 individuals are occupationally exposed in Ukraine and require regular monitoring and recording of their individual doses. The paper reviews the current status of dosimetric monitoring infrastructure in Ukraine with special emphasis on the problematic aspects of the existing elements of personal dosimetry. Obsolete equipment, lack of harmonization and absence of data transfer infrastructure and dosimetry registries dictate the need to establish the united state system for monitoring and recording of individual doses in Ukraine. The proposed three-level System is discussed in the paper reflecting the main tasks and objectives of the System as whole and its specific elements.

1. Introduction

In terms of peaceful use of nuclear energy and application of sources of ionizing radiation, Ukraine is among the most advanced countries. Accordingly, the number of individuals exposed occupationally, due to medical applications or by the residence in the areas with technogenically enhanced levels of radiation (both due to normal operation or as a result of nuclear accidents) is quite large, scoring altogether tens of thousands individuals. Among those about 38,000 individuals are exposed occupationally and require regular monitoring and recording of their individual doses. One would expect that such important aspect of radiation protection infrastructure as dosimetric monitoring of workers must be at the adequate level in Ukraine. Unfortunately the current state of dosimetric monitoring and, particularly, the recording of received doses is in many ways inadequate. Individual dosimetry services are operated by many laboratories being separated and uncoordinated. Measurement techniques are lacking unity and do not match contemporary national and international standards, equipment is obsolete and do not meet modern demands, electronic logging of the results of dosimetric monitoring is sporadic, there is no centralized infrastructure for concentration and dissemination of information regarding individual doses.

Aforesaid calls for elaboration and efficient operation of the nationwide System for management and coordination of dosimetric monitoring of all individuals exposed due to medical, industrial applications or due to residence in contaminated territories, as well as deep modernization of existing dosimetry services.

In response to this situation, Ukrainian legislation has adopted several laws, directives and other legal acts addressing the issues of dosimetric monitoring of workers and public being exposed to enhanced levels of ionizing radiation. This legislation established the essential basis for elaboration of modern and efficient system for nationwide monitoring and recording of individual doses. At the moment the structure and organization patterns of this System are being elaborated aiming modernization of existing dosimetry services and development of the missing elements of this System.

The review of the current status of dosimetric monitoring in Ukraine and the discussion of the approaches to the development of united system of monitoring and recording of individual doses are the subjects of this paper.

2. Current Status of Dosimetric Monitoring in Ukraine

Sources of ionizing radiation and nuclear facilities are widely spread in Ukraine. These sources are associated with medical (diagnostic and therapy) and industrial applications, production of nuclear energy as well as with residence in areas with technogenically enhanced levels of radiation, in particular – the areas contaminated due to Chernobyl accident.

Presently in Ukraine the mixed system for dosimetric monitoring is practiced. Nuclear power plants and some major nuclear facilities have their own dosimetry services, which are responsible, in particular, for regular dosimetric monitoring of workers. Rest of occupationally exposed persons is monitored by dosimetry laboratories affiliated to the territorial authorities for sanitary and epidemiology supervision.

In 2002-2003 Ukrainian Ministry of Health had performed the survey of the status of dosimetric monitoring and conducted the inventory of critical groups requiring such monitoring. Two forms were used for the survey; one (Form A) was focused on the current status of logistics and stuff capability of dosimetry services as well as on the number of individuals who belong to the critical groups requiring dosimetric monitoring. Form B was aimed on revelation of the readiness of the surveyed services for integration into the information infrastructure of the united system.

According to the results of this survey, dosimetry services in Ukraine cover about 38,000 occupationally exposed workers, including 5,500 medical professionals, 16,400 employees of five nuclear power plants and about 16,000 workers dealing with other sources of occupational exposure (industry, research, military). Territorial dosimetry services operate in 13 of 24 oblasts (regions) of Ukraine. The equipment used for dosimetric monitoring is represented by the Soviet era DTU-01 manual TLD readers produced with one exception in 1988-1990; the newest instrument was commissioned in 1995. The effect of the aging of this equipment may be illustrated by the fact that of 31 instruments only 25 are operational, in two oblasts none of available TLD readers is in operation. The coverage of critical groups by dosimetric monitoring is variable and ranges from 38% to 100% depending on the oblast. It should be noted that definition of critical groups requiring dosimetric monitoring is somewhat arbitrary and these groups are formed in non-uniform way. The status of integration into modern information networks is desperate. None of dosimetry services has access to the web and only few dosimetry laboratories have access to e-mail, in many cases sharing the same address with other divisions of the territorial sanitary office. As a rule, databases with the results of dose measurements are not carried and none of services transmit their results to the central authorities electronically. However, based on manual processing of dose records, the periodic reports are submitted to the Ministry of Health.

The situation with dosimetric monitoring at Ukrainian nuclear power plants is much better. At present, personnel of nuclear power plants (about 16,400 workers) is monitored by their own dosimetry services achieving absolute coverage of the main staff and temporary workers. With exception to the Chernobyl NPP, where monthly measurements are taken, NPP staff is monitored on quarterly basis. Instrumentation used for monitoring of nuclear workers is different: Chernobyl NPP operates new Harshaw 8800 TLD systems, semi-automated TLD system AKIDK-101 (Russia) is used in Ryvno NPP; personnel of three other NPP is monitored using manual TLD readers KDT-02M. Each of five NPP has its own informatics environment including, at least dosimetric monitoring databases. However, the software and data formats are not compatible, hampering thus data flow even within the same Atomic Energy Company to which four operational NPPs belong. There is also no unity in the dose assessment methodology, in particular dosimetric monitoring services do not assess effective dose, providing readouts in terms of dose equivalent instead.

Dosimetric monitoring of medical personnel is mainly performed from the single service - Central laboratory of radiation hygiene of medical personnel affiliated to the Grigoriev Institute of Medical Radiology AMS Ukraine in Kharkiv. So far, this the only centralized postal dosimetry service in Ukraine covering medical workers in virtually all oblasts of the country. Totally, 5,500 medical staff members are monitored by this service on quarterly basis. Performance of this service is very good, although it uses aging and obsolete manual TLD readers DTU-01.

One more TLD service originally intended for monitoring of individual exposures of the residents of Chernobyl downwind areas operates since 1987 in Scientific Center for Radiation Medicine AMS Ukraine (Kiev). This laboratory uses two ALNOR/RADOS RE-1 and one Harshaw 8800 automated TLD systems. Since 1996 the emphasis was shifted to monitoring of occupational exposure, quality assurance and dosimetric audit of dosimetry services at NPP, elaboration of the techniques for assessment of effective dose under conditions of strongly anisotropic radiation fields. This laboratory successfully participated in 1996-1998 IAEA intercomparison demonstrating the best result among all participants operating TLD systems.

3. Elaboration of the United System

As may be concluded from the review of the current status of dosimetric monitoring infrastructure in Ukraine, the radical reconstruction and modernization are imperatively demanded in this field. The 2001 Decree of the Cabinet of Ministers of Ukraine "About adoption of the guidelines for development of the united state system for monitoring and registration of individual doses of population" envisages that the three-level united state system will be elaborated covering all critical groups with individual dosimetric monitoring. The System is intended to cover all aspects of efficient dosimetric monitoring, in particular - provision of methodical unity of individual dosimetric monitoring; scientific and methodological guidance of individual dosimetric control; procurement of common technical policy regarding nomenclature and operation of instrumentation; implementation of quality assurance programs; development and support of common information infrastructure intended for logging, storage and access to data on individual dosimetric monitoring as well as keeping the national registry of individual doses; training and certification of personnel engaged in the System of individual dosimetric monitoring.

Successful implementation of this System would allow addressing of the following main tasks:

— Radical modernization of the dosimetric monitoring services.

— Harmonized definition of critical groups and extension of high quality dosimetric monitoring to all members of these groups.

— Development of the united national system for monitoring and recording of individual doses on the basis of certified dosimetry services. This System will be built according to the territorial principle and will include infrastructure for centralized dosimetry (e.g. postal services) and data transfer network covering local databases, regional and central dosimetry registries.

— Development and operation of the central dosimetry registry.

Three levels of the proposed System have different goals and responsibilities. The task of the first level (SCRM AMS Ukraine) is development of the guidelines in the area of dosimetric monitoring and data handling, provision of methodological support for operation of the System, development and implementation of the unified technical policy, development of the information infrastructure, analysis and dissemination of data regarding the results of dosimetric monitoring, training and quality assurance for the local dosimetric monitoring facilities. At initial phase, when availability of modern high performance TLD systems is limited, first level of the System will perform also high quality dosimetry service to the users all over Ukraine. Main task of the second (regional) level of the System is to maintain regional dosimetry registries and concentrate the results of dosimetric monitoring performed in the region of their responsibility by all dosimetry services incorporated into the System.

Later, when equipped with modern equipment, laboratories of the second level will take over routing dosimetric monitoring in respective territories.

The cornerstone of the System is the third (local) level of the united system. It should be stressed that according to their responsibilities, tasks and instrumentation, elements of the third level of the System may differ significantly. So, the third level comprises well equipped dosimetry laboratories of the NPPs and nuclear facilities (level 3a), territorial (oblast) sanitary and epidemiology stations (level 3b) as well as independent services after proper accreditation (level 3c). Tasks of these categories of the third level laboratories vary according to their profile. Specific tasks of each of these categories (3a, 3b and 3c) are presented below.

Level 3a – dosimetric monitoring laboratories of the nuclear cycle facilities:

- routine dosimetric monitoring of the personnel;
- dosimetry database management and keeping raw data of dose measurement;
- transfer of the results of dosimetric monitoring to the State dosimetry registry.

Level 3b – oblast sanitary and epidemiology stations:

- distribution and collection of dosimeters, which are issued by the laboratories of the first and second levels;
- supervision of the usage of dosimeters;
- feedback to end users – transfer of the results of monitoring to persons and management;
- maintaining of the local level of the State dosimetry registry.

Level 3c – accredited independent dosimetry services:

- dosimetric monitoring on commercial basis following methodological guidance provided by the first level of the System;
- keeping of the raw data of dose measurement;
- transfer of the results of dosimetric monitoring to the State dosimetry registry.

It is quite realistic, with proper financial support, to implement the described System in relatively short time. Primary investments should concentrate on enforcement of the Central dosimetry service (level 1 of the System) and implementation of the modern information infrastructure with the central dosimetry registry and local databases and terminals in all elements of the System.

4. Conclusions

Current inadequate status of dosimetric monitoring infrastructure as a key component of the whole radiation safety system is demanding an urgent modernization and elaboration of the united state system for monitoring and recording of individual doses in Ukraine. The proposed plan and structure would allow to bring dosimetry infrastructure in Ukraine to the state-of-the-art state which would be compatible with existing and future European and international radiation protection networks.

Unitary structure of Ukraine, strong administrative command and good communications between regions of the country are positive factors in favour of efficient implementation of the proposed plan. Deficiencies are associated with limited funding of this effort.

Bulgarian Regulatory Framework for Radiation Safety

L. Katzarska

Nuclear Regulatory Agency
Sofia, Bulgaria

Abstract. A short general information for the present Bulgarian regulatory framework and practice related to radiation protection and safety will be presented. The existing legislation on radiation protection will be commented. Somme information on the current inspection practices for occupational exposure, medical exposure control, population exposure control and preparedness to radiological emergencies will be given.

1. Introduction

At present in Bulgaria there are one nuclear power plant in Kozloduy, one research reactor in Sofia and many other activities with sources of ionising radiation in medicine, industry, agriculture etc. Kozloduy Nuclear Power Plant (NPP) has 6 reactors on the site. Recently two of the oldest units were shut down for decommissioning by a governmental decision. The research reactor (ITR) in the capital of the country Sofia is out of operation since 1989 year. The number of workers occupationally exposed in the NPP (own personnel and contractors) is varying in time - approximate level of 3600 to 4900, the collective dose in 2001 year - 5.59 person.Sv, in 2002 was 3.73 person.Sv [1]. The collective dose in the other institutions within the nuclear sector - the Institute of Nuclear Research and Nuclear Energy (INRNE), the research reactor and some small companies is negligible. In the past, more than 90% of the collective dose was received by the persons, employed in the uranium mining industry, however, starting in 1990, all mines were closed.

The total of 3500 supervised work sites with sources of ionising radiation are classified, with respect to the complexity of the safety problems (activity of the source, dose rate, risk of surface contamination, etc.), into three classes: I-76 sites; II-157 sites; III-3119 sites. The number of licensed work sites in medicine is not large (≈160), these are usually big hospitals and policlinics using a lot of radiation sources. The majority of occupationally exposed persons have activities in medicine (more than 4000), their annual collective dose is in the order of 2.2 person.Sv and takes one-fifth of the annual collective dose from occupational exposure in Bulgaria, more than half is received in diagnostic radiology. More than 600 controlled facilities have activities in industry, the total number of employed workers is ≈ 1000, the collective dose ≈1.2 person Sv. The number of licensed facilities in the area of research and education is quite large - 277 facilities. However, the collective annual dose of this group is negligible ≈ 0.1 person Sv.

2. Legislation for Radiation Protection

Historically first provisions for organisation of the state system for radiation protection in Bulgaria were set in the Order No 117 of 7th April 1964, of the Council of Ministers. The Ministry of Health was charged with the preparation of adequate regulations on the use of ionising radiation sources and the state supervision and control of such activities. The main legislation document was the Act on Public Health [2]. Several orders of the Ministry of Health were issued under the Act on Public Health, some of them are still valid. After the first two units of Kozloduy NPP were put into operation in 1974, and during the following expansion of the plant to 6 units, the role of nuclear sector became of increasing importance.

Now, the matters of safety at work in nuclear and radiation facilities are regulated on the highest level in the following acts, adopted by the parliament:

- New Act on the Safe Use of Nuclear Energy [3] , that has replaced since July 2002 the former Act on the Use of Atomic Energy for Peaceful Purposes]
- Act on Public Health]
- Act on Safe Conditions of Labour [4]

The standards for the protection of persons from the harmful effects of ionising radiation were laid down in 1992 - Basic Standards of Radiation Protection (BSRP) [3], that have been replaced by the new BSRP-2000 since January 2001 year. The new dose limits for occupationally exposed workers are to a large extent in accordance with the Basic Safety Standards No 115 of the International Atomic Energy Agency from 1996 year and the Euroatom Directive 96/29.

The following ordinances of the Ministry of Health are relevant for monitoring of occupationally exposed workers:

- Ordinance No 35 on Work with Radioactive Materials and Other Sources of Ionising Radiation [4]
- Ordinance No 40 on Dosimetric Control of Individual External Exposure of Persons Occupationally Exposed to Ionising Radiation [5]

Matters concerning the professional qualification of experts working in the area of radiation protection as well as requirement to the training of persons working with radioactive materials are contained in:

- Ordinance No 6 of the Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) on Criteria and Requirements to the Training, Qualification and Approval of Personnel Employed in Nuclear Facilities [6]
- Ordinance No 220 of the Ministry of Health on the Procedure of Approval of Activities in the Field of Technical Service of Medical Technique and Equipment
- Ordinance No 2 of the Ministry for Environment on Certification of Professional Competence of Experts in the Field of Environmental Protection.

Several documents of the former Committee for Standardisation and Metrology (CSM) regulate the problems of calibration of devices, accreditation of calibration laboratories [7], on type testing and state control over the measuring equipment [8], on units and standards [9].

The specific problems of operational protection of outside workers are treated in the Ordinances No 40 [5], No 35 [4] and in Ordinance No 5 [10] on Licensing of Use of Atomic Energy (§ 62-69) and in the Annex 6 of the NPP internal regulation ‘Permission for Performing Activities and Dose Control of Outside Undertakings’. The current legal documents generally comply with the provisions of Council Directive 90/641 EURATOM but the treatment is spread over several ordinances and regulations.

The emergency planning and preparedness is regulated according to a separate chapter in the new Act on the Safe Use of Nuclear Energy and The Ordinance for Emergency Planning and Preparedness for action in case of radiation accident (1999).

3. Structure

The Nuclear Regulatory Agency and the Ministry of Health have the main responsibilities in the matters concerning radiation protection and persons occupationally exposed to ionising radiation.

3.1. Nucler Regulatory Agency (NRA)

The Nuclear Regulatory Agency is a State body to the Council of Ministers in Bulgaria and determines the policy of the country on the safe use of nuclear energy. The NRA is the main licensing authority in the country. The legislation requires that the issue of licenses for the use of sources of ionising radiation by the NRA. When it is necessary the licensing is co-ordinated with other institutions with competencies in the specific area, usually the Ministry of Health and the Ministry of the Environment and Waters. As a main regulatory body in the area of nuclear safety and safe use of sources of ionising radiation, the NRA is concerned with a lot of problems of radiation protection of occupationally exposed workers, without being directly responsible for the measurement and monitoring of the exposure. In the structure of NRA there is a Radiation Protection and Emergency Planning Directorate. The inspectors from this Directorate are responsible for the licensing and control of all activities with sources of ionising radiation. When it is necessary the inspectors from the Radiation Protection and Emergency Planning Directorate co-operate in their inspections with the colleagues from the NCRRP and Radiation Hygiene sections of IHE.

3.2. Ministry of Health

Several institutions within the Ministry of Health carry out the preventive and routine radiation control of the state: the National Centre of Radiology and Radiation Protection (NCRRP); the Inspectorate of Hygiene and Epidemiology (IHE); the Division for Preventive Medicine and State Sanitary Control of the Ministry of Health.

The NCRRP is charged with the individual monitoring of occupationally exposed workers, with the centralised registration of all data of occupational exposure to ionising radiation and with the medical surveillance of radiation workers. Furthermore the NRRP is running laboratories for environmental radiation control and for retrospective biological dosimetry.

4. Exposure monitoring

4.1. Dose limits

The system of dose limits is an important part of the BSRP. The annual dose limits for occupationally exposed persons are:

- for the effective dose for 5 consecutive years 100 mSv
- for a single year is possible, taking into account the above limit 50 mSv
- for equivalent dose to different organs and tissues:
- for the lens of the eye 150 mSv
- or all other organs or tissues 500 mSv

Additional requirements for women:

- the working woman notifies the employer for her pregnancy immediately after its confirmation
- the employer is obliged to protect the embryo as a member of population
- there is no probability for radioactive contamination of the breast-feeding mother.

Persons between 16 and 18 of age are allowed to be involved in work with ionising radiation only for training purposes. The annual dose limits for this group are:

- for effective dose 6 mSv
- for equivalent dose to different skin and hands: 50 mSv
- there is no probability for radioactive contamination.

Planned special exposure and emergency exposure.

Planned exposures of personnel above the annual dose limits can be allowed by the regulatory authorities under certain special requirements. The persons participating in such activities must be informed about expected dose, character of work and radiation risk and must give their agreement in written form. Persons who have received doses in excess of the annual dose limits (during special exposure, emergency exposure or due to accident) shall undergo a period of compensation of the accumulated dose. There are detailed rules for the way of compensation of the dose through restriction of occupational exposure in the following years. The exact individual plan is set by the supervisory authority after consultation of an occupational physician.

4.2. Occupational exposure due to natural sources

In Bulgarian regulations persons exposed to natural sources of ionising radiation were and are now, generally, considered as occupationally exposed personnel. In the past the main group occupationally exposed to ionising radiation was that of uranium miners. After the mines were closed the number of persons exposed in this sector drastically diminished, there are some tens of persons involved in closing procedures or in activities directed to the reduction of exposure to the environment and to the population in the vicinity of the mines. There are some thousands of miners in metal ore and coal mines, but up to now the exposure to radon was not estimated for these persons on a regular basis.

In BSRP there are some requirements concerning the air lines crew. In cases, when the dose is expected to exceed 1 mSv for a single year, the employer is obliged to measure and register the exposure, to organise the flights in such way to reduce the doses, to inform the crew for the existing risk, to protect the women as it was mentioned. However, there is a tendency, not only in Bulgaria, that the pilots work as self-employers for different airlines, also abroad, execute charter flights, etc.. The overview on working time really spent in the air becomes more problematic. The control on the really spent flight-time of aircraft staff employed in internationally acting airlines is already now a problem and will increase in the future.

4.3. External dosimetry

The Department Dosimetry of External Radiation at NCRRP monitors around 5700 workers in all facilities throughout the country, including 300 workers from the zone with special control in NPP Kozloduy. The service started operation in 1964 with film dosemeters. At present two types of dosemeters are offered for monitoring of whole body exposure - film dosemeters and combined film-TL dosemeters. The Department Dosimetry of External Radiation has participated in the international research projects ‘Dose B’ and ‘Dose-Integral’, carried out on board of space stations MIR and SALUT on estimation of doses to astronauts during long-term flights as well as in the IAEA Co-ordinated Research Programme on Intercomparison for Individual Monitoring of External Exposure from Photon Radiation (1996-1998).

The first laboratory for individual dosimetry at NPP Kozloduy started operation in 1974, and since that time has served the personnel of units I-IV and the contractors at these units. The second laboratory started operation in 1988, and carries out individual dosimetric control for the personnel of units V and VI . The equipment, the dosemeters, the methods of dose estimation are identical. The total number of monitored workers at both laboratories is around 3200. Only TL dosemeters are in use.

4.4. Internal dosimetry

The laboratories at NPP Kozloduy carry out monitoring of the internal contamination of own personnel and all contractors, out-side workers and , if necessary, of the visitors of the nuclear power plant. All workers shall undergo, at least once a year, measurements by whole body counter. The dose due to internal exposure at NPP Kozloduy takes less than 10% from the total absorbed dose, the average annual value for exposed workers being at a level of less than 1.5 mSv. There are no written requirements to the quality of dose assessment in the laboratories for internal dosimetry. However, the staff is aimed to follow the actual tendencies and the recent development in this area, as recommended in the ICRP publications or by internationally recognised institutions. In 1998, the laboratory for internal dosimetry at NPP Kozloduy participated successfully in the intercomparison organised by the EULEP/EURADOS working group.

5. Training in Radiation Protection

Persons employed in nuclear power plants or other nuclear facilities must undergo an adequate training in nuclear safety and radiation protection. The applicants must meet certain requirements regarding their education and work experience, and must pass an exam based on syllabus, developed by the State Qualification Committee, and approved by the EC in 1999. The license is issued for a period of 3-5 years, after that the person must undergo a verification exam. Persons, who are going to take responsibilities in the area of radiation protection in facilities using sources or generators of ionising radiation, must undergo on-job training and must have a certificate for qualification to work in certain areas. The exact requirements for the training and the qualification of the personnel are included in the license of each facility.

6. Conclusion

The Bulgarian regulatory framework for radiation safety in principle is in compliance with the existing IAEA and European Union requirements and safety documents. The necessary further improvements are foreseen by the regulatory body (NRA) and will be implemented in near future.

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[10] ORDINANCE No 4 ON TYPE TESTING AND STATE CONTROL OVER MEASURING DEVICES, CSM .

[11] ORDINANCE No 6 ON QUALITY UNITS AND STANDARDS, 1994 .

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Topical Session 5

SUSTAINABLE EDUCATION AND TRAINING: DEVELOPING SKILLS (NATIONAL SYSTEMS AND REGIONAL SOLUTIONS)

The System of Training and Authorization of Personnel involved in the Nuclear Activities in Kazahkstan

M. Idrissova, A. Kim

Atomic Energy Committee of the Republic of Kazakhstan
Almaty, Kazakhstan

Abstract. The present situation in the field of training and authorization of personnel involved in activity with using of atomic energy in the Republic of Kazakhstan, results achieved during last period is described in this paper. Needs for improving of the system of personnel training in the country is discussed.

1. Introduction

Since 1991, after getting of the sovereignty, Kazakhstan started developing of its own legislative and regulatory system in the field of atomic energy use. In accordance with the Decrees of the President appropriate structures in Kazakhstan were created. They are: Atomic Energy Committee, as a main supervising governmental body, National Nuclear Centre combining all nuclear related scientific institutes, and National Atomic Company "Kazatomprom". On 14 February 1994 Kazakhstan joined the International Atomic Energy Agency. Infrastructure of the using of atomic energy in Kazakhstan includes:

- One power fast reactor BN-350 (now it is shut down and prepared for the decommissioning) and four Research reactors of the National Nuclear Centre.
- Uranium mining and milling enterprises and Fuel fabrication plant.
- Storage facilities for nuclear materials, radiation substances and radioactive waste.
- Organizations using radiation sources.
- Transport organizations.

Also a lot of enterprises use radioactive sources for the different application in medicine, research, industry, agriculture and etc.

According to this the Republic of Kazakhstan needs the effective system for the assurance and guarantees for protection of population and environment against the possible negative influence of atomic energy usage. One of the important parts of that is a system of training and qualification of personnel involved in the nuclear activity.

A big variety of Kazakhstan nuclear facilities and considerable amount of personnel involved in nuclear activities in a combination with limited resources dictate outstanding need in an implementation of thought-out, balanced and systematic approach to the development and upgrade of Kazakhstan nuclear training, qualification and authorization infrastructures.

These considerations were the basis for planning and implementation of the IAEA and KAEC joint activities. Kazakhstan participated in the IAEA Interregional Model Project on Upgrading of Radiation and Waste Safety Infrastructure from 1996 to 2000. This project assist to solve some general question related personnel training, but not all aspects of this matter were covered. More detail those problem were solve by other TC Project. The 1999-2001 activities included the development of personnel-related sample regulation for Kazakhstan taking into account the needs identified under Technical Co-operation Project KAZ/9/006 “NPP Sitting in Kazakhstan” [1].

2. Present Staus and Needs

Currently in Kazakhstan there are about 700 companies and organisations, involved in the activity with usage of atomic energy with total personnel approximately of 7000. They are from big enterprises such as NNP BN-350, National Nuclear Centre of the Republic of Kazakhstan with its Institutes and Nuclear Installations, National Atomic Company “Kazatomprom”, including uranium mines and Fuel fabrication plant. That is one part of personnel in the country. Other part is personnel of medical institutions, geophysics organizations, industrial hagiographists, etc. All personnel need a special training in the field of Nuclear and Radiation Safety. It is very important and for this it is necessary to have requirements for qualification, selection, training and authorization of personnel of all entities of the country.

During the period of the former Soviet Union, Physicians had a special training in the Institutes of Post-graduate Training of Physicians. It was also connect with radiology, radiotherapy and nuclear medicine. This training was conducted every five years.

Now in Kazakhstan is the same institute in Almaty. It has special programs for students for three- six month.

State sanitary-epidemiology service which provides supervision and inspection for medical institutions has a special training program for its own personnel.

There are five companies providing training of personnel for nonmedical organizations in the country. Here are programs for specialists on “Radiation safety and protection” and “Dosimetry”. Those programs have concordance with State sanitary-epidemiology service and approved by the Regulatory body. During last four years by those companies were trained few hundred peoples from different organizations both Kazakhstan’s and foreign.

The companies providing above mentioned training are the low level of education in this area. Now Kazakhstan needs high level of it. That may be a special course on university level or post graduate institute.

For solution of this task Kazakhstan needs to develop a Concept for continuing training of specialists in nuclear field.

3. Regulation in the Field of Personnel Training and Authorization

According to the legislation of the Republic of Kazakhstan [2] all types of activity with using of atomic energy must be licensed by the Regulatory body of the country. One of the general requirements for licensed companies is the having of quality specialists.

Those specialists has to have a special education, such as nuclear physics or radiation physics course in University, or training in the specialized company providing training in the related field.

Training company must to have a license for providing this service. There are special requirements for training companies connected with staff quality, building for training and equipment.

All staff of enterprises and companies conducting activity in nuclear area, who are responsible for radiation and nuclear safety, must have examines in Atomic Energy Committee of Kazakhstan [3].

There are five categories of personnel:

- Management staff of nuclear entities and nuclear facilities, whose job description provides for direct responsibility for ensuring safety during the use of atomic energy. The authorization is granted for the right to safely manage the nuclear facilities.
- Personnel of nuclear entities and nuclear facilities engaged in the supervision and control of nuclear and radiation safety. The authorization is granted for the right to conduct activities on supervision and control of ensuring nuclear and radiation safety.
- Management staff of nuclear facilities, whose job description provides for both direct control of the nuclear facilities and responsibility for ensuring safety of the nuclear facilities. The authorization is granted for the right to manage the operation of the nuclear facility and to ensure its safety.
- Individual categories of operating personnel. The authorization is granted for the right to conduct routine operations at the nuclear facilities.
- Management staff of nuclear entities and nuclear facilities, whose job description provides for both inventory and control of nuclear materials, ionizing radiation sources, radioactive substances and wastes, and physical protection of nuclear facilities and nuclear materials. The authorization is granted to manage and conduct the activities to ensure both inventory and control of nuclear materials, ionizing radiation sources, radioactive substances and wastes, and physical protection of nuclear facilities and nuclear materials.

For each nuclear entity and nuclear facility, a List of job positions which require formal authorization by the KAEC shall be established. For each category is a program for examine. Program includes National legislation in the nuclear area, safety standards and rules, some specific rules connected with the specific type of activity. If the results of examine is positive applicant receives certificate for the right for conduction of activist in the field of atomic energy use. This document is valid in duration of three years.

In addition here presented list of documents elaborated during last three years under Technical Co-operation Project KAZ/9/006 “NPP Sitting in Kazakhstan”.

- Requirements for Kazakhstan Atomic Energy Committee (Regulatory Body) personnel, December 1999
- KAEC documentation structure on requirements for qualification, training and authorization of personnel involved in nuclear activity, December 1999
- Common regulations for the authorization of personnel for the right to conduct activities in the field of atomic energy use, December 2000
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- Common requirements for organization providing training for personnel involved in the field of atomic energy use in the republic of Kazakhstan, December 2001
- Regulations for the authorization of nuclear power plant personnel by the committee for atomic energy of Kazakhstan, December 2000
- Regulatory guide on the development and conduct of authorization examinations of the personnel subject to the authorization by the atomic energy committee of the Republic of Kazakhstan, June 2001
- Quality management system description, November 2001
- Glossary of terms in the field of nuclear facility personnel qualification, recruitment, selection, training and authorization, August 2001.

4. Conclusion

Currently in the Republic of Kazakhstan the state system of training and authorization of personnel involved in the nuclear activity is established. Under IAEA TC Projects were elaborated sets of regulatory documents in this field.

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New Romanian Regulation for Issuing Practice Permits for Nuclear Activities and for Designation of Radiological Protection Qualified Experts

A. Rodna, L. Biro

National Commission for Nuclear Activities Control

Abstract. According to the provisions of Romanian Law 111/1996 on safe conduct of nuclear activities (as amended) any practice shall be authorized, and, the licensee shall use for performing the practice only personnel possessing an practice permit, valid for that practice. The permit shall be issued, based on assessment and examination, according to the provisions of specific regulations. For the persons with special responsibilities for the safe conduct of the practice, the permit shall be issued by the National Commission for Nuclear Activities Control (CNCAN). In August 2000, CNCAN issued the "Radiological Safety Fundamental Norms" that are transposing the Directive 96/29 /EURATOM. In order to regulate the recognition by CNCAN of the qualified experts, and to amend the rules for issuing the practice permits, a new specific regulation, entitled "Norms for Issuing Practice Permits for Nuclear Activities and Designation of Radiological Protection Qualified Experts" was issued in October 2002. The paper presents the content of the above mentioned regulation.

1. Classification of Practice Permits

According to the "Norms for Issuing Practice Permits for Nuclear Activities and Designation of Radiological Protection Qualified Experts", the practice permits are classified on 3 levels (the permits for reactor operators, shift supervisors and management staff of NPP are not covered by this regulation).

The permit level 1 is issued by CNCAN, for the persons responsible for radiological safety of the practices without significant risk.

The practice permit level 1 can be issued also by the licensee, and allows the holder to perform activities under the supervision of a holder of a permit level 1issued by CNCAN, for the case of practices without significant risk, or a holder of a permit level 2 or level 3, for the other practices.

The practice permit level 2 is generally issued by CNCAN, and allows the holder to have responsibilities regarding the radiological safety for the practices with significant risk (they are responsible for work in radiation area or are radiation protection officers). The practice permit level 2 can be issued also, in special cases, by the licensee, in which case it can be classified on sublevels. This requires the licensee to be designated by CNCAN as a personnel certifying body. This exception is intended, till now, to be applied only for NPPs.

The practice permit level 3, which is issued only by CNCAN, is the permit for designation of the qualified experts.

2. Conditions for Issuing a Level 1 or Level 2 Practice Permit

The conditions that have to be fulfilled by an individual in order to get a level 1 or 2 practice permit are:

- the candidate shall have tasks that imply work within an authorized practice;
- the candidate has (normally) at least graduated high school, and has graduated a radiation protection training program, approved by CNCAN for the particular level of the permit requested(1 or 2), and for the particular field and specialty of practice;
- the candidate is medically fitted for radiation work;
- the candidate has the required theoretical and practical knowledge.

For level 2 practice permits minimum stage of work with level 1 practice permit is required. The duration of this minimum stage depends on the level of general and specific education of the applicant.

The practice permits level 1 and 2 are issued by the licensee after written, oral, and practical examination. The permits level 1 and 2 are issued by CNCAN after a written examination. This examination covers radiation protection, legislation, instructions given by the producer of the source, and working procedures and instructions for the particular radiological area. The practice permits are valid for 5 years.

3. Fields and Specialties for Level 1 and 2 Practice Permits

The level 1 and 2 practice permits are issued for the fields and specialties listed in Table1.

Table 1. Fields and specialties for level 1 and 2 practice permits.

Field	Specialty
1. Radiation generators	Installing, repairing, maintenance, verification Nondestructive testing Physical analyses Other applications
2. Sealed sources	Installing, repairing, maintenance, verification Nondestructive testing Irradiation of materials Other applications
3. Unsealed sources	Installing, repairing, maintenance, verification Radiochemistry Marking Radioactive waste Other applications
4. Roentgen diagnosis	Roentgen diagnosis Phthisiology Dental roentgen diagnosis Nuclear medicine Interventional radiology
5. Radiotherapy	Roentgen therapy Therapy with unsealed sources Teletherapy, therapy with particle accelerators Curietherapy (brachitherapy)

6. Complex	Radiation hygiene
7. Particle accelerators	Particle accelerators
8. Nuclear objectives	Nuclear power plants Research and test reactors, critical assemblies Subcritical assemblies Spent fuel storage Fuel reprocessing (theoretical, as no reprocessing is foreseen in Romania) Fuel enrichment (theoretical, as no enrichment is foreseen in Romania) Fresh fuel (experimental) production and storage
9. Nuclear raw material	Geological field work and exploration Mining Milling Fuel fabrication

4. Conclusion

Romanian laws are now in place to control the use of radioactive sources. The National Commission for Nuclear Activities Control has issued the "Norms for Issuing Practice Permits for Nuclear Activities and Designation of Radiological Protection Qualified Experts."

Systematic Approach to Training for Competence Building in Radiation Safety

S. D. Asiamah, C. Schandorf, E. O. Darko, et al.

Radiation Protection Institute
Ghana Atomic Energy Commission
Legon, Ghana

Abstract. Competence building involves four main attributes, namely, knowledge, skills, operating experience and attitude to radiation safety. These multi-attribute requirements demand a systematic approach to education and training of regulatory staff, licensees/registrants and service providers to ensure commensurate competence in performance of responsibilities and duties to specified standards. In order to address issues of competencies required in radiation safety a national programme for qualification and certification has been initiated for regulatory staff, operators, radiation safety officers and qualified experts. Since the inception of this programme in 1993, 40 training events have been organized involving 423 individuals. This programme is at various levels of implementation due to financial and human resource constraints. A department for Human Resource Development and Research was established in 2000 to enhance and ensure the sustainability of the effectiveness of capacity building in radiation safety.

1. Introduction

Education, training and experience are of primary importance for achieving competence in any area of work. Persons who are responsible for nuclear, radiation, transport or radioactive waste safety should have adequate level of understanding of concepts relating to protection and safety. Additionally persons engaged in any profession would need an appropriate level of work experience before they can adequately fulfill their task efficiently.

There are three reasons for training:

— Firstly, for development of worker skills for competent performance of tasks.

— Secondly, when individuals become aware of the risk associated with radiation exposure through appropriate training they become active participants in the decision to accept and where possible to reduce such risk as part of their work.

— Thirdly, the number and seriousness of accidents can be reduced through training. Thus, an employee trained for both normal and abnormal situations is more likely to assist in maintaining a safety culture at all times and keeping doses received as low as reasonably achievable (ALARA).

The International Atomic Energy Agency has recently issued a safety guide on Building Competence in Radiation Protection and the Safe Use of Radiation Sources [1]. This document provides generic guidance on responsibilities of government, the regulatory authority, employers, registrants, licensees and workers for developing national and practice specific competence building programmes to ensure all identified categories of persons required are adequately trained and certified.

Another useful report on good practices and practical examples of how to develop training programmes for regulatory staff using the concept of a competency framework has been issued by IAEA [2].

This paper highlights the categories of persons to be trained, the requirements for education, training, and experience of each category, and the processes for the qualification and certification of persons. The national strategy for building competent personnel are at various stages of development .This is based upon the Radiation Protection and Safety guide on Qualification and Certification of Radiation Protection Personnel, GRPB-G 1 issued in 1995 [3].

2. Minimum Requirements

Under the National Competence Building model, the Regulatory Authority has established the minimum requirements for education, training and work experience for category of persons to be trained shown in Tables I, II, III respectively [3].

Table I. The minimum requirements for basic education for trainee categories.

Category of Trainee	Minimum Requirement for basic Education
1. Qualified Expert	Bsc./ MPhil./Msc. in Science and or Engineering
2. Radiation Protection Officers (Inspectors)	Bsc./ MPhil./Msc. in Science and or Engineering
3. Radiation safety Officers	Bsc/ Msc/ HND in Science and Engineering depending upon the practice
4. Qualified Operators	Bsc/ Msc/ HND in Science and Engineering depending upon the practice
5. Health professionals	An Accreditation from a national body to practice

Table II. The minimum requirements for basic training for trainee categories.

Category of Trainee	Minimum Requirement for basic training
1. Qualified Expert	Refresher Course/workshop delivered by staff of RPI with the assistance of IAEA. Duration 1-3 days
2. Radiation Protection Officers (Inspectors)	On the job training by RPI followed appropriate IAEA regional training courses ,post graduate diploma training and fellowship training in specialized area
3. Radiation Safety Officers (RSO)	Approved practice specific training course provided by RPI or an approved training centre. Duration , minimum 80 man- hrs
4. Qualified Operators	Training delivered by RPI or qualified RSO Duration, minimum 40man- hrs
5. Health professionals	Sensitization Seminar/Workshop by RPI or qualified expert .Duration 1-3 days.

Table I II .The minimum requirements for work experience for trainee categories.

Category of Trainee	Minimum Requirement for work experience
1. Qualified Expert	At least ten years working experience in the relevant area of specialization
2. Radiation Protection Officers (Inspectors)	At least five (5) safety assessments for authorization and regular inspections under the supervision a senior inspector
3. Radiation safety Officers	At least two years experience at the relevant practice
4. Qualified Operators	At least two years experience as an operator with little or no supervision
5. Health professionals	A least five years working experience in the specialized area.

3. National Level Training Strategic Plans

The minimum criteria for education, training and working experience as shown in Tables I,II and III are used to design a national level training policy for the categories of persons who are likely to be exposed to ionizing radiation ,radiation sources and radioactive substances in their respective professional work. The strategic approach to designing and developing a national level training programme consists of job evaluation , training analysis, training material development, evaluation plan, instruction by qualified instructors, evaluation and feedback .

The frequency of training and retraining is related to the frequency of the use of the learned competence. Job performance that are only occasionally required but stressful, highly demanding or complex such as the Research Reactor, the gamma irradiator ,the radiotherapy facilities retraining after the initial training is given top priority and retraining is done annually.

Since needs vary according to the nature of the work and hazards associated with radiation exposure, training scheduling have been prioritized according to the following sequence; Inspectors, Radiation Safety Officers, Operators, Qualified Experts and Health Professional. Appropriate training syllabi have been developed and the knowledge, skills, attitudes and learning experiences have been built in the competence building matrix [3, 4].

4. Overview of Training Programme executed and Lessons Learned

The Safety Requirements for Legal and Governmental Infrastructure for Nuclear ,Radiation Radioactive Waste and Transport Safety require that in order to ensure proper skills are acquired by staff of regulatory bodies and that adequate levels of competencies are achieved and maintained , the regulatory body shall ensure that its staff participate in well defined training programmes .The training programmes should ensure that staff are aware of technological developments and new safety principles and concepts[5].

The Regulatory Authority of Ghana policy is to provide the enabling environment for its staff to benefit from all IAEA assisted relevant training modalities and on the job training and also promote training and certification of registrants, licensees, workers and radiation protection service providers. From 1993 to 2002 the Radiation Protection Institute has organized 40 training events with a total of 423 persons trained and certified. The training events catered for radiation safety officers, operators of irradiating devices and radiation sources within practices. Training materials available are a training room, desktop projector, overhead projector, video deck, video films and appropriate handouts. Some of the training events are provided on-site at the facility premises.

The major challenges is the low priority placed on continuing training by management of some organizations which affects the funding allocated for competence building activities in radiation safety. Maximum cooperation is obtained from institutions where competence building through training is a culture of management and workers.

A department for Human Resource Development and Research was established in 2000 to enhance and ensure the sustainability of the effectiveness of capacity building in radiation safety.

5. Conclusions

Competence building through systematic approach to training in radiation safety is an essential element of safety culture at the workplace. Competence building involves four main attributes, namely, knowledge , skills, operating experience and attitude to radiation safety. These multi-attribute requirements demand a systematic approach to education and training of regulatory staff, licensees/registrants and service providers to ensure commensurate competencies in the performance of responsibilities and duties to specified standards. The key issues of competence building have been addressed by establishing a national system for qualification and certification for regulatory staff, operators, radiation safety officers and qualified experts in radiation safety.

Efforts are being made to have a quality management system for the national level competence building model in radiation safety through the training programmes of the Department for Human Resources Development and Research.

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Radiation and Waste Safety Training and Education: *Malaysian Experience*

M. Daud, H. Shafaai

Malaysian Institute for Nuclear Technology Research (MINT)
Bangi, Kajang, Selangor, Malaysia

Abstract. The increasing use of radiation in various economic sectors requires proper safety practices and standard, thus the need for training. The creation of training opportunities such as on-the-job training, modular training, scientific visit, fellowship training, collaborative training and post-graduate educational training as well as the introduction of suitable training approaches are strategized to meet customer needs and enhance the application of nuclear technology in various sectors for economic growth and product competitiveness. This paper attempts to illustrate the Malaysian experience in implementing radiation and waste safety training for enhancing safety performance in an organization. It also acts as catalyst for economic well being of the nation. In this regard, due consideration has to be given for sustainable training programmes. As such, training must be customer-focus, relevant and attractive. Hence, the customer-focus and demand-driven training have been successfully introduced into the market to meet the needs. In general, incentive is an integral element to stimulate customer interest. This paper will also delve on these stimuli – fiscal, professional and personal, which have been proven attractive.

1. Introduction

The 1980s have seen the new beginning of nuclear technology development in Malaysia. The introduction of Atomic Energy Licensing Act followed by the establishment of Atomic Energy Licensing Board (AELB) are serious initiatives taken by Malaysian government to regulate, safeguard and monitor the ionizing radiation activities in Malaysia. In addition, the AELB is to compliment the functions of Malaysian Institute for Nuclear Technology Research (MINT) in promoting the peaceful use of nuclear technology. Since radiation issues are of national interest, the government has taken proactive approaches by formulating radiation safety strategies whereby due consideration is given to the application of nuclear technology in various economic sectors without compromising radiation safety standard. As a result, radiation and waste safety training has been implemented to the extent that it has emerged as a competitive and sustainable product. The challenge for us now is how to develop and package a training product that is competitive, customer-focus, relevant and attractive.

2. General Scenario of Radiation and Waste Safety Training

Radiation safety practices in the workplace should be a commitment for every member within an organization regardless of positions. Thus, it is the collective responsibility of all members to forge 'safety practice' at a greater height leading to the development of safety culture in an organization. The practices are not restricted to just adherence to safety regulations but more so to encompassing aspects of continuous safety improvement. In Malaysia, efforts have been orchestrated to positioning radiation safety as an integrated safety management of an organization.

Towards this end, training programmes have been developed and designed to cater the following aspects:

- Legislative/statutory requirements.
- Standard module/syllabus.
- Customer needs.

— Market demand.
— Availability of facilities
— Capability of trainers.

As a training designer, it is pertinent for MINT to develop product that is relevant, sustainable and demand-driven training that is shown in figure 1; thus ensuring customers' preferred choice.

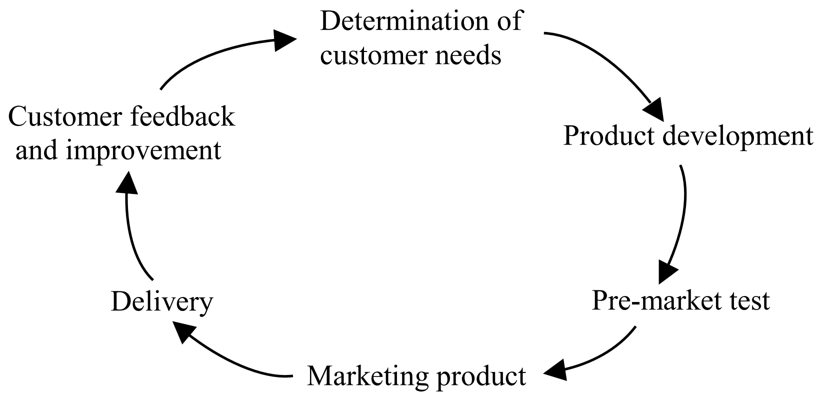

FIG. 1. QMS's training cycle for demand-driven training to ensure sustainability

3. Developing Training Programme

A training programme must be designed to meet the needs of customers, through the creation of training opportunities taking into account their time, locality, convenience, training methods and changing needs. In this regard, MINT has created training opportunities such as on the job training, modular training, scientific visit, fellowship training, industrial attachment, postgraduate training, etc. With suitable training approaches, dedicated trainers, state-of-the-art training facilities and pre-market test, the products have attracted numerous customers from various industries and institutions.

Rapid development in the application of ionizing radiation and the introduction of statutory requirements has created a new opportunity in training. In Malaysia, those involved in radiation activities are required to undergo continuous professional education (CPE) to keep abreast with latest development, enhance knowledge, skills and attitude in radiation related fields. This, in turn, will enhance the application of nuclear technology that contributing significantly to the economic growth and nation well being.

4. Product Sustainability

In the past, products in radiation and waste safety training were mainly monopolized by MINT. However, presently there are other organizations competing in the market. The ability of these organizations to provide such training programmes, should be seen as a success to MINT's overall programmes to promote greater use of nuclear technology and technology transfer.

Due to effective marketing strategies, MINT's training products are widely accepted by the market. This is testimony in the increase of 52.6% participants and 127.9% revenue for the period 1998-2002. The strategies undertaken by MINT have positioned us as a highly valued training provider, and perceived to enable to delight customer, create relevant products, great trainers, with quality management system is in place.

In addition, the success is also due to the formulation of right marketing strategies which adopted the following approaches:

- Costing and pricing strategies.
- Subscription of Aristotle believe, the great Greek philosopher that described the needs to harmonise ‘logos’ (logic), ‘pathos’ (emotion) and ‘ethos’ (character) of customers.

Observation to the natural tendency of human being of:

- justify with business reasons, but buy for personal reason.
- justify on logic, but buy on emotion.
- Product packaging and presentation.

4.1. Reaching Customers

Customers should be well informed of the products. The information should reach customers in appropriate time frame for necessary arrangements in term of administrative and financial procedures. Normally, the information is made available through newsletter, brochures, advertisement, web portal etc. The ‘on-line reservation’ is getting popular even though is not yet a preferred choice. The sale target can be met through marketing approaches that paving for the market penetration and extension, product development and diversification. Hence, the introduction of regional-based and in-company training apart from public training are the appropriate strategies to meet market demand and create customers’ needs. These approaches are proven attractive in customers’ decision due to the following advantages:

- Cost-effective.
- Family commitment.
- Time constraints.
- Within workplace proximity.
- Tailored to organizational activities.

4.2. Smart partnership

This approach is developed as a working partnership to achieve a common set of objectives, in which resources can be shared for mutual benefit based on co-operation and trust. MINT has successfully organized a number of seminars, conferences and symposium concept in collaboration with other organizations. Through this arrangement, partners not only pooled their resources, expertise and finance, but abled to overcome procedural barriers and other constraints. Our postgraduate educational training course has been successfully conducted through tripartite arrangement involving IAEA, MINT and National University of Malaysia.

4.3. Costing and pricing strategy

In determining the fees for a training product, base level cost is first established using the ‘micro accounting system’ issued by the Malaysian Treasury whereby every single cost is accounted. The generic base-cost formula derived from the system is as follow:

$$\boxed{\text{Base Cost Per pax (MYR)} =} \quad \frac{(282 + 0.6x)h + (40 + 20x)d + 45x + 1000}{x}$$

where

x is number of expected minimum participants h is number of hours

d is number of days

The pricing strategy reflects our firm belief in the value of MINT's training products and its position in the marketplace as a leading training provider for radiation and waste safety. Thus, the value pricing and hybrid pricing are the appropriate methods in determining registration fees. Discount is also given for team participations so as to encourage more customers from the same organization.

3

4.4. Stimulus packages

The recent introduction of government's policies to spur economic growth has created greater opportunity for training. Opportunity arising from the policies has been successfully explored and capitalized to suit and harmonize with the ever changing priority of customers and their environment. Hence, MINT's introduction of the following incentive packages were able to attract more customers into buying its products.

- Financial stimulus package.
- Professional stimulus package.
- Personal or emotional stimulus package.

Being an approved training institute by government agencies and professional bodies, MINT is in a position to integrate such incentives to offer customers the benefits of training rebate, double tax deduction and, credited merit point for professional status and practices. This stimulus package is a powerful marketing tool to market a new product or sustain existing ones, and having the ability to attract new customers and retain existing ones. *Training tourism* concept has also been introduced to provide value-added products. MINT's annual event, for instance, is held to gather all customers in related radiation fields. Annual Radiation Protection Officer Conference, should also be seen as an opportunity or incentive for family retreat; especially it is planned in conjunction with school holiday.

The good response to MINT's training products has motivated and mobilized our workforce to work harder in team spirit to delight customers. The improvement in reference materials and publication of textbook is to provide quality training materials and should be seen as MINT's commitment for continuous quality improvement.

5. Challenges and Conclusion

Like any other products, even though it has an added advantage, it has to compete and face stiff challenges in the marketplace. Continuous product improvement, involvement of specialist trainers, competitors and cost-benefit of the products are some of the challenges. In order to rise to the challenges, it requires high commitment from the workforce, relevancy of the products, experience trainers apart from personal benefit to the customers.

The recognition by relevant authorities and statutory requirement play a vital role in determining the success and sustainability of a product. This can be seen from performance indicator in radiation safety & health sector and non-destructive testing sector, in which certain products are categorized as cash cow and of 'dinosaur' status, a species that enjoy a protection status. Other products that are not included in this category are considered 'wild-cat' with market potential but require unique marketing strategies. In addition, the way we treat our customers plays an integral part in ensuring the product competitiveness thus empowers it to be a market leader.

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Brazilian Experience on Qualification of Radiation Protection Officers for Industry Installations

F. C. A. Da Silva, J. C. Leocadio,
A. S. de Pinho, et al.

Instituto de Radioproteção e Dosimetria
Comissão Nacional de Energia Nuclear
Rio de Janeiro, RJ, Brazil

Abstract. This work presents a brief description of the process used by the brazilian regulatory authority – National Commission of Nuclear Energy (CNEN) – to qualify radiation protection officers especially to work at industry practices. A Committee for Certification of Qualification was created in order to be responsible for the elaboration and organization of the rules for the examinations. From 1999 to 2002 more than 400 radiation protection officers were qualified according to this process. The main industrial practices involved were industrial radiography, industrial irradiators, industrial accelerators, well logging petroleum and nuclear gauge. An overview is also given about the national regulatory infrastructure responsible for radiation safety controls, including the Brazilian regulation infrastructure and the national inventory of industrial installations.

1. General Aspects

The Brazilian regulatory authority is the National Commission of Nuclear Energy (CNEN), which is responsible for all activities related to nuclear or radioactivity materials. CNEN has an infrastructure for controlling the industrial radioactive installations, composed by a Director of Radiation Protection and Nuclear Safety and two General Coordinators. One is responsible for the national system of Licensing and Control – CGLC, and also responsible for the administrative process of certification, and the other is the Institute of Radiation Protection and Dosimetry – IRD, responsible for the national system of radiation safety inspections and for the effective examination process of certification. In this paper we are going to describe our process for certification of qualification.

All installations that use radiation sources in Brazil must be licensed by the National Commission of Nuclear Energy (CNEN) and may be subjected to the regulatory process of licensing: authorization, inspection and personal certification. CNEN has a data base programme with the national inventory of sources and installations. Nowadays there are 3067 radioactive installations, 41% in medical field, 31% in industrial area, 22% in research, 4% in commerce and 2% in services area.

The industry area has 950 installations that use radioactive sources as work tools. Those facilities are classified into the following practices: industrial radiography (162 installations), industrial irradiators (9 installations), industrial accelerators (14 installations), well logging petroleum (23 installations), nuclear gauge (612 installations) and others (130 installations).

The Brazilian regulation related to industrial radioactive installations comprehends a general regulation and six specific guidelines. The following regulation is straight connected to the process for certification of qualification:

— General Regulation: *Basic Guideline for Radiation Protection*, NE3.01-CNEN, 1988 [1]. This document establishes the basic guidelines for radiation protection and specifies the basic principles, occupational radiation limits, and limits for the public. It also specifies obligations for the director of the installation, for the radiation protection officer (RPO) and for workers, as well as the basic controls for protection of men and the environment against possible hazardous effects from ionising radiation. It also contains the minimum necessary items for elaboration of a suitable radiation protection programme. An upgrade based on IAEA recommendations of BSS 115 [2] was already proposed and will be adopted soon.

— Specific Guideline: *Certification of Qualification for Radiation Protection Officer*, NE3.03-CNEN, 1999 [3]. It establishes the requirements for certification of qualification of radiation protection officers for performing in nuclear and radioactive facilities, as well as in the transport of radioactive materials. It specifies the areas of performance, requirements for personnel, and training documentation. It also presents the methodology for evaluation, emission and validity of the certification. Also included in this document are the main violations of requirements that cancel the certification emitted by CNEN.

2. Process for Certification of Qualification [3, 4]

Based on national regulations, each industrial installation that deals with radiation sources must have at least one radiation protection officer (RPO), responsible for the radiation protection service. However, for practices classified as IAEA Category 1 [5] – industrial radiography and industrial irradiator – it is necessary to have at least two RPOs.

In 1998, a Committee for Certification of Qualification for RPOs was created, in order to coordinate the process for certification of qualification. That committee has now nine permanent members. It is organised by a president, four IRD members and four CGLC members. The main objectives of this committee are to organize the examination, to lay down rules, to elaborate the examination program, to choose the examiners and to deliberate about RPOs' penalties.

The national system for qualifying RPOs is based upon the following assumptions:

— The certification of qualification will occur once a year.

— The candidate must be a graduated professional (engineer, physicist, chemistry, etc).

— The candidate must prove, with a certificate, that a previous formal training was received.

— The candidate must pass two types of examinations of knowledge:

  i. A general written test, about global aspects of ionising radiation;

  ii. Specific examinations, for the given type of practice that the RPO works with. This step is divided in two parts: a written discursive test and a practical and/or oral test.

— The certification is valid for five years.

— The certification can be cancelled when violations of requirements or unsafe conditions are found during RPOs' duties.

The general written test follows a program, with fixed percentages for each topic. The main topics are nuclear and atomic physics (12.5%), biological effects of radiation (12.5%), basic aspects of radiation protection and safety (25%), nuclear instrument (20%), national legislation (12.5%), statistics (2.5%) and international recommendation – IAEA BSS 115 – (15%). This general written test is unique for all practices, and usually it has fifty questions with five options as answers, as a maximum. If the candidate is approved in the general written test – grades 7.0 to 10.0 – then he is able to do the next examination.

The following examination is the specific examinations for the given type of practice that the RPO works with. Those specific examinations are subdivided into two phases: a written discursive test and a practical and oral test. The former phase is performed in the next day of the general written test, and the latter happens within the next five days.

Some rules are followed for the specific examinations:

— Practices classified as IAEA Category 1: industrial radiography, industrial irradiators and industrial accelerators.

It is necessary to do both examinations: the written specific discursive test and the practical examination. In the written specific test the candidate must demonstrate capability when questioned about practical procedures of radiation protection, safety culture, security of sources, transportation, emergency procedures and, mainly, must write about some aspects of a radiation protection programme. During the practical examination, the candidate must demonstrate ability to perform specific radiation protection and safety procedures related to the given practice. The final grade for the specific examination is composed by 40% from the written specific discursive test and 60% from the practical examination.

The practical examination is generally performed on the candidate's installation. However, the practical specific examination of RPOs for industrial radiography is performed at the Industry Laboratory of IRD. This laboratory is equipped with seven complete industrial gamma radiography devices: one is a selenium-75 source (Gammamat-SE-TIFF), four are iridium-192 sources (two Gammamat-TIF, one Tech-Ops-660 and one SPEC-2T), two are cobalt–60 sources (Unitron-110AB and Rigaku CO-5), and also there is a X-ray machine (Andrex-3011). The laboratory also has many tools for emergency situations and survey meters for monitoring.

— Practices classified as IAEA Category 2 and 3: well logging petroleum and nuclear gauge.

For well logging it is necessary to do both specific examinations: a written discursive test, similar to the one for Category 1, and just an oral examination, with questions about practical procedures of radiation protection, emergency procedures, etc. In this case, the final grade is also composed by 40% from the written specific discursive test and 60% from the practical examination.

As nuclear gauge is a practice with low risk, the candidate has to go through only the written specific discursive test. In this, the basic aspects for a radiation protection programme are approached, and the candidate must demonstrate capability to write about practical procedures of radiation protection, security of sources, transportation, emergency procedures, etc. The final grade is 100% due to the written specific discursive test.

Candidates will receive their certification only if their final grade at the specific examinations is greater or equal to seven, from a maximum of ten.

The Brazilian regulatory authority – CNEN – does not offer any particular training courses with the purpose of preparing candidates for becoming RPOs. Courses with this objective are given by private organizations. There are almost fifteen organizations in the country, for this matter.

The certification of a RPO is valid for five years. After this, it is necessary a re-qualification. If the RPO proves that he had been working for two and a half years with radiation sources, he is able to maintain his RPO certification.

Nevertheless, if inspection reports appoint that the performance on duty of a given RPO have relevant violations of requirements or unsafe conditions, the Committee is powerful to cancel his certification.

3. Enforcement

3.1. During the period 1999 – 2002, after tough and deep investigations, when evidences were confirmed during inspections, the Committee decided to cancel two certifications of RPOs. The Committee determined that they should be able to return to work with radiation as a RPO just after special retraining and re-certification.

4. Results

From 1981 to 2002, the brazilian regulatory authority – CNEN – certified 1576 RPOs in industry area. This includes 405 RPOs qualified using the present process for certification of qualification. Table I shows an overview of the number of RPOs per practices.

Table I. Number of Radiation Protection Officers (RPOs) certified in industry area

Industry Practice	Radiation Protection Officers			Number of Installations
	Until 1998	1999 to 2002	Total	
Industrial radiography	479	74	553	162
Industrial irradiators	15	17	32	9
Industrial accelerators	24	9	33	14
Well logging petroleum	12	24	36	23
Nuclear gauge	641	281	922	612
Total	1171	405	1576	820

In the last examination, which occurred in 2002, there were 129 candidates for becoming RPOs, in five industry practices. The average approval was 79%. Table II shows the approval percentage for each practice.

Table II. Overview of the examination in 2002 for Radiation Protection Officer (RPO) in industry area

Industry Practice	Number of Candidates		
	Total	Approved (%)	Failed
Industrial radiography	25	23 (92%)	2
Industrial irradiators	5	5 (100%)	0
Industrial accelerators	6	4 (67%)	2
Well logging petroleum	5	4 (80%)	1
Nuclear gauge	88	66 (75%)	22
Total	129	102 (79%)	27

5. Conclusions

Using this process for certification of qualification we guarantee that the radioactive industries have a well-prepared team of Radiation Protection Officers (RPOs).

Nowadays the number of RPOs is higher than the number of industrial installations in Brazil. Despite of this, CNEN will continue to offer once a year the examination for certification of qualification. The main idea is to keep us updated with brand new recommendations, and also have constantly new RPOs being ready to work.

We are now in a phase of improvements, when new modifications in the process are being introduced in order to achieve even better results. One suggested improvement, for example, is to let more time elapse between the general written test and the specific examinations (written specific discursive test and the practical and oral test). The rationale is to have two complete split blocks: the first one will be the general written test. The candidate can prepare himself just for this examination. If he succeeds, then he can start to prepare himself for the next block. This second block – the specific examinations – is supposed to occur just about two months later. We believe that these new rules will provide better conditions for the candidates to become better prepared for acting as a Radiation Protection Officer.

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Progress in Implementation of National Education and Training Framework for the Groups Professionally Connected with the Nuclear Radiation

P. Krajewski

Central Laboratory for Radiological Protection
Warsaw, Poland

Abstract. The new national regulation establishes legal basis for all activities and practices involving exposure to ionizing radiation. Acccording to the Atomic Law, The Council of Ministers, issued in the form of regulation, the types of positions important for ensuring nuclear safety and radiological protection, detailed conditions for issuing authorizations for radiological protection inspectors and people occupying positions mentioned above, together with required scope of training and requirements for the bodies conducting the training. Recently, the extended program of training of radiological protection inspectors elaborated by Central Laboratory for Radiological Protection has been accepted and implemented. However, it has became clear that professional education of qualified personnel employed in places where ionising radiation is used or made, needs support by the basic education that should result in much better preparation of students of the courses led on higher educational level. Currently, the national education and training framework is developed to link together institutes, universities and governmental atomic agency as well as regional institutions responsible for radiological safety. The main goal of this teaching and training system is to disseminate of knowledge on nuclear science and best respond to the national needs and makes as well as the best use of the national experimental facilities. The framework will evolve in the course of the system development and will be shaped by current situation in European countries.

1. Legal Basis

The new national regulation Atomic Law (Act of Parliament of 29 November 2000), establishes legal basis for all activities and practices related to peaceful use of atomic energy, involving actual and potential exposures to ionizing radiation emitted by artificial radioactive sources, nuclear materials, ionizing radiation generating devices, radioactive waste and spent nuclear fuel and the activities conducted in radiation emergency situations as well as in long-term exposure conditions. This Act constitutes The President of the National Atomic Energy Agency, further called "the Agency's President", as a central organ of the governmental administration, competent in the issues of nuclear safety and radiological protection to the extent specified in this Act. The Agency's President shall be nominated and recalled by the Prime Minister.

In chapter 3 of the Act that is dedicated to the nuclear safety, radiological protection and employees health protection one implements position of an authorized radiological protection inspector. Although, responsibility for compliance with nuclear safety and radiological protection requirements shall rest with the manager of the organizational unit, the inspector of radiation protection holds internal supervision for compliance with nuclear safety and radiological protection requirements in the unit conducting the activities/practices involving exposures according possessed by him authorization. An employment of inspector is obligatory and is indispensable condition to posses a license for such kind of activity. In a frame of his duties the inspector performs particularly:

— control of activities in respect of labour instruction relating to the nuclear safety and radiation protection and work conditions permissible for particular worker groups,

— registry of workers and different persons, staying in conditions at the risk exposure,

— control state of education and training standard,

— elaboration of dosimetric monitoring programme in work environment and implementation of individual doses records system for acceptance by manager of organizational unit,

— co-operation with security institutional services and the labour hygiene, persons implementing the programme of assurance of quality, the fire - fight services and environment protection service in extension of protection against ionizing radiation,

— applying to manager of organizational unit with conclusion about inhibition of work, when the conditions violate permission (license) or regulations of nuclear safety and radiological protection,

— supervision of conduct action according the facility emergency preparedness plan in a case of radiation emergency.

The scope of radiation protection inspector's capabilities comprises (inter alia):

— formulation of illation to manager of organizational unit about changes of working conditions, in peculiarity in situation, when the results of measurements of individual doses motivate such conclusion;

— monitoring the workers' qualification and protective measures in respect of nuclear safety and radiation protection and formulation conclusions to manager.

2. Functions

Furthermore, according to the Act obligation, The Council of Ministers, issued in the form of regulation, the types of positions important for ensuring nuclear safety and radiological protection, detailed conditions and proper procedures for the Agency's President for issuing authorizations for radiological protection inspectors and people occupying positions mentioned above, together with required scope of training, requirements for the bodies conducting the training, taking into account the training curriculum and organizational forms, standard form of authorization certificate and overall scope of inspector's authority and duties. Types of positions having the essential importance for assurance of nuclear safety and radiation protection jointly with obligatory scope of education are as follow:

— research reactor operator (R-O),

— dosimetry specialist (R-D),

— senior dosimetry specialist (R-D),

— manager of research reactor shift (R-O K),

— manager of research reactor (R-OK),

— assistant director on the nuclear safety and radiation protection (in the unit possessed the nuclear research reactor) (R-OK+R-D),

— expert on the nuclear material inventory records (S-E),

— operator of spent nuclear fuel storage facility (S-O),

— manager of radioactive waste disposal facility(S-O),

— manager of radioactive waste neutralization plant(S-O),

— operator of accelerator or devices to teleradiotherapy and brachytherapy with radioactive sources (S-A).

The Agency's President approves education programmes, certificates educational centres, assigns type - matter of examines board and issues authorization relevant to the particular position. Detailed conditions of authorization the particular type radiation protection inspector are presented in Tab.1.

3. Education and Training

This new legal provision establishes framework for central orientated education system of the groups professionally connected with the nuclear radiation. This is forcing the national educational centres to elaboration of such a system of teaching and training that responds best to the national needs and makes the best use of the national experimental facilities. It stimulates and enhances the efficiency of the training actions in universities, research and technological institutes, and the teachers' educational centres. Recently, the extended program of training of radiological protection inspectors (IOR-1 and IOR-3) elaborated by Central Laboratory for Radiological Protection has been accepted and implemented (in February 2003). The program consists of 72 hours of lectures, 12 hours of laboratory exercises, and 12 hours of computing skills and covered a wide range of topics, inter alia: basis of nuclear physics and ionising radiation, natural and man-made sources, detection of ionising radiation, application of ionising radiation in medicine, technology, and science, biological effects of ionising radiation, basic quantities and units of radiation dosimetry, dosimetric instrument and measurement devices, principles of nuclear safety and legal provisions concerning radiological protection. The 17 lecturers and trainers are involved.

The extended education programe for nuclear facilities inspectors (IOR-2) has been elaborated by Department of Training and Consulting in the Soltan Institute for Nuclear Studies together with Institute of Atomic Energy at Swierk. Moreover, a variety of national centres in Poland have been involve in elaboration and implementation education programmes related to the Atomic Law obligations. For example: Institute of Nuclear Physics in Krakow (highly developed center of nuclear physics and its application in medicine, especially hadron therapy), Institute of Atomic Energy at Swierk (working with highly radioactive substances, running the only one in Poland nuclear reactor), Radioactive Wastes Management Plant at Swierk (the only institution in Poland responsible for collecting, processing, storing and protecting the nuclear wastes), Academy of Mining and Metallurgy in Krakow (Faculty of Nuclear Physics and Technology, which is one of the best centre specializing in the use of nuclear methods in technology and material studies), The Institute of Nuclear Chemistry and Technology in Warsaw (inventors of many nuclear methods for technological processes, irradiations, for environment protection), Warsaw University of Technology (Institute of Precision and Biomedical Engineering, which is leading unit on development and safety of radiological equipment and medical software), Warsaw University (Faculty of Physics, Nuclear Physics Division), Institute of Occupational Medicine in Lodz (which carries most of practical activities concerning radiation protection in the field of medical radiology), Great Poland Cancer Centre in Poznan and Warsaw Oncology Centre.

The scope of these programs when approved by Agency's President enables students to apply for authorized radiological protection inspector licence. Several research institutions mentioned above express interest to provide the training courses of the groups professionally connected with the nuclear radiation according to requirement of the new regulation. The currently crucial problem is tutoring and authorisation of medical physics experts which specialization has been recommended by Council Directive 93/47/EURATOM and implemented recently by polish regulation. The new educational system (3 years specialization) has been worked out and submitted for acceptance by Ministry of Heath. National Society of Radiation Protection Inspectors organizes every year workshops that offer great help to the groups professionally working with ionising radiation: medical technicians, State's borders' officers, officers of local governments etc. by disseminating the recent achievements in the field of nuclear physics and radiation protection. The lectures focus on current radiological topics as for example: the nuclear wastes problems, solutions, emergency procedures including problems of nuclear terrorism and regional vs. European laws and practices connected with the production and use of the ionising radiation. However, it has became clear that professional education of qualified personnel employed in places where ionising radiation is used or made, needs support by the basic education that should result in much better preparation of beginner students to adopt a higher educational level. In Poland number of hours dedicated at primary and secondary schools to nuclear physics is too small to make the teaching of this subject truly effective. Moreover, high-school students encounter series of difficulties in perception of the nuclear science. These result from not only small number of lecture hours dedicated to nuclear physics, but also from the lack of appropriate school laboratories. This requires an urgent promotion of more harmonised approaches for education in the nuclear sciences and engineering.

4. Conclusion

Currently, the national education and training framework is developed to link together institutes and universities and governmental atomic agency as well as regional institutions responsible for radiological safety. The basic principle and proposals of the framework has been formulated in the Long Term Programme of Atomistics entitled " The atomistics in service of knowledge and society" in "Public Education and Information" chapter. Apparently the courses organised must be attractive and responding precisely to the established needs. They should consist of lectures, experimental demonstrations, videos, laboratory practices, information on accessible e-learning systems and information to be found in the Internet, excursions to the nearby nuclear centres etc. The framework will evolve in the course of the system development and will be shaped by current situation in European countries. The close collaboration with EC various education centres is necessary for understanding the technological progress made in various countries and for updating current knowledge and to provide the public with sufficient and competent information.

Table I. Detailed conditions of authorization the particular type radiation protection inspector, with regard on kind of activity connected with level of risk of radiation exposure, ad quem supervising inspector gets authorization.

Activities and practices involving exposures	seniority (years) in hazard condition		scope of training and examination
	higher education	secondary education	
Manufacturing, conversion, storage, disposal, transport or use and trade of nuclear materials, radioactive sources, radioactive waste, excluding usage of radioactive sources for medical purposes	3	1	IOR-1
Conversion, storage, disposal and transport of spent nuclear fuel	4	2	IOR-2
Constructing, commissioning, operation and decommissioning of nuclear facilities as well as spent nuclear fuel disposal facility, and constructing, exploitation of spent nuclear fuel storage facility.	4	2	IOR-2
Construction, exploitation, closure and decommissioning of radioactive waste disposal facility	3	1	IOR-1
Manufacture, installation, use and maintenance of equipment containing radioactive sources and trade in such equipment; excluding radioactive sources devices used for medical purposes	3	1	IOR-1
Manufacture, purchase, commissioning and application of the ionizing radiation generating devices; as well as laboratories and workrooms using ionizing radiation sources, including X-ray rooms; excluding radioactive sources devices used for medical purposes	3	1	IOR-1

Intended addition of radioactive materials in the processes of manufacturing consumer and medical products and trade in such products	3	1	IOR-1
Use radioactive sources, use and maintenance of equipment containing radioactive sources and the ionizing radiation generating devices for medical purposes; commissioning of X-ray rooms with generator above 300 keV for medical purposes, intended administration of radioactive materials to humans and animals, for medical or veterinary diagnostics, therapy or research purposes.	4	2	IOR-3

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Needs and Requirements in Industrial and Research Field

P.N. Lirsac[a] , T. Juhel[b]

[a]Ministère de l'Industrie
Paris, France

[b]CEA Saclay -Institut National des Sciences et Techniques Nucléaires
Gif sur Yvette, France

Abstract. The French needs in radiation Protection Training are often perceived as mainly linked to the French Nuclear programmes : nuclear power production, nuclear research, fuel recycling… . As a matter of fact, these activities involved 81950 exposed workers in 2000. At the National level, a comprehensive set of radiation protection training courses has been developed to cover the specific needs, from expert to operator level. However France has a very large and diversified range of non nuclear activities related to the use of ionising radiation sources. Approximately 40 000 sources of ionising radiation sources, which are not generators, are currently used, corresponding to more than 500 authorisations. In 2000, 177 000 workers were exposed to ionising radiation for medical or industrial purposes, corresponding to 70 % of the total number of occupational exposures in France. A large number of radiation Protection Training courses are necessary to cover the needs generated by this large variety of medical and industrial applications. The training courses aim to train very different categories of trainees : daily versus occasional user, different type of specialists and activities including all levels of potential risks. Recently and in addition to the French national training programmes, Radiation protection training needs are considered at the European level. All these training strategies will be presented and discussed.

1. A variety of applications, a variety of needs

Although the applications that have been found for radioactivity in the industrial and research sectors are often little known; they are extremely numerous and are employed in most countries throughout the world. Radioactivity is used in a wide variety of forms: sealed sources (with an extremely broad band of activity), unsealed sources, ionizing ray generators, accelerators, etc. Such applications are widespread in all European countries. In France, for example, during 2000, 176,967 industry researchers and medical personnel were monitored for exposure to x-rays. The significance of the number of non-nuclear staff involved in radiological applications becomes apparent when this figure is compared to the number of staff followed up for similar reasons in the French nuclear sector, where only 81,950 staff were monitored: roughly half the number of those working outside the nuclear industry.

This broad diversity of applications and fields, as well as the varied levels of risk involved, result in significantly different training requirements, since a variety of training objectives need to be met depending upon the situation.

Currently such training programmes are developed on the national level by each individual European country. Despite this diversity, there has never been a greater need to develop a common radiation protection culture, and shared curricula are becoming a necessity for a variety of reasons, such as: providing comparable responses to calls to tender; free movement of workers across borders, the increasing prevalence of such "migration"; international transport of radioactive materials;

requirements for meaningful communication between radiation protection managers or safety authorities, especially in accident-related or emergency situations.

2. The Need for Standardization

The above arguments are regularly referred to at European conferences and outside of the European context in organizations such as the International Atomic Energy Agency (IAEA), the Nuclear Energy Agency (NEA), the International Radiation Protection Association (IRPA), etc.
Developing a common classification of the various levels of responsibility practised in radiation protection in the various countries, as well as standardising the levels of training programmes involved is one of the key issues in getting to a shared radiation protection referential and thus to mutual recognition.

In a survey asked by the European Commission, it was observed that there were differences concerning both the levels of responsibility practised as well as in the training curricula, both within current member states, as well as in applicant countries.

3. The Responses of Europe and the IAEA

The notion of levels of responsibility and related curricula is dealt with on the European level by directives, as well as by the IAEA, as many European member states are members of this organization, via the "basic safety standards" and the appended technical guidelines.

3.1. The European directive: a unique level of responsibility

Under the terms of the COUNCIL DIRECTIVE 96/29/EURATOM dated 13th May 1996 , the person in charge of radiation protection is designated as a "qualified expert" (Article 1).

In the medical field a specific text exist. For other fields the qualified expert's duties are described in articles 12, 19,20,23, 38 and 47. The status of a qualified expert must be recognized by the relevant authorities in the country (Article 1). Each member state must enact the necessary measures in order to validate the skills and knowledge of qualified experts, and must plan on appropriate training programmes for these specialists (Article 38).

After consultation of the scientific expert group indicated under Article 31 of the Euratom treaty, the Commission provided additional information in a specific communication. Its Annex 1 specifies that "surveys performed by the Commission indicate that there is considerable diversity in the current approaches of Member States to training and necessary qualification to obtain recognition as a qualified expert". It is for this reason that it is impossible to produce a single, approved set of requisite conditions for designating such experts.

An alternative approach, which has been adopted in the present annex, consists in developing a basic training programme that all qualified experts must follow. The depth of content taught in this programme shall be determined by the level of complexity of the advice that the qualified expert shall be called upon to provide in the course of his duties... This is why, in the same annex, a syllabus is provided for qualified expert training programmes, with additional recommendations for certain categories of experts who act in nuclear installations, an industrial settings, in research, in medical applications and on accelerator sites.

But a training course alone is not enough; actual experience is also vital, and the duration of such experience will depend upon the complexity and scope of the working context...The surveys have revealed a wide diversity in the practices of the Member States.

Since the publication of this text in 1998, compliant training programmes have made their appearance, but a recent survey commissioned by the Commission and published in 2002, shows that a great deal still remains to be done before a homogeneous European approach to training and accreditation of qualified experts may be achieved.

3.2. The IAEA

For the IAEA, the definition of the qualified expert as indicated in the BSS115 glossary and reproduced below, is different from that of the European Community :

"Persons having the knowledge and training needed to carry out physical, technical or radiochemical tests enabling doses to be assessed, and to give advice in order to ensure effective protection of individuals and the correct operation of protective equipment, whose capacity to act as a qualified expert is recognised by the competent authorities. A qualified expert may be assigned the technical responsibility for the tasks of radiation protection of workers and members of the public." This approach is mainly based on skills, and is a pragmatic definition, but is sometimes difficult to assess.

The role and mission of these experts are defined throughout this document as well as in the technical guidelines. The IAEA also defines, in the same glossary, a second level of responsibility: that of the RPO (Radiation Protection Officer) which is as follows: "Any person who is technically knowledgeable in questions of radiation protection linked to a given type of practice, whom the licensee designates to supervise the application of the provisions specified in appropriate standards".

The IAEA sets out a detailed syllabus for training qualified experts in the form of a basic common programme to which a number of training modules and appropriate On the job training are added depending upon specialization. Such a syllabus should be also designed for RPOs.

The BSS specify that "the licensee, if required in cooperation with employers, shall draft, maintain, disseminate and update a programme of radiation inspections in the workplace, under the supervision of a qualified expert and an RPO if the regulatory Authority so prescribes". This programme is defined in the standards as well as the nature and frequency of radiological inspections.

4. Current status

In 2002, the enquiry performed at the behest of the Commission demonstrated that there is still a wide diversity in national approaches to the issues both concerning training and accreditation of qualified experts. In many countries, in order to respond to professional objectives, qualified experts are divided up into several categories through creation of subdivisions based either on the level of complexity, the level of risk, or merely on the professional sector involved.

4.1. Training in the nuclear industry : training the specialists

In France, in order to meet the requirements for radiation protection training in nuclear environments, a whole range of multi-tiered training programmes has been designed in compliance with national requirements. (see Table I).

Table I. Meeting the training needs for radiation protectionists working in the nuclear field

Candidate	1st Level	Technician Level	Upper Level Technician	Post Graduate Level
Staff	CAP - BEP (vocational diplomas, lower than high school)	High School Diploma	High School Diploma + 2 years additional education	Master's Degree + validation of professional expertise
Student	not available	Scientific or technical High School Diploma	BT or DUT = Bachelor's Degree	Master's Degree in Scientific field or Engeneering diploma

In addition to the various classical training programmes, new methods are making their appearance in France, including alternating work/study programmes and distance learning, etc. Such methods are often used to train staff with a wide variety of professional backgrounds. Hence there may be additional requirements for testing of professional skills as well. It is essential that these requirements are precisely defined and stated.

4.2. Training outside of the nuclear industry

In France, radiation protection training programmes outside of the nuclear industry are taught by a " personne compétente " in radiation protection. This "personne compétente", who works under the responsibility of the employer, must take a specialized training course, provided only by training organizations approved by National Authorities.

The content of the training course is determined by a decree. Due to the translation into French law of the directive 96/29-EC , the course content of training modules taken by " personne compétente " will shortly come up for review. This will take into account both training outside of the nuclear industry, as well as training within the nuclear industry. However, the expected decree dealing with changes to the training curricula has not yet been published.

In the past, problems have been encountered in obtaining recognition of such training programmes, both for French nationals having French accreditation and wishing to work elsewhere in Europe, and for non-French European nationals wishing to work in France. It would appear to be of considerable importance and urgency that discussions are undertaken in order to provide for, at least, partial recognition of training and accreditation between countries.

5. Training curricula for Specific Audiences

As indicated previously, the applications of radioactivity are highly diverse, and in many cases it will be necessary to train members of staff for whom radiation protection is not a profession in and of itself, but that will nonetheless need to know the basics. This category would include nurses, firemen, radiologists, industrial gamma ray device operators, police officers, etc.

This type of training programme, which includes radiation protection instruction inserted into a more global curriculum, does not require a specific approach, but does respond to a real need. Some professional categories, such as persons involved in transporting radioactive materials, would benefit from a more European integrated approach, which would appear, in any case, to be a requirement due to the universal nature of the profession.

6. Conclusions

As illustrated in the case of France, in order to meet requirements for training in radiation protection in a given country, a broad range of appropriate and targeted training programmes is necessary in order to cover the various needs.

This is the approach that was adopted by the EU member states and the applicant countries. Their efforts were mainly based, to a great extent, on a national approach, which tends to complicate efforts to "harmonize" the training levels practiced in Europe, and thus enable mutual recognition of accreditation status. Even if bilateral efforts are initiated, there is currently no sign of a more global approach.

The training requirements in the EU member states and applicant countries seem to be covered, on the national level, to varying degrees. However, it would appear that difficulties are encountered in organizing top-level training programmes in some countries (such as training courses for qualified experts), either for structural reasons, or because the requirements on the national level are not adequate to warrant the setting up training sessions on a regular basis. In such cases, a transnational approach extremely useful in order to meet such training requirements, and would naturally foster a European approach to radiation protection training, at least insofar as training programmes for qualified experts are concerned. In this case, a European think tank could be envisaged as a first step along the way.

In addition, it should also be noted that such radiation protection training programmes train specialists in a specific kind of a risk. In actual practice, the assessment of workstations very often requires assessment and in-depth knowledge of risk prevention in a variety of areas, since the risk of radioactivity is not always the dominant potential source of danger. In this respect, it would be of great interest to obtain feedback from the various European member states in order to take national experience into account when attempting to produce viable educational specifications for qualified expert training programmes.

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Design of the National Training Course on Radiation Safety: Its insertion in the Cuban system of education and training

N. Cornejo Díaz

Center for Radiation Protection and Hygiene
Havana City, Cuba

Abstract. The Center for Radiation Protection and Hygiene has been organizing, since nine years, the national training course on Radiation Safety, taking into account the particular needs of the Country in this area. The curriculum of the course, after some years of improvements, is showed and some aspects related to the design of the course are discussed. The training course plays an important role in the national system of education and training in Radiation Safety. The insertion of the course in this system is also commented. The creation and maintenance of an updated database, with the names, occupations and address of participants, have demonstrated to be very useful in the dissemination of the knowledge in Radiation Safety and in the continuous improvement of the imparted courses and offered services. It should also be noted the importance of the participation of the Regulatory Authority during the organization phase of the course in order to address the key aspects to be included in the course syllabus.

1. Introduction

The Center for Radiation Protection and Hygiene (CPHR) is the institution in charge of the development of the scientific-technical bases for the Radiation Safety in the Country and provides important services for the development of the National Nuclear Program. Those services are, among other: internal and external dosimetry, calibration of radiation monitoring instruments, environmental radiological surveillance, radioanalytical measurements, consulting services on Radiation Safety and trainings.

The education and training are of primary importance to keep the radiological risk "as low as reasonably achievable". Although in the Technical University are established under – graduate programs and master – degree courses in different areas of Radiation Safety, those activities do not cover all the necessities of the national infrastructure for Radiation Safety. It is necessary to systematically refresh the acquired knowledge and to complement it with new developments in this field. Training is also required for persons without a formal education in Radiation Safety who need to gain, in relatively short period of time, more knowledge about the subject in order to perform their work in a more safe way.

Considering the above mentioned ideas, in 1995 the CPHR designed and implemented the National Training Course on Radiation Safety. From their beginnings, the course is carried out annually in April and for that reason it is known as the April Course.

2. Design of the Training Course on Radiation Safety

The training course is oriented mainly to persons who are to be involved in the organization and implementation of Radiation Protection Programmes. It is also suitable for the personnel of the Regulatory Authority, and especially for safety inspectors. The lecturers of the course are senior specialists from the CPHR and from the Regulatory Authority.

During nine years the syllabus of the training course has been evolved in order to systematically consider the progress in the national standards and international recommendations and the feed-back from trainees. An abbreviate form of the course curriculum is included in Table I. A monograph, whose content is very related with the curriculum shown in the Table I, was published in order to support the course implementation. This book has been used also as educational material in some regional training courses in the framework of the Model Project.

An aspect of supreme importance has been the definition of the course length. After some years of experience, it has been defined that the optimum length of the course is between two and three weeks. Longer times make more difficult the participation of persons who are very necessary in their work, mainly in those installations with reduced working staff. It is necessary to indicate that this training course is complemented with other more specific, designed according to the particular necessities of the radiation users and are carried out mostly at the users facilities.

The evaluation is carried out in such a way that at the end of each week the teaching staff examines and questions the trainees. Each exam is accounted for the final result of the evaluation. The trainees who acquire the knowledge imparted during the course receive a terminal certificate, which is required by the Regulatory Authority for the process of personnel authorization. Each year the curriculum is reviewed by discussion with the trainees and by answering questionnaires. The Regulatory Authority, whose specialists participate also as lecturers, reviews the course curriculum during its organization phase.

At the end of the course, each year, a database with the affiliation addresses of the trainees and lecturers is actualized and distributed among the persons involved. This allows to maintain working relationships, not only among professors and students, but also among the own students, being one of the objectives of the course the achievement of the systematic exchange of information among the students.

Table I. Course curriculum.

TOPIC		**GENERAL CONTENT**
INTRODUCTION		Administrative aspects; visit to the CPHR installations and laboratories
		Individual presentation of trainees: type of practice and responsibilities
BASIC ASPECTS	L(1)	The atom model; the nucleus; elementary particles; radioactivity; law of radioactive decay; types of ionizing radiation; interaction of radiation with matter – fundamentals
	L	Biological radiation effects: stochastic and non – stochastic effects; somatic and hereditary effects; prenatal exposures; biological indicators
	L	Types of radiation sources – an overview. Risk perception
	L	Quantities and units in radiation protection; SI units
MEASUREMENTS AND INSTRUMENTATION	L	Radiation measurement principles; types of instruments
	E	Dose rate measurement and dose assessment
	E	Surface contamination measurements
	L	Introduction to the methods of radiological surveillance
	L,V	Film dosimetry; equipment; working procedures
	L,V	TLD dosimetry; equipment; working procedures
	L,V	Internal contamination assessment; equipment working procedures
	L,V	Radiometric and spectrometric measurements; principles; equipment
DOSE AND SHIELDING CALCULATIONS	L	Practical procedures for dose calculations; external exposures and internal contamination; point and extended sources
	L	Shielding fundamentals: attenuation law; use of tables and diagrams; work-load; use factor and occupancy factors
	G	Practical problems for dose and shielding calculations

Table I. ...continuation

REQUIREMENTS OF THE SAFETY STANDARDS	L	Practice and intervention, general requirements; types of exposures;
	G	General requirements to the practices; administrative and management requirements; Radiation Protection requirements; technical and verification requirements; practical aspects
	L	Specific requirements to the occupational exposure;
	L	Medical surveillance and occupational health
	L	Specific requirements to the public exposure
	L	Management of radioactive waste: principles; requirements and methods. Clearance and their practical aspects;
	V	Visit to the CPHR installations for storage of radioactive wastes
	L	Requirements for the transport of radioactive materials; practical issues
	L	Specific requirements to the medical exposures; justification; optimization, guidance levels
	L	Requirements concerning the potential exposures; philosophy; methods of risk analysis and safety assessment
	L	Requirements to the Intervention; emergency preparedness; emergency planning
LESSONS LEARNED	G	Lessons learned from operational experience; from incidents and from accidents in the relevant practices
NATIONAL LEGISLATION AND REGULATORY CONTROL	L	The system of notification and authorization of practices; national regulations and standards; presentation and analysis of new regulatory documents;
	D	Concerns about the regulations and available services
RADIATION SAFETY PROGRAMS (2)	L	Components of a Radiation Safety Program; normal and emergency conditions; organization and management; selection and qualification of the personnel; occupational exposure; exposure of the public; medical exposures; quality assurance; emergency planning;
	L	Particularities of Radiation Safety programs in industrial applications: industrial radiography and radiology; industrial irradiators; well logging; nuclear gauges
	L	Particularities of Radiation Safety programs in research and medical applications: Nuclear Medicine; Teletherapy; Braquitherapy; Radiodianostic
	GD	Preparation of Radiation Safety Programs according to the trainees practices; presentation and discussions

(1) L: lectures; V: visit to lab; E: exercise; G: group working; D: discussions

(2) This topic is more flexible, according to the practices involved in the training course

3. Insertion of the Training Course in the National System of Education and Training on Radiation Safety

The Figure 1 offers a general panoramic about the importance of the course for the national system of education and training on Radiation Safety. Darker lines indicate the interrelations of the course in the system framework. It can be appreciated that the course complements the under graduate studies.

The course feed – back contributes to improve the specific courses organized by different institutions involved in the system (i.e. medical institutes, Technical University, CPHR, and Regulatory Authority, among the more relevant ones) and also provides useful information to CPHR for eventual improvements of the offered services in the field of Radiation Safety.

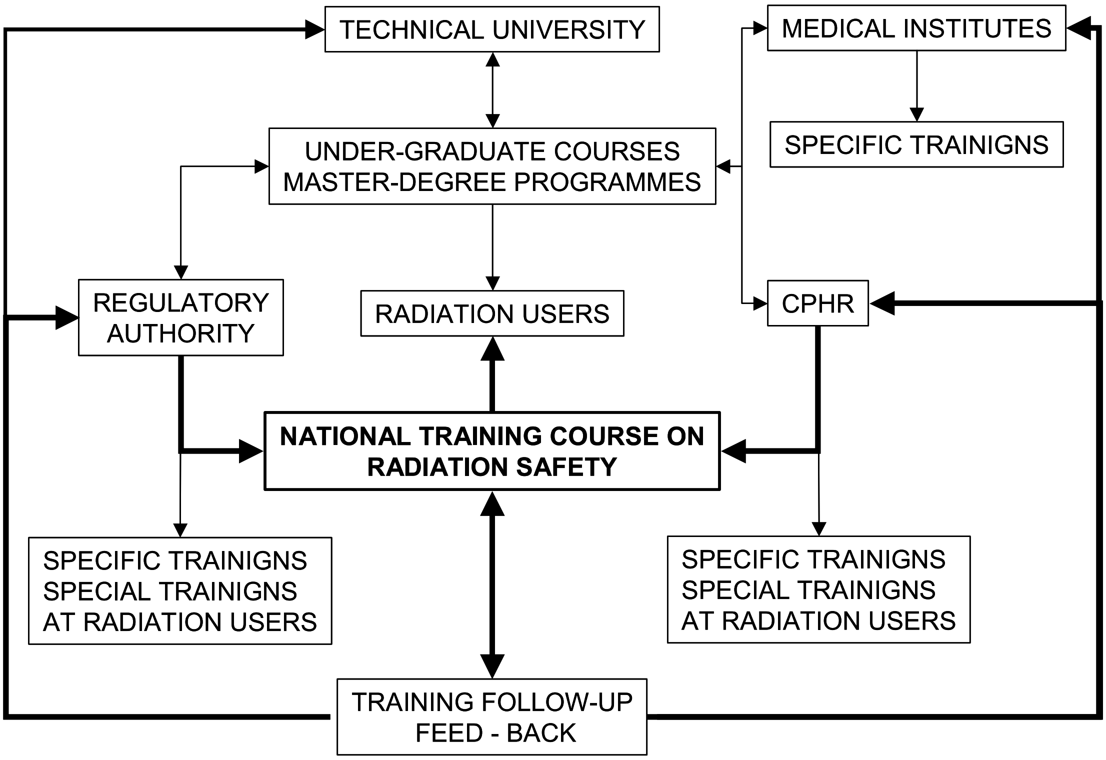

Fig. 1. Simplified schema of the national system for education and training in Radiation Safety

4. Conclusions

— The training course has demonstrated to be an useful tool to know, in a systematic way, the needs of the radiation users in terms of knowledge and resources;

— The participation of the Regulatory Authority during the organization phase of the course is of great value, in order to address the key aspects to be included in the course curriculum;

— The final evaluation of the training course by the trainees (by discussions, questionnaires) has contributed to improve not only the course curriculum but also related organization aspects;

— The creation and maintenance of an updated database, which includes the names, occupations and address of participants, have a key importance in the dissemination of the knowledge in Radiation Safety and in the continuous improvement of the imparted courses and offered services.

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Training as a Major Challenge to Sustainable Development of Radiotherapy Practice in Nigeria

A. M. Umar, S. B. Elegba, M. O. Ogharandukun

Nigerian Nuclear Regulatory Authority
Abuja, FCT, Nigeria

Abstract. Radiotherapy has been practised in Nigeria for over three decades. The absence of a nuclear regulatory body over the period has manifested in the inefficacious and unsafe practice. The newly established Nigerian Nuclear Regulatory Authority (NNRA) carried out radiological audit inspections in all the five radiotherapy centres in the country. The revelation from this exercise shows that there is acute shortage of radiation protection officers, therapy nurses, radiographers and medical physicists. The few available are overworked and have little time to improve their competences. As a result, radiation protection and clinical radio-dosimetry are best regarded as some accessories to the crux of the radiotherapy practice. Consequently, the radiation protection and medical physics practitioners are not regarded as equal partners in the radiotherapy team and may therefore not enjoy the confidence and respect of the hospital management. In the end, the efficacy and safety of radiotherapy practice are jeopardized. It is in an effort to stem this tide that the NNRA embarked on a series of enlightenment programmes to awaken all the stakeholders to the gradual collapse of radiotherapy and the need to take positive action towards a sustainable radiotherapy practice in the country. At the end of a Workshop for Senior Medical Doctors, a strong appeal was made to the Federal Government of Nigeria and the International Atomic Energy Agency (IAEA) to support a vigorous national training and retraining programme for radiation protection officers, medical physicists, radiographers and radiotherapy nurses. This is possible within the framework of AFRA and other Agency TC programmes in particular and other multilateral cooperation programmes in general.

1. Introduction

The use of ionizing radiation and nuclear technology in health care delivery actually predates Nigeria's independence, though regulatory control through appropriate governmental infrastructure is a new enterprise. Most of the activities have been in the field of diagnosis and treatment of ailments. The advantages provided by this method over conventional methods are very obvious especially in the treatment of cancers. In Nigeria today, about 100,000 new cases of cancer are diagnosed annually and efficacy of treatment depends on appropriate and early diagnosis of the disease. Radiotherapy has provided the most reliable and effective method of cancer treatment.

Radiotherapy practice in Nigeria began with the establishment of the **Department of Radiation Biology and Radiotherapy** of the Lagos University Teaching Hospital (LUTH) in 1969. The first equipment were an **Orthovoltage** 250 kV and a **Dermopen** 50 kV machines for the treatment of deep and superficial conditions respectively. There were also manual after-loading Caesium applicators for intra-cavity therapy. In 1970, the Canadian government donated a Theratron Cobalt-60 machine, but this did not go into operation until 1975. Closely following LUTH was the University College Hospital Ibadan (UCH), which established its Radiotherapy Department in 1970. Today, there are five (5) radiotherapy centres in the country: four in Federal tertiary hospitals and one in a private hospital. Between them, there are five (5) Cobalt-60 machines and a Linear Accelerator (LINAC). The distribution of these hospitals show that there are two (2) in Lagos, one (1) in Ibadan, one (1) in Zaria and one (1) in Abuja.

A Radiotherapy Department is usually chaired by a Consultant Oncologist/Radiotherapist. He is also the responsible representative of the Hospital on radiation protection matters. The staff members include Radiotherapists, Medical Physicists, Radiotherapy Radiographers, Nurses and other support staff. The Head of Department reports to the Chief Medical Director who is the Chief Executive of the hospital.

Normally, radiotherapy centres, in addition to the basic radiotherapy machine (a LINAC or Co-60 machine), have a Treatment Planning Systems (TPS), a Simulator, a superficial Orthovoltage machines and one or several Brachytherapy machines. Support facilities include a Darkroom for film processing and a Mould Room. The state of these additional equipment and their functionality are a different issue altogether. For example, no TPS in all the hospitals was in working condition. Thus treatment planning is usually done manually, which is tedious and prone to human errors.

2. Radiation Protection

The Nigerian Medical and Dental Council (NMDC) [1] has regulatory responsibilities for medical practice in the country. While the Radiographers Registration Board of Nigeria[3] regulates the practice of medical radiography. Neither of the two bodies regulate the use of ionizing radiation in the health sector. In this respect, the NMDC authorizes general medical and dental practices and registers hospitals. The status quo did not highlight the potential harmful radiological implications of the practices and so did not support the development of radiation protection culture as an important part of the practices.

Consequently, there was almost no radiation protection and safety programme in most of the radiotherapy centres. This had many manifestations. There was no organizational and management control systems for radiation protection responsibilities in the Hospitals. There was no designated radiation safety officer (RSO) with powers and equipment to conduct routine checks and stop any unsafe practice. No workplace monitoring, area classification and personnel monitoring with TLD, film badges or any other means was carried out. There were scanty written local rules for safety if and where they existed. Quality assurance programmes or post repair tests on equipment were hardly carried out or documented. A programme for transportation of radioactive materials or of return of spent sources to manufacturers was almost inexistent. There were no emergency procedures in place to handle such situations as damage to the source, loss of source shielding, stuck sources, and misadministration of radiation to patients. All these on their own require some regulatory framework for radiological protection regulation in the country.

3. Legislation and Regulation

The vigorous national efforts in the area of peaceful application of nuclear energy in general, made it imperative for the country to establish a regulatory framework for nuclear safety, radiation protection and security of radioactive substances. Thus the **Nuclear Safety and Radiation Protection Act 19 of 1995**[2], was promulgated in August 1995. The Act provided for the establishment of the Nigerian Nuclear Regulatory Authority (NNRA) and charged it with the responsibility for **nuclear safety and radiological protection regulation** in Nigeria. In this regard, it empowered the NNRA to amongst others, **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, transport, storage and disposal of any radioactive material, nuclear material, radioactive waste, prescribed substances and any apparatus emitting ionizing radiation**.

By virtue of this Act, the NNRA was established in May 2001 and has since then taken measures to strengthen its capacity to fulfil its statutory responsibilities, including radiation protection in radiotherapy. The NNRA, by the provisions of the Act, has responsibility for formulating policies and guidelines for regulating nuclear safety and radiological protection and ensuring their implementation. In this regard, the NNRA has powers to:

— issue codes of practice which shall be binding on all users of radioactive and prescribed substances, and of sources of ionizing radiation,

— review and approve safety standards and documentation, and

— do everything necessary to ensure that all concerned persons and bodies comply with laid down regulations under the Act.

With the support of the Agency through expert mission and national experts, the NNRA developed regulations for various practices involving the use of ionizing radiation. These efforts resulted in the promulgation of the **B**asic **I**onizing **R**adiation **R**egulation **O**f **N**igeria (**BIRRON**)[4]. BIRRON implements the best international practices as contained in the ***International Basic Safety Standard for Protection against Ionizing Radiation and for the Safety of Radiation Sources*** **(BSS)** and the provisions of the Act. BIRRON and the supporting **Codes of Practice** to be issued under it are to:

— Establish a Framework for Ensuring that Occupational Exposure to Ionizing Radiation, whether Natural or Man-Made, and from External Radiation (e.g. X-Ray Set) or Internal Radiation (e.g. Inhalation of Radioactive Substance) is safe;

— Ensure that Exposure to Ionizing Radiation does not Exceed Dose Limits Specified for Individuals;

— Ensure that Exposure to Ionizing Radiation is kept **A**s **L**ow **A**s **R**easonably **A**chievable (**ALARA** Principle), and

— Ensure the security of radioactive sources from cradle to grave.

4. Radiological Audit Inspection

The development of BIRRON brought in its wake the need to enforce standards and ensure compliance with the Act. In this respect, the NNRA decided to benchmark all the practices in the country. Hence **Radiological Audit Inspections** were carried out in the five (5) radiotherapy centres in the country. One of these resulted in sanctions and another in the replacement of Cobalt-60 source in two centres. Generally, recommendations for the improvement of practice were made to the respective hospitals for implementation. Two of the centres have fully complied with the recommendations and this resulted in the lifting of the ban imposed after 12 months. Follow-up missions are planned for the others.

The outcome of the exercises was quite revealing on the level of radiation protection and safety, the state of the equipment, the personnel and their qualifications and the overall management of these facilities. The design and location of most facilities were excellent and conformed to well-known standards, although in some cases, shielding requirements were not adequate. All cadres of qualified personnel; radiation oncologists, medical physicists, therapy radiographers, radiation safety officers and trained nurses are in short supply. In almost all centres, the Treatment Planning System was absent or not functional. In some of the facilities, there were no organizational and management control system. There were also no local rules and supervision for safety, workplace monitoring, and area classification. Personnel monitoring programme are at best incomplete. Quality Assurance programmes are absent. Calibration dosimetry and quality assurance were not conducted by or under the supervision of qualified medical physicist except in one of the facilities. Emergency programmes are also not in place in most facilities. There appeared in general to be a poor system of documentation for personal exposure, area survey, patient discharge survey, maintenance and repair work and clinical dosimetry.

There is a general lack of structured communication channel between hospital management and the radiotherapy unit leading to a significant management unawareness of the peculiar needs. There were usually no dedicated budget for the operation and maintenance of the facilities, and a lack of commitment to radiation protection and safety. In most cases, no medical physicist/Radiation Safety Officer (RSO) - a crucial post in radiation protection infrastructure - was appointed and empowered to carry out such responsibilities. Other findings of the exercise are summarised below.

4.1. Personnel

Presently, available records show that there are only eight (8) radiation oncologists, seven (7) medical physicists and five (5) radiographers distributed amongst these centre. Thus, there is generally a high patient to specialist ratio. The same is true for trained engineers and technicians who man and maintain the equipment.

Table I. MANPOWER PROFILE + Not adequately trained

CENTRE	ONCOLOGIST	MEDICAL PHYSICIST	THERAPY RADIOGRAPHER	THERAPY NURSE	RPO
A	1	1+1	1+1	2	-
B	2	1+½	1	2	1
C	3	1^+	$1+2^+$	1	-
D	1	½	$1+2^+$	-	-
E	2	2^+	1	$2+2^+$	1

4.2. Equipment

There are five (5) Cobalt-60 machines and one (1) LINAC. Three of the Cobalt-60 sources were well past 3 half lives and so could only be used for palliative treatment. Many of the equipment were second hand and without complete service manuals. They were generally poorly maintained or calibrated and lacked accessories. Other equipment include Ceasium-137 Brachytherapy sources and Orthovoltage teletherapy machines.

TableII. EQUIPMENT PROFILE * Not working

CENTRE	LINAC	COBALT-60	ORTHOVOLTAGE	BRACHITHERAPY	TPS	SIMULATOR
A	1	-	1	2	1*	1*
B	-	1+1*	-	1	-	-
C	-	1	2*	-	1*	1*
D	-	1	1	-	-	-
E	-	1	1	1	1+1*	-

4.3. Radiation Protection and Clinical Dosimetry

There appeared not to be a significant coordinated protection/safety control system at organizational and management levels. In two instances, there is programme for work place monitoring, area classification and personnel monitoring with TLD badges that were not calibrated. In most cases equipment for work place monitoring were either faulty or nonexistent. There were no written local rules for day-to-day running of the services in general, no RSO was appointed and provided with sufficient powers and resources to fulfil the responsibilities of the office. There are no emergency procedures and even where **they exist, there appeared not to be any significant experience or routine in practical drills.**

5. Challenges

Available statistics indicate that one (1) in every four (4) persons over the age of 50 years has the risk of developing cancer. Of this number, sixty per cent will require radiotherapy treatment. Presently, 100,000 new cases of cancer are diagnosed annually in the country. The number and distribution of the radiotherapy centres in the country is not adequate to cater for those in need of these services. In this regard, national efforts must be geared to proliferate more facilities in the country especially realizing that three (3) of the four radiotherapy centres in federal institutions were established under TC projects of the IAEA. Most of the challenges can be traced to lack of a National Regulatory Authority (NRA) over the forty (40) years of radiotherapy practice in the country. This in turn has led to a poor identification of the appropriate manpower required for the practice, loss of quality assurance and lack of sustainability.

The number of qualified personnel in the relevant disciplines is inadequate, thus leading to a high patient to specialist ratio and all its attendant problems. Consequently, there is under utilization of installed facilities. This is more pronounced in the case of radioactive sources, such as Cobalt-60 and Caesiun-137 which decay regardless of use. This in turn breeds inefficiency and finally loss of sustainability. Revenue generated from the use of the facility will not be sufficient for its amortization. This therefore provides explanation for using sources that are in their fourth half-lives. The net effect of all these is loss of efficacy and money on the side of the patients. The fact that the four of the centres are owned by the government leads one to consider funding of the centres as a challenge. But total dependence on government resources, without good management practices will still make the practice not sustainable.

6. Conclusion

There is therefore the urgent need for collaboration between government, the IAEA and national professional organizations to develop the necessary manpower needs for radiation oncologists, medical physicists, therapy radiographers, radiation safety officers and trained nurses. In addition, the sixteen university teaching hospitals must restructure their programmes to cater for the training needs of these professionals; as the cost of overseas training of these specialists is not affordable. The same is true for trained engineers and technicians who man and maintain the equipment used in radiotherapy. Furthermore, there is the penchant to import obsolete second hand equipment without complete service manuals is also a challenge. These are also poorly maintained and lacked necessary accessories. Adequate funding mechanism must be developed and emplaced. Recent efforts by the Federal Government to bulk purchase equipment for diagnostic radiology and radiotherapy, though commendable, should be seen only as temporary and not sustainable.In all these challenges, there are opportunities for collaboration between the government and the IAEA in the are of manpower development and expert service.

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The Greek Atomic Energy Commission's Post-Graduate Education Activities on Radiation Protection at National and Regional Level

P. Dimitriou

Greek Atomic Energy Commission and University of Athens
Athens, Greece

Abstract. The Greek Atomic Energy Commission (GAEC) has a range of activities, in providing post-graduate education and training on Radiation Protection, at national and recently regional level in Greece. In particular, GAEC is a participant and a major contributor to the Inter-University Post-Graduate Course on Medical Radiation Physics, which is currently running under the administration of Athens' University in co-operation with other four Greek Universities and the Research Center "Democritos". It also contributes to the Post-Graduate Course on Medical Physics of the University of Patras' in radiation protection issues. At regional level, GAEC through an International Atomic Energy Agency (IAEA) Technical Cooperation (TC) Programme, has recently, organized and hosted in Athens (2003), the 18 weeks Eastern Europe's Regional Post-graduate Educational Course (PGEC) on "Radiation Protection and the Safety of Radiation Sources", in the English language based on the IAEA's Standard Curriculum for PGECs.

1. Introduction

The Greek Atomic Energy Commission is the regulatory body, responsible for matters related to nuclear technology and radiological protection from ionizing radiation. Greece has in force a legal framework, compatible with the Basic Safety Standards. Among others this framework determines the GAEC's authority on radiation protection issues and its responsibilities in the provision of education and training in radiation protection to the occupationally exposed radiation workers.

Historically, GAEC provides education and training in radiation protection since 1960. Since that time GAEC has organized and hosted more than 500 national and international educational events, addressed to the personnel occupied in medical, industrial, research and other applications of ionizing radiation. At Post-Graduate level, GAEC organized the Medical Radiation Physics Course on regular basis, since 1961. This course was upgraded to an Inter-University Post-Graduate Course on Medical Radiation Physics (IPCMRP) in 1993, and is currently running in co-operation with five Greek Universities and the Research Center "Democritos", leading to Master's degree. It also contributes to the Post-Graduate Course on Medical Physics of Patras' University in radiation protection issues, which also leads to Master's degree.

In the context of its related activities and valuable experience acquired during the past years, GAEC has proposed and is now hosting through an IAEA TC Programme, the IAEA's Eastern European Region PGEC on Radiation Protection and Safety of Radiation Sources, given in the English language. The structure and the goals of the above courses are discussed.

2. Inter - University Postgraduate Course on Medical and Radiation Physics

The IPCMRP, was established by low in 1993 and re-organized in its present form in 1998. As it has been already mentioned above the IPCMRP is based upon the close co-operation of five Greek Universities the GAEC and the Research Center Democritos. The Course is financially supported by the Greek Ministry of Education and the EU. The Course is given in the Greek language. About 10 to 15 physicists are attending the Course. Entering examinations include written examinations as well as personal interviews. The good knowledge of the English language is compulsory. Students are assigned to the cooperating universities in a proportional manner, taking into account the capabilities of each University and the regional needs for Medical Physicists and the preference of the students. The duration of the Course is five semesters. The first semester is devoted to lectures and practical exercises in fundamental topics in Medicine, Mathematics and Physics. The second semester, includes specialised topics on Medical Radiation Physics and Radiation Protection [1]. Both semesters are conducted in the GAEC premises in Athens. The third and fourth semesters include foul time in service training at the University Hospitals. The fifth semester is devoted to research work and preparation of a diploma thesis. After successful completion of all educational stages the students are awarded a Master's Degree. After being graduated they can participate to the examinations given by an authorized Committee in order to get the professional license of Medical Radiation Physicist, which is issued by the Ministry of Health. Students wishing to acquire Ph.D degree may continue their studies at the University where they are assigned.

The principal goal of the IPCMRP is to provide a number of highly qualified Medical Physicists (M-RP) according to the national needs, as the medical field covers the 90% of the applications of ionizing radiation in Greece. These M-RPs should be capable to act as Qualified Experts in the field of medical exposures according to MED 97/43 Euratom Directive and to provide high standard services within the medical radiation laboratories. In addition, they should have adequate knowledge to act, following specialized training, as Qualified Experts according to the BSS 96/29 Euratom Directive, in radiation protection and safety of radiation sources other than in medical applications, in order to cover relevant needs of the country. The aforementioned goal is achieved through the full use of the infrastructure of every one of the participating institutions, taking advantage of their scientific potential and experience.

3. The University of Patras' Postgraduate Course on Medical and Radiation Physics

This Course is running on regular basis by the Faculties of Medicine and Physics of Patras' University since 1993. It is attended by 10 – 15 participants coming from Greece and other European Countries. It is a four semesters Course leading to a Master's Degree. The Syllabus of this Course is similar to that of the IPCMRP, however it is more dedicated to Medical Physics rather Medical Radiation Physics. The first semester includes introductory to the Medical Physics topics, while the second semester, more specialized ones. The third and fourth semesters include research work and preparation of the diploma thesis. Graduates of this Course, having an additional six months on the job training at a Hospital Medical Physics Department, can participate to the examinations given by the Ministry's of Health Committee, in order to get the professional license of Medical Radiation Physicist. They may also continue their studies to acquire a Ph.D degree.

GAEC contributes to this Course, providing during the second semester a one-week course on radiation protection and personnel dosimetry issues. The principal goal of this Course is similar to that of the IPCMRP.

4. IAEA's Eastern European Region PGEC on Radiation Protection and Safety of Radiation Sources.

GAEC in co-operation with the IAEA, organized and implemented through the Agency's TC Programme, the Eastern European Region PGEC on Radiation Protection and Safety of Radiation Sources based on the IAEA's Standard Syllabus [1,2] This 18 weeks Course for the PGEC, was conducted in the English language and was held in Athens, from 24 February to 27 June, 2003. The Technical Co-operation and Nuclear Safety (NS) IAEA's Departments along with GAEC, have worked closely together for its organization and implementation.

The Faculties of Medicine and Physics of the University of Athens, the Technical University of Athens, the Faculty of Medicine of the University Ioannina, main Hospitals in the area of Athens, and the Research Center Democritos, supported GAEC in this endeavor, providing their Laboratories and scientists to support the PGEC with state-of-the-art infrastructure and highly experienced Local Lecturers and Trainers.

Twenty-one participants from nineteen European Countries of the Region (Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Georgia, Hungary, Latvia, Lithuania, FYROM, Malta, Republic of Moldova, Romania, Slovenia, Turkey, Federal Republic of Yugoslavia and Greece) attended the course. About 50 local lecturers and trainers and six external lecturers supported also the Course. Lecturers elaborated the standardized training material prepared by IAEA for both the PGEC and other specialized training events [3]. The Course will be evaluated [3] at the end of June 2003.

The purpose of the course is to meet the initial educational requirements on a graduate level for staff earmarked for positions in radiation protection and on the safe use and operation of radiation sources in the different fields of ionizing radiation in order to cover the relevant national and regional needs.

The target audience is young professionals, needing to acquire a sound basis in radiation protection and knowledge of related safety fundamentals in order to become, in the course of time, leaders, and qualified experts in the countries of the Eastern European region. The goal of the Course is also to produce a pool of trainers at national and regional level in order to have sustainable training programmes, in a harmonized way consistent with the requirements of the Basic safety standards.

5. Conclusion

As it may be concluded, the education and training in radiation protection and especially at a PGEC level, is one of the mechanisms and primary strategies of the GAEC for the application of the Safety Standards at National level. Recently in this field GAEC's activities, have been extended to the Eastern European Region in order to support IAEA's efforts to harmonize the education and training provided among its Member States. However in order to have sustainable educational and training programmes in the Region, the further close co-operation among the Agency's Technical Cooperation and Nuclear Safety Departments, the GAEC and the local collaborating institutions, has to be supported.

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Algerian Experience in Radiation Protection Training and Education

H. Saibi, S. Chelbani, M. S. Hamlat

Centre de Recherche Nucléaire
Alger, Algeria

Abstract. In Algeria the training in radiation protection began from the end of seventeen's. Then since 1980 a training program was established which allowed to obtain a qualified human power with different degree (technician, magister and specialized engineers) both in radiological safety and in medical physic. The syllabus of the different education were defined and the basic theoretical education was performed in Algeria while the practical training was carried out in foreign laboratories with financial support of the EU and the IAEA. The syllabus were revised in 1985 to take into account the experience of the first certified persons. In addition, the opportunity was given to some persons, through education grants, to prepare PhD degree in radiation protection and medical physics in European universities. All these training actions allowed to about one hundred persons to get different degrees. Beside these academic education our staff fellow an on-going training mainly through bilateral and regional cooperation with the IAEA (TC project, AFRA, RAF). Over the last ten years, the education was stopped by reason of no need for training and now it is necessary to review the former syllabus to adapt them to the new radiation protection environment and to educate other persons to assure the relieving and the replacement of all those who have left the institution. As an regulatory prescription, our institution organize radiation protection courses and workshops to the end users of radiation sources and to the bodies (customer, immigration officer, fire-brigade) which are involved in the control of the possession and uses of these sources. An average of one hundred workers are trained annually.

Training Tools Standardisation Project. Design of a web site to hold radiation protection training materials

M. Marco[a], **M. Rodríguez**[b], **R. Villarroel**[b],

[a]IEE-CIEMAT, Spain
[b]CSN, Madrid, Spain

Abstract. Spanish education and Training System on radiation protection, based on the European Basic Safety Standards, is well defined in the country regulations related to radioactive facilities licensing and radiation protection. A system of personnel licenses is established considering two levels of required training (operators and supervisors), according to responsibilities assigned during the operation of the radioactive facility. Five different training programmes are defined by regulations, according to the uses of radiation: Nuclear Medicine, Radiotherapy, Laboratories using non sealed sources, Industrial Radiography and Process Control and Analytical Techniques. An special case is that of medical radio diagnosis facilities where personal accreditations are granted to individuals to manage these facilities and to operate X-Ray equipment. Two different training programmes are also defined in this case: General an Dental/Podology radio diagnosis. Personnel Licenses and Accreditations are granted by the Regulatory Body (CSN) which is also responsible for defining training programs to be followed by applicants. The scope of required training courses includes basic Radiation Protection knowledge as well as specific knowledge on operational Radiation Protection for different use fields. Training programmes are well developed and have been largely experienced for different areas of expertise, including diagnostic radiology. In order to improve the standardisation and quality of the courses given to obtain licenses and certifications, and to make easier the tasks of the organisations groups involved in such educational activities, the CSN and IEE have been considering to develop a training web site, which could provide easy access to training materials/tools for course organisers. The project has been started at the beginning of 2003 with the main objective of providing training materials for course organisers, trainers and for professional participants. The project also aims to obtain necessary standardisation of the radiation protection knowledge provided to workers, including both theoretical and practical training.

Training materials are being prepared based on core modules with specific modules involving different targets groups (uses of radiation). For each one of the modules the following material is to be developed and made available in the web site:

- Learning objectives.
- Syllabus.
- Training Schedule.
- Visual aids for trainers.
- Study texts to be purchased to trainees.
- Practical training sessions guidance (demonstrations and laboratory exercises).
- Examples of questions to be used for oral/written assessment.

The poster will present the initial version of a useful tool for practitioners in the field of radiation protection as a mechanism for facilitating optimisation of training courses.

Topical Session 6

NEEDS FOR EDUCATIONS AND TRAINING AT THE INTERNATIONAL LEVEL (INCLUDING IAEA PROGRAMMES ASSISTING IN ESTABLISHING ADEQUATE INFRASTRUCTURES)

Re-establishment of the Radiation Safety Regulatory Authority in the former Federal Republic of Yugoslavia, now Serbia and Montenegro, and need for its staffing, education and training at both national and international level

S. Jovanovic

University of Montenegro
Faculty of Natural Sciences
Laboratory for Nuclear Spectrometry
Podgorica, Serbia and Montenegro

Abstract. By February 2003 the Federal Republic of Yugoslavia transformed into a loose confederation of the constituent entities (states) Serbia and Montenegro, the name of the country being adequately changed as well. Following this political change, a large number of former federal competences passed to the constituent entities, radiation safety issues being among them. Consequently, regulatory authority is about to be re-established and appropriate new legislation brought in force. While in Serbia ex-federal laws and staff will likely continue to operate (just under the new administrative umbrella of the Republic of Serbia), in Montenegro it should be newly formed, practically from the scratch. Within a long list of tasks to be done in Montenegro in this respect, there is an urgent need for the regulatory authority staffing, education and training.

1. Introduction: Political change - transformation of the Federal Republic of Yugoslavia into Confederation of Serbia and Montenegro

Following the decision of its Assembly, on February 4, 2003, Federal Republic of Yugoslavia (FRY) transformed into a new state, a loose confederation, in effect, of the two constituent states, Serbia and Montenegro. The name of the new country is now "Serbia and Montenegro". Only very few competences remain in the portfolio of the confederation, including mainly the defence and foreign affairs&trading issues. These competences will be conducted on the parity-of-the-two principle.

The former FRY existed thus for just some ten years (1992-2003). Also the new confederation is a kind of a test-state: it is agreed that after three years the constituent entities will decide whether to stay together or to continue independent.

2. Consequence: Re-establishment of the Regulatory Authority for Radiation Safety

Among the vast majority of competences, which passed from ex-federal level to the constituent republics, as a consequence of the above political change, are the radiation safety issues - including creation of the legal and governmental infrastructure for nuclear, radiation, radioactive waste and transport safety.

In the ex-federation (FRY) the regulatory authority for radiation safety was shared between the Federal Ministry of Health and Federal Ministry of Economy and Internal Trade, while the legal framework was based on the Federal Radiation Protection Law [1]. For the inspection and enforcement, federal inspectors were entitled for the whole territory of FRY. However, in practice, this law was effective only in Serbia. In Montenegro it was practiced only fragmentary and inconsistently, with Ministry of Health of the Republic of Montenegro being entitled for the inspection and enforcement [2], while regulatory authority in its full sense did not exist.

In Serbia several institutions were - and still are - authorized to perform radiation protection monitoring and measurements, including "Vinca" Institute, "Dr. D. Karajovic" Institute, Universities of Belgrade, of Nis, of Novi Sad, etc. In Montenegro, University of Montenegro (Laboratory for Nuclear Spectrometry) and Center for Eco-toxicological Research in Podgorica, were/are authorized.

Therefore, it is likely - and it is logical - that in Serbia ex-federal legal and governmental nuclear safety infrastructure will continue to operate under new administrative umbrella, i.e. given the name of Serbian Nuclear Law and Serbian Regulatory Authority. In Montenegro, the system should be re-established practically from the scratch, rather than adjusting the remainders of the existing one. In this context, one should also bear in mind the large disparity in sizes between Montenegro and Serbia and, consequently, the same disparity in nuclear facilities and infrastructure (e.g. "Vinca" Institute, having two old shut reactors and a spent fuel depository, is in Serbia, near Belgrade).

In Montenegro the formation of the Regulatory Authority for Radiation Protection and Safety is in course. A working group, the germ of the Authority to be established, is currently busy with drafting the Nuclear Law. The group includes experts for applied nuclear physics, radiation protection, radio-ecology, medical physics, oncology, radiology, international law and human rights - however without adequate experience in regulatory practice - as well as representatives from the Ministries of Health, of Environment and of Interior of Montenegro. After consultations at the Legal Division of the IAEA and the appropriate revisions, it is assumed that the draft will be passed by the Government of Montenegro to the Assembly for adoption. In this way, legal fundament will be laid for the formation of the Regulatory Authority for Radiation Protection and Safety in Montenegro

3. The need for Staffing, Education and Training of the Regulatory Authorities in Serbia and Montenegro

Taking into account (1) unfortunate political and economic circumstances in former FR Yugoslavia in the past decade and their negative impact on all aspects of life and professional activities, (2) new changes&developments on the international political scene, in particular the threat of terrorism and the response of the international community, the OUN and the IAEA and (3) the need for standardizing its legislation with EU and with IAEA, Serbia and Montenegro enthusiastically took part in RER/9/062 and RER/9/065 Agency Model Projects.

4. Conclusion

We expect hereby to gain experience and find a valuable assistance in our efforts to implementing safety standards and regulations, as well as the support to push these issues in our local legal framework and daily practice. Perhaps the most urgent need in this sense is that for the training and education of the competent personnel to be in charge of these duties in future. Both domestic and international training and education scheme should be established and followed towards this goal.

5. Acknowledgements

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IAEA Project on Radiation Protection

Indonesia Experience

E. Hiswara

R &D Centre for Radiation Safety and Nuclear Bio-medicine
National Nuclear Energy Agency (BATAN)
Jakarta, Indonesia

Abstract. IAEA PROJECT ON RADIATION PROTECTION: INDONESIA EXPERIENCE. Indonesia has been involved in the IAEA/RCA project on radiation protection infrastructure (RAS/9/018) since its inception in 1987. When in 2000 IAEA established two new model projects, i.e. Strengthening the effectiveness of the regulatory framework and national programme for occupational radiation protection (RAS/9/026) and Development of technical capabilities for sustainable radiation and waste safety infrastructure (RAS/9/027), Indonesia was also participated. This paper presents the view of the author as National Project Coordinator for RAS/9/018 during 1997 – 2001 before handed over his responsibility to National Focal Person as required by the Agency.

1. Introduction

The Regional Co-operative Agreement for Research, Development and Training in related to Nuclear Science and Technology (RCA) entered into force on 12 June 1972 for a five period, and has been subsequently extended several times. The governments of Australia, Bangladesh, China, India, Indonesia, Japan, Republic of Korea, Malaysia, Mongolia, Myanmar, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, and Vietnam are now party to the agreement as extended.

In the beginning of the third extension in 1987, the Government of Japan notified the IAEA of a proposal for a major 5 year RCA project: Strengthening of Radiation Protection. Major funding was provided through Japan's extra-budgetary contribution to RCA. In addition, the Government of Australia started to fund this project in 1988. The number of the project was previously RAS/9/006, which then changed to RAS/9/018 from 1997.

The main intention of the project was to contribute to the strengthening of radiation protection capabilities in the Region with particular emphasis on the establishment and development of infrastructure. To assist with the development of the project, the IAEA was endeavouring to identify the current situation through the commissioning of Radiation Protection Advisory Team (RAPAT) missions, which later on replaced by IAEA Peer Review Mission of Radiation Safety Regulatory Infrastructure.

The author was involved in the RCA/9/018 project during the period 1997-2001. After participating in model projects, Indonesia has been asked by the IAEA to designate one manager for all activities in radiation protection. During the transition period (in the first half of 2002), however, the author was still involved, e.g. participating in PFM in Bangladesh, February 2002. The opinion describes herewith, therefore, also touching the early times of the involvement of Indonesia in model projects.

2. Experience with RAS/9/018

As has been described above, RAS/9/018, which previously numbered RAS/9/006, was a collaborative work among RCA member countries in the field of radiation protection. The work was formulated every 5 years in Project Formulation Meeting (PFM); firstly in 1987, and subsequently in 1992, 1997, and 2002. In between there were Expert Advisory Group Meeting - which attended by the member of Coordination Group of the project, and Mid-term Review Meeting – which attended by the all participating RCA countries. The objectives of the meetings were seeking further effective and efficient ways of the conduction of activities, improvement of the content of activities in this region, evaluation of activities conducted in previous year, and re-evaluation of the future plans to harmonize with activities of the Agency in this region.

Decision about what activities will be conducted in the next future years was usually taken at every meeting, and it was quite democratically, i.e. the proposed activity that attracted the highest vote will be nominated as the future activities. Seven to ten activities under the frame of RAS/9018 were conducted each year.

In order to gain a better understanding of the regulatory infrastructure and the implementation of radiation protection in each country, review missions have been proposed during the Mid-term review meeting in Bali in the year 2000. Indonesia was the first country that received the mission. Dr. A. Bilbao of IAEA and Dr. C. Mason of ARPANSA were the member of the mission visiting Indonesia during 24-28 April 2000. In summary, the review team was of the opinion that the regulatory program for radiation safety in Indonesia is substantially effective and that BAPETEN (the Indonesian Nuclear Energy Control Board) has the competence and the commitment to implement the regulatory infrastructure.

Commenting the conduct of the mission, Indonesia had a view that the mission had been too stressing to the regulatory aspects, whereas the implementation of radiation protection had only a bit been touched. This view was taken by the Agency, so that in the latter visit to other countries, the team included one member from RCA countries who overview the implementation aspects.

3. Opinion on the Implementation

Since 1987, Indonesia benefited a lot from all activities conducted under the frame of RAS/9/018. At least 30 scientists from Indonesia have attended various training courses and workshops conducted during 1987-2002. Participation in these activities has increased the knowledge and quality of human resources for radiation protection in Indonesia.

However, most of the training courses and workshops were conducted in one week. While realizing the short budget of the Agency, the author of the opinion that the duration was not enough. Both theoretical and practical aspects usually were given during that one-week. This causes that only ‘skin layer’ of practical that can be given, not a full one. In fact, most were not practical at all, but just a demonstration from the host country. This is one of the reasons that why a participant cannot get the most from a training course or workshop.

It is suggested, therefore, to separate the theoretical and practical into two different activities. In a theoretical training course or workshop, let the practical aspect be given only as a demonstration in one day. On contrary, in a practical one, theoretical aspect is allocated only for one day. In addition, omit country presentation that usually takes a full one-day. It is enough to just distribute the country report among participants.

Another activity is intercomparison program. After conducting the measurement and reporting the results to coordinator, participants of the program usually held a meeting to discuss the results. In respecting the ethics, coordinator usually was not disclosed about which laboratory that perform not satisfactorily. This is understandable. Unfortunately, there is no follow-up from the coordinator on how to improve the performance of those laboratories. It seems that the laboratories are hoped to improve their performance by themselves. There should be, in author's opinion, a visit from the Agency or coordinator to the laboratories to help with suggestion or equipment, if necessary.

4. Opinion on the Model Project

By the end of the first phase of model project in 2001, the Agency realized that it would be more effective if the project were expanded to include other countries that have not been participated but are still developing their infrastructures in radiation protection. This leads to the invitation from the Agency to Indonesia to joint two new model projects, i.e. Strengthening the effectiveness of the regulatory framework and national programme for occupational radiation protection (RAS/9/026) and Development of technical capabilities for sustainable radiation and waste safety infrastructure (RAS/9/027). Indonesia accepted the invitation and become participant of model project since the end of 2001.

In the beginning there were confusion between RAS/9/018 and the new projects. The author was still a National Project Coordinator of RAS/9/018, while another person acts as National Counterpart for model projects. However, by June 2002 it was concluded that only one person act as liaison officer for all activities in radiation protection, and this person is called National Focal Person.

The redundancy of activities was also seen during the earlier time of model projects. Some activities were regarded as joint activities between RAS/9/018 and model project. However, the meeting of RCA coordinator, Regional Manager for radiation protection, and Chairman of Coordination Group in September 2002 have resolved this problem of redundancy.

When the Agency decided to stop the support to RAS/9/018 in the first quarter 2002, member of RCA countries reacted quite strongly. A paper to support its continuation, signed by every National Counterpart and/or National Project Coordinator, was sent to the Agency and discussed at the RCA meeting at the 2002 General Conference. However, despite this effort, finally RAS/9/018 project came to an end by the close-out meeting held in Hanoi, Vietnam, in February 2003.

The approach of model project is per country, differ from RCA programs that are trying to solve regional problem. Model project also accommodates specific request from a country as long as it is related to its milestone. These are positive side of the model project.

However, as perform by activities under the frame of RAS/9/018, model project also stresses the regulatory infrastructure. The performance of regulatory aspects, in author's opinion, depends also upon how good the implementation of activities. It makes no sense if regulatory exist but no activities ever conducted. A review mission on the implementation of radiation protection, therefore, should also be a priority.

5. Some Other Useful Suggestions

As has been described above, the implementation of the Agency project on radiation protection mostly in the form of training course, workshop and intercomparison program. We would like to propose that in the future the implementation should also cover an expert visit, on-the-job training, maintenance network and equipment donation:

Expert visit. The expert should be the one who lives in one of the project's member countries. If a country needs assistance, then the country can ask the coordinator to look for the appropriate expert to help them. Another way is every member country provided a list of experts who are willing to share their experience and expertise to a needy country. It will be better if the fund to dispatch the expert is available from the expert's country. This is an activity known as a TCDC activity.

On-the-job training. Some develop member countries can invite a researcher from other countries to work in their laboratory for a period of times. Even though the training course is good for gaining knowledge, but it is enough for gaining experience since the duration of a training course is usually only one week. By on-the-job training, the experience as well as the expertise can be obtained more effectively.

Maintenance network. Some countries may in the past received technical assistance in the form of equipment. As the time passing by, the equipment may defect and cannot be operated. The problem arises is that no one in the country can make the repair. It would be beneficial if there were a program to dispatch an expert to repair such broken equipment.

Equipment donation. Some countries may have been modernized their laboratories with the supply of more sophisticated equipment. Their old equipment, however, may be still in good condition and in operation. They can be asked to donate these old equipment to countries that need them.

6. Concluding Remarks

The Agency project on radiation protection has undoubtedly built the competence of human resources in radiation protection in Indonesia. However, in general, the performance of radiation protection in Indonesia, both from regulatory and implementation aspects, is still not satisfactorily enough. We have to take serious efforts to make the ideal condition of radiation protection come true. We have to strive for it.

In accordance with this situation, we thought that the Agency still has many rooms to help country like Indonesia to realize their dream. Those rooms, *inter alia*, may take the form as suggested above.

Infrastructures for Radiation Safety in Portugal
Progress achieved and remaining gaps

F.P. Carvalho, J.G. Alves, M. B. Martins, et al.

Instituto Tecnológico e Nuclear
Departamento de Protecção Radiológica e Segurança Nuclear
Sacavém, Portugal

Abstract. Radiation safety in Portugal is ensured through a set of laws establishing the competencies of several government bodies. The central licensing and inspecting body, is currently the Ministry of Health. An independent regulatory authority does not exist. Technical services, expertise and laboratories do exist in the Department of Radiological Protection and Nuclear Safety (DPRSN), of the Nuclear and Technological Institute (ITN). The spread of competencies over several bodies and the concentration of technical activities at DPRSN prevent an efficient dealing of Radiation Protection matters. Progress in the radiation safety infrastructure was recently achieved with the creation by law at DPRSN of a National Register of Doses, a National Inventory of Radioactive Sources, and a Database for Environmental Radioactivity measurements. However, understaffing of DPRSN is currently a major drawback in safety. Although DPRSN has been able to train a large number of fellows under a national training programme in radiation protection, and with additional support of the IAEA Regional Model Project, most of these trainees are now working as health physicists and radiation protection officers in hospitals. National short-term training courses were also organised by DPRSN for professionals in industrial radiography, medical and interventional radiology and basic radiological protection, sometimes with external lecturers supported by the IAEA Regional Model Project. Other courses are planned to ensure education and training in radiation protection and certification of the metrology laboratory, dosimetry and analytical services of DPRSN are underway.

1. Introduction: The past of radiation protection in Portugal

Formal technical infrastructures and laws to ensure protection against ionising radiation were set up in Portugal in the early sixties. A comprehensive act creating the National Commission for the Protection against Ionizing Radiations, regulating professional exposure and enforcing dose limits for members of the public was issued in 1961 (Decree-Law 44060). A technical infrastructure *Serviço de Protecção Contra Radiações* had already been created at the *Junta de Energia Nuclear* in 1958. Since then, this Service underwent several transformations, but corresponds to the current Department of Radiological Protection and Nuclear Safety (DPRSN) of the Nuclear and Technological Institute (ITN).

The DPRSN is in charge of a number of duties and was entrusted with several competencies by the Decree-Law 311/98 of 14 October. These competencies include the risk assessment of exposure of workers and members of the public to ionising radiation, the control of transport of radioactive and nuclear materials, the assessment of the safety of radiological facilities, radioecological studies, research and training in radiation protection, amongst others. The same Law grants autonomy to DPRSN as necessary to accomplish its mission. In the 90's and in the first years of this century, it became clear that the national infrastructures were not in compliance with the Basic Safety Standards recommended by the IAEA, namely because of the lack of a regulatory authority independent of the main radiation users [1]. The inconsistency of the legal system became obvious with the attempts to transpose to the national legislation the European Union (EU) Directives 96/29 and 97/43 Euratom. Furthermore, the infrastructure of radiation safety was 'eroded' with the retirement of a large number of highly qualified professionals not replaced by young staff.

2. Participation in the IAEA Regional Model Project

Portugal, through the ITN-DPRSN, joined as participant the IAEA Regional Model Project RER/9/062, as a means to rebuild national technical capabilities in the field, and, at the same time, to introduce the concepts proposed in the Basic Safety Standards aiming at modernising the legal and organisational radiation protection system.

The support provided by the IAEA through the Regional Model Project has been instrumental to provide expert training abroad to a large number of young health physicists. This supplemented the training provided by DPRSN, to Fellows, to health physicists from hospitals, persons responsible for radiation protection in industrial companies and to DPRSN staff members (Tables I-IV). Actually, during the last three years the DPRSN provided long duration training to 25 Fellows under a national programme for professional education in radiation protection. Most of them attended also short-term IAEA regional training courses in fields such as internal and external dosimetry, protection in medical radiology, nuclear medicine and transport of radioactive materials. Many other candidates from radiological services of public hospitals, endorsed by ITN-DPRSN, were supported by the IAEA and could attend training courses organised by the Regional Model Project. Most of the young Fellows trained by the DPRSN were already hired by hospitals throughout the country and are currently working in radiological protection. Unfortunately, the DPRSN was not able to offer jobs to at least some of them and, despite the status of Government laboratory for radiation protection, continues understaffed.

Table I. Projects RER/9/062 and RER/9/065: Regional Training Courses (RTC)

Title (number of attendants)	Place and date
RTC on Organization and Implementation of a National Regulatory Programme for the Control of Radiation Sources (attendants: 1)	Ljubljana, 06/2001
RTC on the Assessment of Occupational Exposure Due to External Radiation Sources (attendants: 1)	Istambul, 06/2001
RTC on the Assessment of Occupational Exposure Due to Intakes of Radionuclides (attendants: 2)	Budapeste, 10/2001
RTC on Radiation Protection in Diagnostic and Interventional Radiology (attendants: 2)	Chisinau, 06/2001
RTC on Sources, Assessment, Monitoring and Control of Public Exposure (attendants: 1)	Vilnius, 10/2001
RTC on the Safe Transport of Radioactive Material (attendants: 1)	Vilnius, 10/2001
RTC on Radiation Protection Aspects of Radioactive Waste Management (attendants: 1)	Chisinau, 10/2002
RTC on Practical Response to a Radiological Emergency (attendants: 1)	Riga, 10/2002

Table II. RTC under Project RER/6/012 Quality Assurance and Quality Control in Radiation Oncology

Title (number of attendants)	Place and date
Basic Clinical Radiobiology (attendants: 1)	Uppsala, 05/2002
RTC on Radiation Protection and Safety in Nuclear Medicine (attendants: 2)	Tirana, 06/2002
Modern Brachytherapy Techniques (ESTRO) (attendants: 1)	Lisboa, 06/2002
RTC on Radiation Protection and Safety in Radiotherapy (attendants: 2)	Ankara, 10/2002

Table III. National Training Courses (NTC) organized by DPRSN and with support from the IAEA

Title (number of attendants)	Place and date
NTC on Radiation Protection in Industrial Radiology (attendants: 16), IAEA Lecturers: Mr Alexandru Rodna, Mr Johannes Heijninigen	Lisboa, 11/2001
NTC on Radiation Protection in Diagnostic and Interventional Radiology (attendants: 18) IAEA Lecturers: Ms Anna Benini, Mr Carlo Maccia	Lisboa, 11/2001

Table IV. NTC organized by DPRSN in 2000 - 2002

Title (number of attendants)	Place and date
Training Course on Radiation Protection and Safety (attendants: 25)	Madeira, 05/2000
Training Course on Radiation Protection and Safety (attendants: 24)	Pego, 04/2001
Training Course on Radiation Protection and Safety (attendants: 5)	Lisboa, 05/2002
Training Course on Radiation Protection and Safety (attendants: 15)	Pego, 12/2002
Training Course on Radiation Protection and Safety (attendants: 17)	Pego, 12/2002

An expert mission of IAEA, in September 2001, in the framework of the Regional Project, carried out an independent assessment of the legal infrastructures and of the legal competencies attributed to different official organisms under the Ministry of Health, Ministry of Environment and Ministry of Science and Technology [6]. The Mission Report was delivered to the competent national authorities and the recommendations made therein will be, hopefully, taken into consideration.

3. Present Day Radiation Protection Infrastructures

Radiation sources existing in Portugal have already been described elsewhere [2][3]. Briefly, they encompass cobalt sources in medicine and industry, linear accelerators, one nuclear research reactor, hundreds of radioactive sources used in industry and thousands of X-ray equipment.

The licensing authority of radiological facilities is the Directorate General of Health (DGS), under the Ministry of Health. This authority has reduced technical staff and no means to carry out technical tasks. Licensing by this body is mainly an administrative act. The DPRSN, under the Ministry of Science and Higher Education, has no legal duties in licensing and inspection. However, it is frequently called upon by the DGS to provide technical advice on safety and perform measurements in radiation facilities.

The DPRSN has reasonably well equipped laboratories and trained staff. Currently, performs the individual monitoring of 9,500 workers, radiological safety assessment of facilities (medical, industrial and research), provides calibration of equipment in a SSLD, keeps the national metrology standards of radiation, carries out national surveys for monitoring environmental radioactivity and radiation doses, amongst other tasks [4][5].

These activities were started long time ago and, in latest years, despite the shortage of staff, there has been an increasing effort to keep tighter control over all radiation sources and radiation exposure from all sources.

4. Recent Laws and Progress made in radiation safety

During 2002, following the need to transpose the UE Directives 96/29 and 97/43/Euratom, new laws were issued by the Ministry of Health, namely the Decree-Laws 165/2002, 167/2002, 174/2002 and 180/2002 all dealing with radiation protection.

Following this set of new legislation there is no outline of a unifying regulatory authority. The UE Directive 96/29 is not completely transposed yet, e.g. the dose limits [6] and NORM requirements were not enforced and radiation safety matters are still scattered over several institutions. However, the responsibilities of DPRSN have increased from the outcome of these Laws:

— a National Register of Doses was entrusted to DPRSN: individual doses recorded in the country since 1957 and measured by DPRSN using film badges and TLD are presently available on an electronic database;
— a National Inventory of Radioactive Sources was entrusted to DPRSN: this inventory shall include all radioactive sources imported, in use, or transferred, as well as the radioactive waste; the database is in advanced stage of preparation;
— a Database of Radionuclide Concentrations and Radiation Doses in the Environment was entrusted to DPRSN: although results are plenty and available at DPRSN, an electronic database is not yet implemented.

These new Laws confirm also the important role of DPRSN in metrology and quality control of radiation monitoring equipment and in the management of radioactive waste. The need for quality control of radiation emitting equipment, as well as for continued education and training in radiological protection are also stressed. Furthermore, a National Commission of Radiological Emergencies was created under the lead of the National Civil Protection, and includes representatives of various organisms from Health, Environment, National Fire Brigade, Medical Emergencies, and the DPRSN.

5. Resilience of the System to Changes

In the laws recently issued as part of the transposition of the UE Directives, the Directorate General of Health, Ministry of Health, is confirmed as the central authority in radiation protection with functions of licensing, inspection, regulation and enforcement for medical radiation facilities. In the competencies assigned to other organisms, the ITN, under the Ministry of Science and Higher Education, was given the assignment to inspect the teaching (i.e., universities) and research facilities (e.g., ITN laboratories). Furthermore, ITN was given the competency to authorise the transport of radioactive materials. No clear provision was made in the law to inspect radiological industrial facilities, remaining basically uncovered.

The legal system does not foresee the existence of an independent regulatory authority, able to supersede all radiation users, radiation facilities, and private and government bodies. Therefore, safety assessment, licensing and inspection actions, despite the availability of technical skills to perform them, are not under the supervision of an independent body to ensure unbiased safety and security of radiation uses. This inconsistency of the national radiation infrastructure has been identified by the IAEA expert mission [7], as well as by the EU Mission of Verification under Article 35 of the Euratom Treaty.

6. Conclusions

Portugal possesses the basic technical capabilities to ensure satisfactory radiation protection services. Nevertheless, the national legal system is still not in compliance with the international basic safety standards, and gaps remain in the definition of the competencies of government bodies. Specially, the lack of an independent regulatory authority is a weakness that should be overcome rapidly.

Education and training of young staff shall be ensured by DPRSN to meet the needs of the country in well-trained professionals. Furthermore, the enforcement of current laws and future regulations depends upon the capability to hire new staff for the DPRSN, according to the needs of the country, and for a future regulatory authority. As pointed out by an independent IAEA expert in a Report to the IAEA, «understaffing is a threat to security».

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Radiation Protection and Nuclear Safety PG Courses in Argentina

Facing the changes

D. G. Hernandez , A. L. Biaggio

Nuclear Regulatory Authority
Buenos Aires, Argentina

Abstract.. The evolution of the regulatory authority and the radiation protection and nuclear safety training activities in Argentina is briefly described. The history of the Post-Graduate (PG) Course on Radiation Protection and Nuclear Safety since 1980 to 2002 is introduced, and the reasons for major changes in the policy followed during more than two decades is explained. It is also summarized the reasons for the new policy of two consecutive Post-Graduates Courses, the first one on radiation protection and the second one on nuclear safety, and the main modifications are briefly described. Finally, it is presented a prospective of the PG courses for the following years based on the current situation in Argentina and the Latin-American Region.

1. Introduction

Since its creation, in 1950, the National Atomic Energy Commission of Argentina (CNEA) was committed to promote the safe use of radionucleidos and nuclear materials as well as the safety of nuclear and radiation facilities. Education and training was immediately recognized as the key tool to assure an appropriated level of radiation protection and nuclear safety.

By the end of 1950's it was mandatory the inclusion of topics of radiation protection and nuclear safety in all training courses for potential users of radioactive substances in the medical, industrial and research areas, and similar requirements were applied to CNEA personnel responsible for the design or operation of its facilities and laboratories. The key elements of a national emergency system for dealing with radiation and nuclear emergencies were defined by the end of 1950's and fully implemented during the following decade. In addition, during the 1960's, the CNEA also promoted the basic law and regulations for the safe use of x-rays equipments, being in this case the national regulatory authority the Ministry of Health. [1]

The independence of the Regulatory Branch of the CNEA was gradually increased and by the 1970's it was a fully independent organization that reports directly to the highest CNEA authority. All activities with radioactive and nuclear materials, including those carried out by the others braches of the CNEA, or in its behalf, had to undergo a formal process of independent assessment and authorization. As at present, the appropriate specialized education and on the job training were basic requirements for the authorization of the operating personnel.

2. Brief history of the Argentinean PG course

In 1977 the Regulatory Branch of CNEA took the decision to create a full time course on Radiation Protection and Nuclear Safety aimed at covering internal needs of the CNEA and related organizations (Operators and Regulators).

By the end of 1978 it was decided to give a formal academic level to the course and an agreement was signed between the Engineering School of the University of Buenos Aires, the Ministry of Health and the CNEA. The first Postgraduate Course on Radiation Protection and Nuclear Safety (PGCRPNS) was run in 1980. Since that year, the International Atomic Energy Agency (IAEA) supports the course, mainly by granting scholarships to university graduates from the Latin America region.

In 1994, when the regulatory activities were formally separated from the CNEA, it was created the Nuclear Regulatory Body: an independent governmental body performing all the regulatory activities of the former Regulatory Branch of the CNEA, and since that time the PGCRPNS was running by the regulatory authority. Later on, by the Act 24804 of 1998, were improved the definitions of the functions and faculties of the Nuclear Regulatory Body, and the name of the organization was changed to the current one; Nuclear Regulatory Authority (ARN.)

Since the beginning, the PGCRPNS was the basic tool for the initial education and training of the staff of the regulatory authority as well as qualified experts of the CNEA; private and state companies involved in the design or operation of radiation and nuclear facilities, and health professionals and researchers of several organizations. As complementary activities for building competence in radiation protection and nuclear safety, the ARN provides on the job training in several regulatory areas and also run, since the 1970’s, a shortest course (about 10 weeks) mainly intended to provide the basic education to radiation protection officers of other organizations and technicians of its own staff. Also, every year several specific short courses are organized by the ARN, and ARN professionals regularly collaborate with several courses organized by other organizations and universities, given lectures in radiation protection and nuclear safety topics.

Several reasons, let in 1994 to the reduction of the total extension of the course from its original 35 weeks to 26 weeks, and to split it into two “modules”: the first one mainly dedicated to radiation protection and the second one dedicated to nuclear safety. All the Argentineans participated in the two modules, but most of the participants from other countries only carry out the “Radiation Protection Module”. In order to properly accommodate internal and regional needs, the extension of the two modules was gradually increased and from 1998 till 2002 the total extension was 30 weeks; 21 devoted to the Radiation Protection Module and 9 dedicated to the Nuclear Safety one. The table below summarizes the number of participants in the PGCRPNS since 1980 to its last year, 2002.

TABLE I. Number of participants by country in the PGCRPNS, 1980 – 2002.

2.1.Country	*2.1.1. Participants*	*2.1.2. Country*	**Participants**	*2.1.3. Country*	*2.1.4. Participants*
Algeria	4	Argentina	286	Bolivia	23
Brazil	26	Colombia	26	Costa Rica	10
Cuba	38	Chile	25	Ecuador	23
El Salvador	6	Spain	1	Philippine	7
Guatemala	11	Haiti	2	Morocco	1
Mexico	20	Nicaragua	6	Panama	9
Paraguay	11	Peru	40	Poland	1
Dominican Rep	6	Romania	1	Uruguay	19
Yugoslavia	1	Venezuela	29	Vietnam	1
Zaire	2				
					Total: 635

3. Facing the Changes

Although the syllabus of the PGCRPNS was updated continuously, by the middle of 1990’s some indicators starts to call for a major change, in particular:

— At the national level there was a clear loss of momentum of the nuclear activities, while the applications of radionuclides and ionizing radiation in the industrial and medical areas increased continuously.

— With a few exceptions, a similar situation was evident worldwide, and particularly in the Latin-American Region.

Also during the second half of 1990's, the IAEA developed a clear policy regarding education and training in radiation protection [2-5] and a "Standard Syllabus" was agreed upon for which a minimum extension of 19 weeks was recommended. [6]

By the end of 2001, the Board of Directors of the ARN decided to fully apply the "Standard Syllabus" for the "Radiation Protection Module" of the course and to use the experience gained during the year 2002 to properly define major changes, if necessary, to the current PGCRPNS. The past experience, as well as the specific experience gained last year, clearly indicate that the standard syllabus is thematically appropriate, but its proper implementation would require a slightly rearrange of the topics order and the extension of the course should be 19 "effective weeks", i.e. about 95 working days dedicated to lectures and practices.

Based on an analysis of the situation, by August 2002 the Board of Directors of the ARN decided to promote a formal division of the PGRPNS into two PG courses and, accordingly, to develop new syllabus for both Courses and sign a new agreement with the Engineering School of the University of Buenos Aires. The new agreement and the thematic syllabus for both PG courses were developed during the last quarter of 2002 and all was planned for running two consecutive courses during the year 2003:

— The PG course on Radiation Protection and the Safe Use of Radiation Sources (PGRPSURS) with a total extension of 25 weeks, and

— The PG course on Nuclear Safety (PGNS) with a total extension of 10 weeks.

4. The Current Situation

The Post-Graduate Course on Radiation Protection and the Safe Use of Radiation Sources will start on April the first 2003 and last till September 19[1]. The participants shall have a University degree on a science or technology career. The objective of the course is to provide the educational and basic training capacities for Qualified Experts in Radiation Protection. The main changes in the syllabus are the following:

— The radiation protection of industrial and medical practices is more intensively addressed.

— More time is devoted to practices (labs exercises, case studies, practical problems, simulations, assessment and control activities, and technical visits to different facilities.)

— The time dedicated to radiation protection aspects of nuclear fuel cycle facilities, including nuclear reactors, was significantly reduced.

— The topic of train the trainers was fully introduced (the cooperation of specialized professional of the Buenos Aires University was agreed upon.)

It is interesting to note that when splitting the original course one of the problems to be faced was the one dealing with protection against potential exposures. Basic concepts like redundancy, diversity and in depth defense, as well as tools like probabilistic analysis, are fully applicable to the protection against potential exposures and where formerly addressed in the nuclear safety module. Therefore, it was decided to incorporate such topics in the PGCRPSURS, though in a more conceptual than quantitative way.

The Post Graduate Course on Nuclear Safety will start on September 22 and last till November 28. The participants shall either have approved the first course or demonstrate equivalent expertise. This course is mainly devoted to research reactors and nuclear power plants with a week dedicated to criticality prevention (a common problem to transport, storage and several process involving enriched

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[1] At the time this paper was written, March 2003, the first course has not yet started.

uranium or plutonium in some nuclear facilities), and an overview about the chemical risks associated to the handling of UF6 and to reprocessing. This course is aimed at to provide the educational level and basic training to regulators and operators of nuclear facilities.

5. Conclusions

It is considered that with the new policy the national and regional radiation protection needs will be better addressed. The syllabus of the new PGRPSURS, its extension and practices are better tailored for addressing the radiation protection aspects of the industrial and medical uses of radioactive materials and ionizing radiation, where an increasing demand of Qualified Experts in Radiation Protection is expected. This fact, coupled with the need of replacing old radiation protection officers, will assure a significant participation of both national and Latin-American professional. In addition, as this change is in line with the IAEA policy regarding education and training in radiation protection, the ARN will be in better position for cooperating with the Agency in implementing such policy.

With regard to the PGCNS the situation is not the same. Although it is also considered that the new syllabus of the PGCNS will better addressed the national and regional needs, it is not expected a significant number of participants during the next couple of years. However, the average age of operators and regulators in Argentina is too high (nearly fifty years) and there is a need of incorporating fresh professionals in the near future. It is foreseeing that after a couple of years the current national political and economical troubles will be overcome and new professionals will be incorporated each year on a regular basis, being this course a key tool for the initial education and training of such professionals. It is also expected that, as usual, some Latin-American professionals from countries with nuclear reactors will participate into the two PG courses.

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Local, National and International Eperience in Training Activities Related to Protection of Ionizing Radiation and Safety of Radiation Sources

M. A. M. Gomaa

Atomic Energy Authority
Cairo, Egypt

Abstract. Training activities related to radiation protection was recognized by the Egyptian Competent Authorities forty years ago. Egyptian Atomic Energy Authority and approved Institutes are recognized as approved training centers. Several training programs were completed (nine month specialized training program, three month- qualification training program and three month- Research Reactor Radiation Protection Services training program). Seven Egyptian Training Institutes are also carried out Radiation Protection Training Programs. Egyptian Societies also carry out training programs. Regionally, Radiation Protection Programs are carried out through Middle Eastern Radioisotope Center for Arab Countries and Arab Atomic Energy Authority. Several Training programs were carried out in Radiation Protection as well as various topics of peaceful uses of atomic Energy. Internationally, Training Programs are carried out through International Atomic Energy Agency- through projects, model and AFRA projects and International Organizations.

1. Introduction

Fifty years ago, several scientific Research institutes were established in Egypt. Among this institutes are the Egyptian National Research Institutes (1955) and the Egyptian Atomic Energy Commission (1957)1. Ionizing radiation were used for research purposes at these institutes as well at the Egyptian universities. Furthermore, ionizing radiation were in use mainly for medical purposes at the Universities Hospitals in Egypt and in limited number of clinics. Other uses of ionizing radiation were limited in either research or applications.

The need for training was properly spelled in the very old Egyptian Law 2 and in its executive regulation 3 as well as in the ministerial orders as a condition to hold I R license 4.

The Training process was also developed over the last 40 years. From the concept of proper training

(on job training under the supervision of I R expert for few days) to one month training course(1991). And from two radiation protection institutes (1960) to seven institutes(1994).

2. Local Radiation Protection Training Institutes

The current approved training centers are the followings:

- Egyptian Atomic Energy Authority,
- Cairo University-Faculty of Medicine,
- Cairo University-Faculty of Science,-
- Al-Azhr University –Faculty of Science,
- Alexandria University-Faculty of Medicine,
- Mansoura University-Faculty of Medicine,
- National Institute for Standards.

3. EAEA Training Center

Although the Egyptian Atomic Energy Authority was involved in radiation protection training activities from 1960. A training center was established within the Authority. Furthermore and in 1991 Reorganization of the EAE Authority Infrastructure a new post was established as the Vice President for Training and International Co-operation 5. Following IAEA technical reports, EAEA updated its training course syllabus and it is now attending the updated course is mandatory to work with ionizing radiation within its laboratories.

A specialized training course was also introduced 4 years ago to train the newly employed personnel by the EAEA. The training program lasted nine months.

4. Qualification Training Course

Two years ago, a new qualification training program was introduced

The current course lasts 3 months.

- The general lay out of the course is as follows:
- 1st week, atomic and nuclear physics
- 2nd week, radiation and nuclear chemistry and applications
- 3rd week, biological and medical sciences
- 4th week, radiation protection
- 5th week, reactors and accelerators
- 6th week laboratory
- 7th week, visit to radiation facilities
- 8th week, agricultural sciences
- 9th week, Isotopes and applications
- 10th week, fuel cycles and materials
- 11th week, elemental and isotopic analysis
- 12th week, nuclear safety and radiation control
- 13th week quality control and quality assurance, security ,legal and administrative aspects
- 14th week, visit to laboratories and facilities.

In general, teaching activities were carried for 4 hours daily,5 days a week

5. Radiation Protection Services for Research reactors

Among the radiation protection training activities a special program was completed last year.

This program was devoted to radiation protection services at research reactors.

All junior personnel involved in operation, radiation protection ,inspection attended this program

The program lasts for 2 full days a week for 13 weeks.

This program aimed mainly to inform the junior staff of the field of research reactor from material – operation- protection - to waste disposal . The program was based on visits to laboratories where lectures were given as well practice.

6. Radiation Protection Program for I R users

For licensing IR users, EAEA offers 5 weeks course for two levels

- for university level
- for intermediate levels

Each course lasts 5 weeks. The contents of the course are the same but the scientific materials are simplified in the intermediate level course.

The contents of the course are as follows:

- 1st week, basic radiation physics,
- 2nd week radiation detection and instrumentation,
- 3rd week basic radiation protection,
- 4th week, operational radiation protection,
- 5th week, emergency planning and legal aspects.

In general ,these programs re repeated three times yearly. In 2001 and 2002 that program was repeated 20 times per year as a result of the need to implement the new ministerial order of 2000 5.

The training center provide other training programs such as:

- medical radiation physics program
- welding inspection
- radiation detection instruments and its calibration
- Assistant radiography radiation protection training program
- Radioactive waste training program
- Stable isotopes
- Medical assistance for radiation and nuclear emergencies.
- Neutron generator training program
- Elemental and isotopic analysis training program.

7. On Job Training and Awareness

On job training and awareness programs are carried out at several sites as complementary training to personnel within the training center of the company and/or near working area. Usually, on job training lasts one to two days while awareness program lasts one to two hours.

8. Regional Training Activities

For many years the Middle Eastern center for radioisotopes for the Arab counties played important role in training users of ionizing radiation from the Arab counties. This program lasts 5 weeks and its similar to the same program operated by the Egyptian Atomic Energy Authority. Other training activities include training programs devoted to:

- handling of radiation and nuclear accidents
- isotopic hydrology
- nuclear medicine
- industrial radiography.

The Arab Atomic Energy Agency was active in training programs. More than 20 programs were completed in the various fields of the peaceful uses of atomic energy through out the Arab Countries. Radiation protection training programs and handling radiation accidents were among AAEA programs.

9. International Training Activities

International Atomic Energy Agency assists member states in training personnel in the field of radiation protection. In 1997, a specialized radiation protection program was completed through

Co-operation between Syrian Atomic Energy Commission, Arab Atomic Energy Agency and International Atomic Energy Agency. This program was in Arabic and it lasts 9 weeks. That program was developed to be a postgraduate radiation protection program and it lasts 9 months.

Other radiation protection activities carried out in Egypt were organized through either model projects such as RAF/9/29 or through AFRA projects such as RAF/6/26.

Bilateral co-operations between Egypt and Germany resulted in a training program dealing with radiation and nuclear accidents.

10. Conclusions

For proper implementation of radiation protection training programs and building competence in radiation protection in the Arab countries:

— reference documents should be translated into Arabic and

— specialized programs should be designed to different radiation protection expert group

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Training Specialists in Radiation Protection for former Soviet countries region
Problems and perspectives

A. Timoshchenko, V. Figurin, I. Matveenko, et al.
International Sakharov Environmental University
Minsk, Belarus

Abstract. One of problems FSU countries are faced with is the absence of well developed radiation protection infrastructure. It came as a heritage of USSR organization when radiation protection was governed from few centers concentrated mostly in Russia and Ukraine. Particularly, training specialists for the brunch was carried out in only several places. One of directions to overcome the situation is to create under IAEA umbrella regional training center providing training in Russian because of common usage of it in the region. The support of regional intergovernmental structures can now be insufficient to achieve reliable results. Such a center can be located in Minsk at International Sakharov Environmental University (ISEU), because Belarus has an intermediate position among the countries: there is considerably high concentration of specialists and facilities for training in almost all issues of radiation protection and safety of radiation sources except nuclear power installations. The last questions can be covered by Institute of Atomic Energy in Obninsk (Russia) in co-operation with ISEU. Ways to achieve sustainable functioning of the center and peculiarities of training programme subjected by specific regional training needs are discussed. Russian training courses can be of interest also for eastern European countries too.

The thesis is devoted to the section TS5 *Sustainable education and training, developing skills (national systems and regional solutions)*

1. Introduction

After disintegration of the Soviet Union many counties being a part of it were faced before the problem of keeping radiation protection infrastructure at a due level. Partially, training specialists is one of the greatest problems in many post-soviet countries because there was no appropriate academic basis for that. It was appeared that only Russia, Ukraine and Belarus have an adequate number of specialists who have necessary state of qualification in radiation protection and are involved in training programmes. So creation of a regional training center on radiation protection for FSU countries is one of main directions of sustainable development of radiation protection infrastructure in them.

2. State of the Art

Some steps in this way where done in the framework of Community of Independent States. In September, 1998 the Agreement on co-operation in the field ob radioecology, radiation safety, radiobiology and related topics were signed by Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgystan, Moldova, Russian Federation and Tadjikistan. Later on Ukraine has joined to the Agreement. The co-ordination of activities in the brunch was committed to the Ministry of education of Belarus. Since November, 2000 Ministry of education entrusted International Sakharov Environmental University to realize the positions of the agreement.

There were several meetings of representatives of participant countries. But things go very slowly. The main problem is that it is very difficult to estimate real demand of specialists needed to be trained because of difference in legislation on radiation protection in the countries, lack of money spent by governments on use of radiation sources and radiation protection issues leading to uncertainness in perspectives of specialists employment, imperfection of national radiation protection infrastructures and many other consequences. National authorities often can not give even short time forecast of training needs. Therefore, working out methods to estimate real needs of countries is of great importance.

In the same time IAEA in accordance to its regional programmes is contributing to training specialists for the region funding the post-graduate educational course on radiation protection and safe use of radiation sources (PGEC) in 1998 and 2000 in Russia (JINR, Dubna), and in 2001 and 2002 in Belarus (ISEU, Minsk). It was a great contribution to develop opportunities and improve facilities for training in the region.

3. Peculiarities of PGEC and other courses in Belarus

Training programme for PGEC in Belarus is the only Russian language PGEC programme in the world now. It can be more easily for them to pass the course in Russian for representatives from South East European countries like Moldova, Georgia, Azerbaijan, Armenia. Russian language may be better for training for many participants from Lithuania, Latvia, Estonia; it can be preferable for some from Bulgaria, Serbia, Slovenia, Bosnia and Herzegovina, Croatia, Poland, Hungary, Romania, Czech and Slovak Republics.

Use of Russian language at PGEC is critically important for Middle Asia countries like Kazakhstan, Uzbekistan, Tadjikistan, Turkmenistan. Specialists from these countries got used to use Russian as scientific and technical language. It is impossible for them to attend the course in Syria because they do not know Arabian language. That is why these countries should be involved in the East Europe region training activities. This is the specific organizing point for the region which should be taken into account for IAEA divisions.

PGEC in Minsk has also some specific features particular to the region being not anticipated by the standard programme. They are:

— special computer training;

— field practice in radioactively contaminated region;

— testing procedures;

— defending graduate work by each participant.

Special computer training is focused in using software for solving problems in radiation protection, dose estimation, database forming, searching for materials using INIS, etc. It is needed to do for some time because in many countries of FSU up-to-date computer techniques are coming in use very slowly. Sometimes, participants of the course do not possess elementary skills of using common software because of lack of practice at home. There working places have no adequately equipped. The other purpose to use computers widely is to facilitate calculations in solving problems. Participants of the PGEC in Belarus have an opportunity to use for calculations such software as Mathematica, Maple, MathCad, MathLab, Stadium and some other statistical software, ArcView and ArcInfo for processing data distributed in space and time.

The other particular point of PGEC in Belarus is the week field practice in Polesski Radioecological Reservation near the settlement Khoiniki in Gomel region. There participants develop practical skills in implementation of radiation monitoring programmes, getting acquaintance with agricultural and forestry technologies using for alleviation of radionuclides transfer and intake.

For estimation quality of knowledge and skills achieved by participants several kinds of testing procedures are developed. Knowledge of theoretical material of each part of the course is tested via special computer testing programme which provides an ability to change questions of one level randomly. So each participant is faced before his/her own pool of questions and can be estimated individually. Solving problems require other skills which are tested at special control lessons where participants during 2-4 hours try to calculate the output of nuclear reactions, interactions of radiations with matter, geometry of a source, dose calculations, etc. Practical skills of using devises, making measurements and processing experimental data are developing on practical exercises anticipated by the syllabus. Every participant should defend his/her results obtained during practical lesson making a report.

But defending graduate work is considered as the most useful endpoint for participants. Because of lack of time (4 months) it can not be totally completed research. It should be considered as essay on specific topic of radiation protection close to that a participant meets at his/her working place. In 2002 among graduate topics were

The PGEC can be considered as the background for any training programme. As it was approved on IAEA technical meetings in 2001-2002 it should be supplemented by different short-term training activities to train as qualified workers and operators for the first level of radiation protection specialists as well as regulators and qualified experts for different brunches of radiation protection and safe use of radiation sources. At Sakharov University there are several two-week courses for qualified workers and operators, radiation protection officers and regulators for different brunches of economics except health issues now. Training for medical radilogists is given in Belarus by Medical academy of post-graduate education. Except this ISEU provides five-year academic programme for training specialists in radiation protection and related topics.

4. Steps forward should be done

Due to the IAEA contribution and support of Belarus government Sakharov University now has a good ground for developing sustainable regional center. Generally, the sustainability consists of many issues to be fulfilled. The most important of them are:

1. presence of a system of quality assurance of training which comprises the following:

    1.1. a set of training programmes meeting long term training needs of the region including PGEC compulsory;

    1.2. up-to-date training materials organized in a flexible system of standardized blocks able to be applied for training different specialists;

    1.3. qualified and optimized teaching staff;

    1.4. availability to adequately equipped laboratories and radiation installations for practical training;

    1.5. admission procedures for participants and trainers, periodical running of training programme for trainers;

    1.6. adequate system of monitoring and control of all kinds of activities (academic, organizing, technical etc.);

2. involvement of a centre in the international network of national and regional training centres;

3. stable and satisfactory financing from national, regional and international sources according to correspondent training needs.

To gain these goals the following results should be achieved:

for ISEU

- to finalize a package of training materials for PGEC in Russian;
- to prepare and commence the training course for trainers;
- to re-fresh the list of short time courses and renew training material for them;
- to develop testing procedures for participants;
- to create special web site with materials on the courses conducted;

for ISEU and National Authorities

- to estimate training needs on national level;
- to create perspective national programme of training specialists on radiation protection and safe use of radiation sources;
- to contribute to maintaining laboratories for training;
- to co-ordinate training activities of all Belarus institutions, organizations and radiation protection bodies;

for ISEU and CIS countries authorities

- to estimate training needs for the region;
- to co-ordinate efforts in producing educational programmes and learning materials;
- to insist executive bodies of CIS for appropriate financing of the activities;

for ISEU and IAEA:

- to make access to all training materials approved by Steering Committee for all countries of the region;
- to agree for long-term technical co-operation.

5. Admission Procedure

The special question of region training needs connects with admission procedure for participants. For PGEC it has been recently stated by the first Steering Committee (SC) meeting in Vienna in November, 2002 that the age of a participant should not exceed 35 years old. But in many radiation protection bodies of FSU countries because of lack of directly trained specialists many of radiation protection personnel having the age from 40 to 50 years old are now attracted from different brunches. The most part of them have basic health education and are too far from many of radiation protection issues especially dosimetry techniques, models of intake, etc. The have to be retrained but not subject to retraining according to decision of SC. The way out may be as the following:

- to change policy of IAEA and SC for FSU countries for the current five years allowing to attract more than 35 age for training on PGEC;
- to change staff policy of FSU countries attracting young persons to the brunch (e.g. like Estonia is doing now) during current five years and
- to train them during full five-year programme, for instance, in ISEU.

6. Conclusions

It seems that taking proposals given above for implementation will allow overcoming problems in training specialists for radiation protection system of many of FSU countries having considerably low level of radiation protection infrastructure development now. The role of IAEA as international co-ordinator and contributor of making radiation protection policy in the region sustainable should be particuliar for the region taking into account specific regional training needs. It will take some time (approximately 5-7 years) for levelling situation in comparison to other regions.

Acknowledgements

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The Status of the Radiation Protection Expert in the EU Member States and Applicant Countries

J. van der Steen

NRG, Radiation and Environment
Arnhem, The Netherlands

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 to that, the plans to establish a European Radiation Protection Education & 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[1], 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. 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, qualification 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 & 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 by involving local know-how in the various countries, taking into account the highly specific nature of the subject and, secondly, 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.

[1] Contract number B4-3040/2000/311262/MAR/C1, reference ENV.C.1/ETU/2000/0104r.

2.1. Preparation of the questionnaire

In drafting the questionnaire, special attention was paid to formulate 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 in five parts, each addressing specific topics. These are:

- **Legal aspects**: 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 aspects**: What are the requirements for RPEs in the different work areas? What should be their level of expertise and experience?
- **Education and training aspects**: 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 aspects**: Is there a registration of experts? Have the certificates a limited validity?
- **Mutual recognition aspects**: Is there a legal provision for mutual recognition? What are the barriers for mutual recognition?
- **Discussion platform aspects**: Is there a need for a discussion platform? What is its role? Is there interest to participate?

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 10^{th} IRPA Conference in Japan where training and education of radiation protection experts was identified as an increasingly important component of 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 an a world-wide scale. The problem of the recognition of transient radiation workers was also pointed out at the 10^{th} IRPA Conference as something IRPA could look at in the future.

Given the broad participation of EU radiation protection societies in writing the discussion paper [2], and because of 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, there doesn't exist a radiological protection society. For those countries, use was made of two databases, one of the Applicant Countries' missions to the EU in Brussels (environment contacts) and one of 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 and, on the other hand, areas where a fair degree of harmonization was already there.

3. Results and Conclusions

Responses were received from all 15 EU Member States (100 %) and from 7 of the Applicant Countries (54 %; Czech Republic, Estonia, Hungary, Latvia, Malta, Poland and Romania).

For the EU 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 these 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 of the 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 EU Member States have their own national education systems for the training of RPEs. Luxembourg doesn’t offer training courses, so their pool of RPEs is educated in other countries. In some countries, international bodies such as the EC, the IAEA and the European Association for Nuclear Medicine support some courses, depending on the sector of work.

About half of the EU Member States consider their own current education systems sufficient to train Qualified Experts, 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 the responders consider the education system as sufficient to train people to the QE level.

Practical work is part of the training programme in most of the EU 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 EU 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 zero up to several years, depending on the sector.

In most of the EU 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 above-mentioned topics.

4. Recommendations

Based on the conclusions of the survey, some recommendations are made. The recommendations are repeated here briefly:

— In the context of the single market and the enlargement process, it is recommended to try to achieve harmonisation 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 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 & 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 EU 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 programs 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 for assuring 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 & 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 & Training Platform. It is to be expected that the European Commission will launch in short time a feasibility study for this purpose.

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IAEA Activities on Education and Training in Radiation and Waste Safety: Strategic approach for a sustainable system

K. Mrabit, G. Sadagopan

International Atomic Energy Agency
Vienna, Austria

Abstract. The statutory safety functions of the International Atomic Energy Agency (IAEA) include the establishment of and provision for the application of safety standards for protection of health, life and property against ionizing radiation. The safety standards are based on the presumption that a national infrastructure is in place enabling the Government to discharge its responsibilities for protection and safety. Education and training is an essential element of the infrastructure. The IAEA education and training activities follows the resolutions of its General Conferences and reflects the latest IAEA standards and guidance. Several General Conference resolutions have emphasized the importance of education and training [e.g. GC(XXXV)/RES/552 in 1991; GC(XXXVI)/RES/584 in 1992; GC(43)/RES/13 in 1999 and more recently GC(44)/RES/13 in 2000]. In response to 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 the 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. This 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 last General Conference 2002, the IAEA was urged to continue to implement the Strategy, including the convening of the Steering Committee. The first Steering Committee meeting took place during the week 25-29 November 2002.

The purpose of this paper is to present 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 International Atomic Energy Agency cover the establishment of and provision for the application of safety standards for 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 so called BSS) are based on the presumption that a national infrastructure is in place enabling the Government to discharge its responsibilities for protection and safety. Education and training is an essential element of the infrastructure and is one of the main IAEA's mechanisms of the provision for the application of safety standards.

The education and training provided by the IAEA follows the resolutions of its General Conferences and reflects the latest IAEA standards and guidance. Several General Conference resolutions have emphasized the importance of education and training [e.g. GC(XXXV)/RES/552 in 1991; GC(XXXVI)/RES/584 in 1992; GC(43)/RES/13 in 1999 and more recently GC(44)/RES/13 in 2000].

In response to 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. This Strategy was endorsed by the 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 a 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 also encouraged 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 Agency can be summarized as follows:

— Post-Graduate Educational Courses in Radiation Protection and Safety of Radiation Sources.

— Specialized Training Courses.

— On-the-Job Training (OJT).

— Scientific Visits.

— Workshops and Seminars.

— Distance Learning.

In addition, the Agency carries out other activities that support the aforementioned training modalities. These support activities include: (a) preparation of standardized training aids and material; (b) promotion of and assistance to Regional Training Centres, and co-operation with Collaborating Centres; and (c) publications relevant to education and training.

2.1. Postgraduate 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 them would be expected to become the trainers in due time. 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 Agency has been assisting the organization of the regular PGECs in different Regional Centres and in different Agency's official languages. These include Argentina (Spanish), Syria (Arabic), Germany, Africa (English), Morocco (French) and Belarus (Russian).

2.2. Practice specific specialized training courses and workshops

The specialized or task-specific/practice-specific training courses are usually shorter in duration. These courses last in general one or two weeks and are in principle given to those who have already attended PGEC. Workshops are also task 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, transport of radioactive materials, emergency response and preparedness, safety and security of radioactive sources, safety in industrial applications etc. They are frequently organized as national or regional or inter-regional courses for different target audiences like regulators, radiation protection officers, technicians, etc. The Agency is annually supporting more than 50 national and regional events.

2.3. Fellowships and scientific visits

Fellowships and scientific visits are also supplementing the education and training courses. They are meant to provide individual practical training in well-recognized national and/or regional centres. 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/managers, senior level persons, and specialists requiring exchange of information and observation of other facilities for transfer of know-how, joint collaboration, etc. The Agency 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 also a 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 also as refresher training or be used for equalizing/harmonizing purposes to prepare an individual(s) to reach a certain level for successfully attending a training event. There is an ongoing IAEA/RCA project on paper- based Distance Learning in Radiation Protection. The participating countries are Australia (co-ordinator), Korea, Indonesia, Mongolia, Thailand, The Philippines and New Zealand. The results of the trials (I and II) and feedback have proved this to be one of the effective mechanisms of radiation safety training. 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 rather been reactive than proactive. 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 Basic Safety Standards and other safety standards. This is meant to operate in the context of a combination of regional and international collaborations, in which, of course, the IAEA would continue to play a primary role.

One of the first steps in the implementation of this strategy by the Agency 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) and Safety Report Series No.20 on “Training in Radiation Protection and the Safe Use of Radiation Sources” (2001). 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 Series document provides detailed guidance on the organization, implementation and evaluation of education and training activities. The Standard Syllabus for postgraduate educational course in radiation protection and safety of radiation sources has been revised taking into account the requirements of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS).

4. The New Vision and Strategy

The new vision and approach to strategy is to:

— Optimize effectiveness of its education and training programme to ensure short term and long term availability of necessary expertise and competence.
— Answer the need for harmonisation and quality of training and education according to International Basic Safety Standards and other relevant standards
— Optimise finite resources of both Member States and IAEA.

The main components of a comprehensive strategy proposed for the future are described in detail in the Report of Advisory Group on Education and Training “Strategic Approach to Training - Strategic Plan 2001-2010” of April 2001. The main lines of action adopted for the implementation of the strategy are:

— to enhance/encourage the “train-the-trainers” approach;
— to promote and strengthen national and regional and collaborating Training Centres; and
— to 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;
— to continue developing the network of Regional and National Training Centres;
— to put in place a robust mechanism for the development and updating of appropriate training aids and materials and optimize the direct involvement of specialist Agency personnel in training activities;
— to put in place a procedure to facilitate the development of trainers in radiation safety; and
— to set up a data bank 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 like the European Union .The representatives of the European Union 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, European Union and Professional organisation (IRPA) The first meeting was held in Vienna in November 2002 with 19 members. The Steering Committee is chaired by the Agency.

The objective of the meeting was to provide the Agency with relevant advice on its education and training activities, and also review the standardised training material developed , advise on the establishment of inter centre network. on the meeting 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.

Standardised training packages have been developed for few modules of PGEC, and for specialised training courses. In general, contents of the training packages for specialised training are Power Point Slides for the presenters, narrative lecture notes for students, practical or student exercises, multiple choice questions . The training packages developed for regulators in different practices includes detailed On the Job Training Programme also. 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 out of 23 completed. This includes workbook, self check questions also.The Steering Committee acknowledged the IAEA's effort in developing the training packages, and recommended to launch a project to establish the Inter Centre Network, establish and maintain an adequate pool of recognised trainers for each area of interest through train the trainer workshops.

IAEA PUBLICATIONS IN THIS AREA

[1] *Safety Standards Series RS-G-1.4, Building Competence in Radiation Protection and the Safe Use of Radiation Sources, IAEA, Vienna, 2001.* This Safety Guide provides guidance for the regulatory bodies for the establishment of training and qualification requirements and a strategy for building competence. The Safety Guide is jointly sponsored by WHO, PAHO and ILO;

[2] *Safety Report Series No.20, Training Courses on Radiation Protection and Safe Use of Radiation Sources, Vienna 2001.* This report provides assistance to trainers and training providers on how to set up training courses, distance learning and on the job training as well as 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 the IAEA Technical Reports Series No. 280 on Training Courses on Radiation Protection that was published in 1988.

[3] *Training Course Series 18, Standard Syllabus for the Postgraduate Educational Course in Radiation Protection and the Safe Use of Radiation Sources, IAEA, Vienna 2001* is intended to facilitate the implementation of such courses by Universities and training centres. The course is aimed at professionals in the early stage of their careers. The structure of the syllabus follows the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. This syllabus supersedes the one published in 1995.

Topical Session 7

AUTHORIZATION, INSPECTION AND ENFORCEMENT (EFFECTIVENESS AND EFFICIENCY OF THE ACTIVITIES OF THE REGULATORY BODIES), INDEPENDENCE OF REGULATORY AUTHORITIES

Control of the Import of Diagnostic X-Ray Machines in Sudan

M. Y. Osman, N. A. Abbas, E. H. Osman, et al.

Sudan Atomic Energy Commission (SAEC),
Khartoum, Sudan

Abstract. The quality control program has been applied to a number of x-ray machines sited at 10 different states of Sudan . The results of the study showed that the majority of the tested machines do not comply with the radiation protection requirements and that the most pronounced faults were associated with KVp and time accuracy . Inventory of x-ray machines in the government sector in 10 states of the country showed that most of the available equipment are very old and that most of the imported machines are second hand this fact partially explained the unsatisfactory results of Q.C tests . To solve this problem a new regulation for importing x-ray machines has been developed and adopted based on this regulation 12 x-ray machines have been prevented from entry to the country.

1. Introduction

According to the Sudan Atomic Energy Commission (SAEC) Act the entry of all radiation sources is only permitted to licensed persons who should apply to get an import and use licenses . This Act was issued in 1971 and has been updated in 1996 but although that it has been applied effectively for all imported sealed and unsealed radioactive materials as well as to x and gamma rays machines used for radiotherapy, the import of all other medical equipment including diagnostic x- ray machines – radiographic, fluoroscopic ,dental, ct, etc. has been under the control of another body , the pharmaceutical department. In this study the situation of the currently available x-ray machines is described together with the summary of results of Q.C tests done for them both in government and private sectors. Also the newly adopted system to control the entry of x-ray machine has been outlined.

2. Quality Control Program

The Quality control (Q.C) service has been stated in Sudan in 1987 using one Q.C kit then the service was widely spreaded in the capital (Khartoum) from the year 2000 after the availability of trained staff and new three Q.C kits. The program so far covered all the governmental clinics and a substantial number of the private clinics in Khartoum and the service is slowly spreading to cover x-ray equipment in other states of the country.

Currently a number of 11 major Q.C tests are being done for the radiographic x-ray machines. The results of these tests showed that most of the available x-ray machines are not complying with the required requirements and that the most frequent error is in KVp accuracy (Fig. 1).

In the year 2000 the service covered 12 governmental hospitals and in 2001 it covered 35 machines in the private sector and in 2002 covered 21 machines in the same sector .The corrective actions are rarely done especially in the public sector and this is mainly due to financial constraints, another reason for that is the non availability of spare parts for those – usually old – machines as well as the non availability of the service manuals. Fig. 2 summarizes the results of Q.C tests for x-ray machines done over the last three years. Also the figure shows the number of machines that have been improved to satisfactory requirements.

FIG. 1 : Results Of Q.C Test

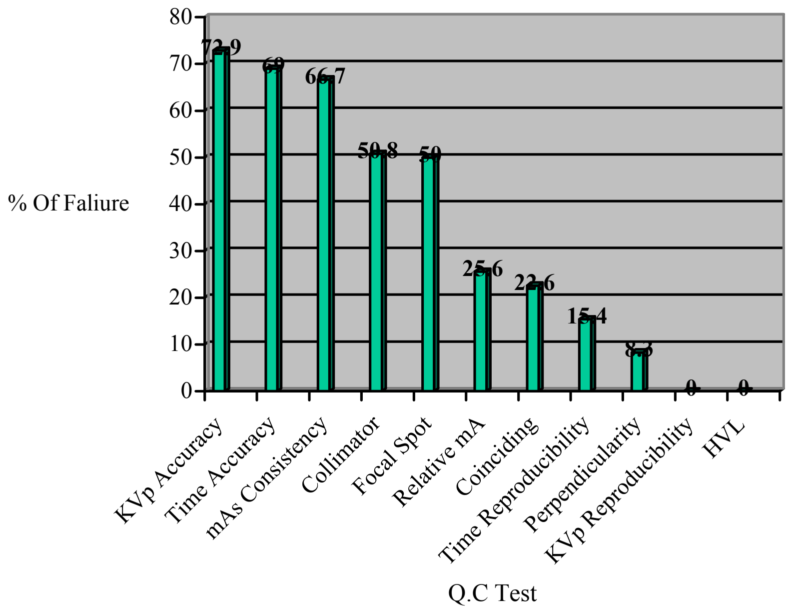
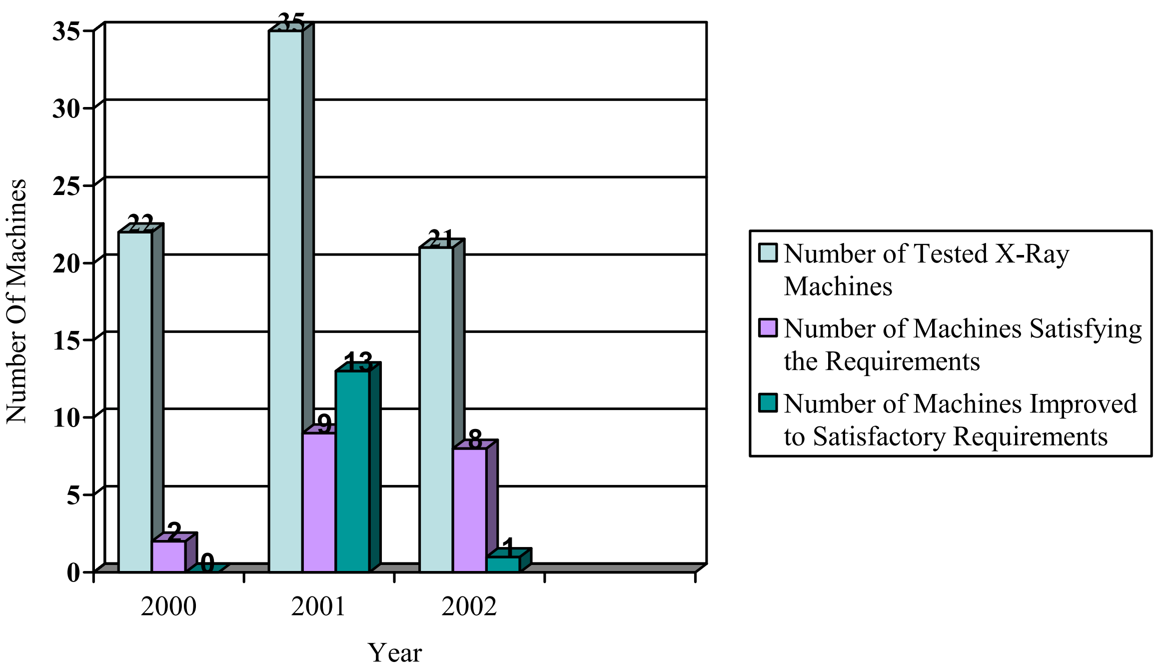


FIG. 2 : Summary Of Q.C Results In The Last Three Years



3. Inventory of X- Ray Machines

An inventory of x-ray machines (up to the year 2000) that covered 10 states out of the 26 states of the country has been carried out in the public sector . The inventory showed that there are about 110 X-ray machines imported from 19 different companies .Most of these machines (71) are located in Khartoum state .The following types of x-ray machines are currently available in the country ,Major, Mobil, Fluoroscopy, Portable, Dental , C-Arm Simulator, Angiography, Mammography and CT (Fig. 3)

The eldest –yet working machine – was found to be installed at the year 1960. Most of the machines that have been imported during the last decade are second hand and they are now physically in poor conditions (fig. 4 & 5).

The inventory showed also that a very high percentage of the available machines (74.6 %) have no operation manuals and even a higher percentage (84 %) have no service manuals, this fact together with the fact that most of the machines models are currently obsolete make the task of maintaining or repairing them extremely difficult.

4. Regulations to Control the Import x-ray Machines

All the above mentioned facts necessitated taking action to regulate the import of the x-ray machines so as to prevent the escalation of the problem , for that , successive meetings between the RPEMD and a group of professional service engineers who work in both public and private x-ray departments have been held to discuss and lay down the required regulations. Our task was to make balance between the acute needs of the country for x-ray machines –taking the economical factor into consideration- and the compliance with radiation protection requirement to protect workers, patients and public from any unnecessary radiation exposures.

The adopted regulation , in addition of stating the minimum required specifications of each category of x-ray machines , has the following points:

Any importer of x-ray machine should apply for an import and use licenses. such applications is then to be revised by RPEMD and licenses are issued –upon the recommendation of the RPEMD - from the Radiation Protection Technical Committee (RPTC) which is the only relative regulatory authority in the country

License is only issued upon the fulfillment of the following conditions:-

Any imported second hand or refurbished machine should be accompanied with a certificate from the manufacturer stating that they are still providing maintenance service for the machine.

An operation and a service manuals should be available in English or in Arabic (the local language)

The importer should submit an undertaking stating that the machine will not be put in operation unless:

the machine has successfully passed the Q.C tests and a validity certificate has been issued for it

a license has been issued for the designated x-ray room

Since the date of implementation of these regulations (September 2002) 12 x-ray machines were found to be out of specifications and therefore have been seized by the custom office.

5. Conclusion

The permit of entrance of the imported x-ray machine has become practically – for the first time – under the control of the regulatory authority . Regulations to control the import of these machines has been developed to suit the country needs and at the same time comply with the radiation protection requirements.

FIG. 3 : Types Of X-Ray Machines Available In The Governmental Sector

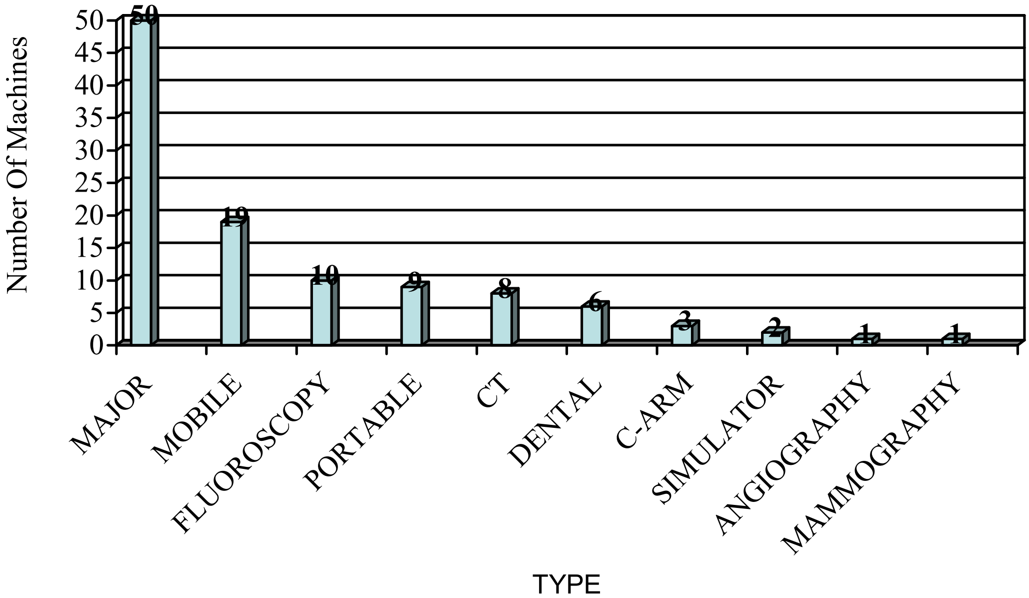


FIG. 4 : Number Of Available Imported X-Ray Machines In The Governmental Sector During The Period 1950-2000

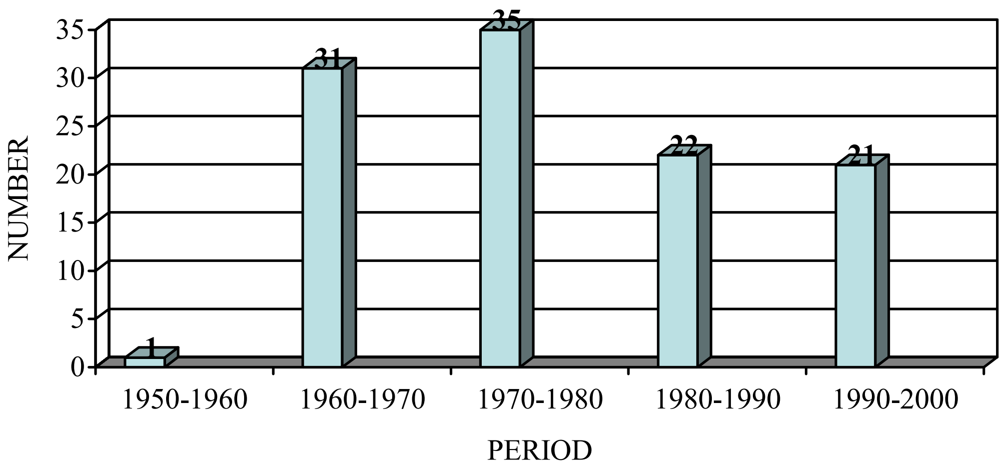
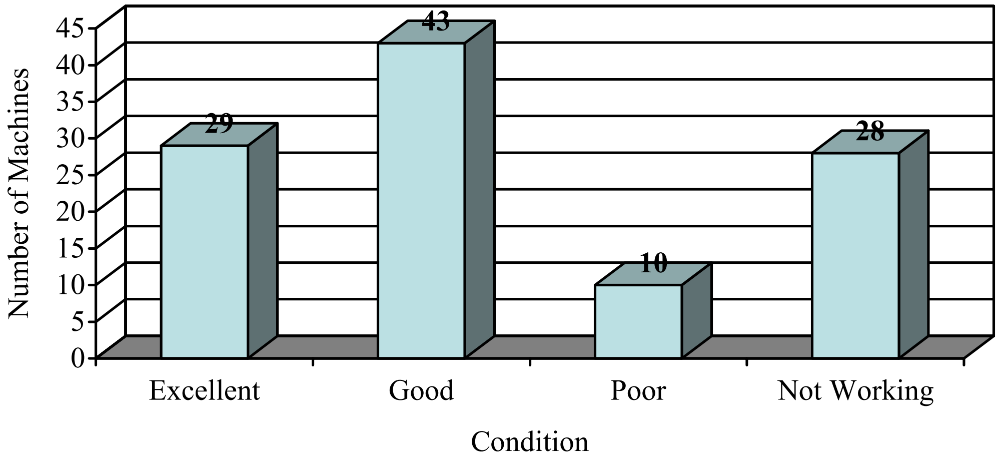


FIG. 5 : Physical Conditions Of X-Ray Machines



Development of the Radiation Safety Infrastructure in the Republic of Kazakhstan (implementation of the experience with the Model Projects)

A. Kim

Atomic Energy Committee of the Republic of Kazakhstan
Almaty, Kazakhstan

Abstract. Major factors, by which the radiation situation in Kazakhstan is formed, are: enterprises of nuclear fuel cycle, including uranium mining and milling activity and geological exploration of uranium; nuclear power plant and research reactors; residues of atmospheric and underground nuclear explosions, which were conducted for military and peaceful purposes at the different test sites; mining and milling of commercial minerals accompanied by radioactive substances; using of radioactive sources in industry, medicine, agriculture and scientific research. Since 1991, after getting of sovereignty creation of own legislative basis of the country for the field of atomic energy use started. It includes laws, regulation and standards for nuclear and radiation safety of nuclear installations, protection of personnel, involved in the activity with using of atomic energy, population and environment. Applicable system of state regulation in this area, including the central regulatory body in the field of atomic energy use and various ministries, agencies and committees, was created. As a result of these reforms, regulatory activities were improved in the country. Implementation of the Model Project was very useful for those. This paper presents the current matters of nuclear and radiation safety in Kazakhstan and some difficulties, which Kazakhstan encountered during the transition to an independent state. Examples of positive and negative results of implementation of Model Project are presented also.

1. Introduction

The Republic of Kazakhstan one of the new independent countries of the former Soviet Union is located immediately to the south of Russian Federation and west of China. It encompasses over 2.7 million sq. km of land area and has a population of over 14 million. Before disintegration of the Soviet Union, Kazakhstan had no own legislative base in the field of atomic energy use and had no state bodies, called to execute the control at observance of security measures by atomic energy use. Since 1991, after getting of the sovereignty, Kazakhstan started developing of its own legislative and regulative system in this area. In accordance with the Decrees of President appropriate structures in Kazakhstan were created. They are: Atomic Energy Agency, as a main Supervising governmental body, National Nuclear Centre combining all nuclear related scientific institutes, and National Corporation of Atomic Energy and Industry Enterprises KATEP. On 14 February 1994 Kazakhstan joined the International Atomic Energy Agency.

The general purpose of activity in the field of atomic energy use in Kazakhstan is safely and effective ensuring safety of the present and future generations and environment protection from radioactive contamination both by normal and extraordinary situation and maintenance of nuclear weapon non-proliferation regime.

According to those tasks the Republic of Kazakhstan needs the effective system for the assurance and guarantees for protection of population and environment against the possible negative influence of atomic energy usage and system for the control of radioactive materials.

2. Factors affecting Radiation Safety in Kazakhstan

The situation in the field of radiation safety on a territory of the Republic of Kazakhstan is formed currently by the following main factors [1].

2.1. Activity of the enterprises of uranium mining and milling industry, including geological exploration of uranium

As is known, the Kazakhstan takes one of the first places in the world on quantity of prospected uranium stocks (about 50 % of uranium stocks of former USSR). A long time (more than 40 years) development more than 20 deposits was conducted. The enterprises of this industry branch are located practically on all territory of Kazakhstan. Ulba metallurgical plant in the East of the country produces nuclear fuel for NPP. At realization prospecting, and processing processes on uranium mining and milling enterprises were made radioactive waste, total weight which is about 220 million tones with activity 250 thousand Ci more.

2.2. Power and research reactors

In Kazakhstan there are 5 nuclear installations, including one nuclear power plant BN-350 in Aktau-city, and four research nuclear reactors of the National Nuclear Centre. One of them is located in Almaty, and three of them are located in Kurchatov-city (on the territory of the former Semipalatinsk Test Site).

Potential radiation danger of nuclear installation exists directly only during their technological activity, in duration 30-40 years, i.e. less vital term of one human generation. After closing of nuclear reactors the direct danger disappears, but there is the special danger of a fulfilled nuclear fuel and a radioactive waste, formed for a time of operation of object.

At the present time NNP BN-350 reactor is shut down. The decommissioning procedure of this reactor has started pursuant to the Governmental Decree of 22 April 1999.

All research reactors operated currently.

2.3. Nuclear explosions

As a result of conduction of nuclear explosions (about 500 atmospheric and underground explosions for military and peaceful purposes) on Semipalatinsk Test Site and other sites were formed the waste of low activity on a surface and average activity in cavities of explosions as a kind of melt mountain mass [2,3].

The volumes of the waste are evaluated as 12.3 million tonnes with activity of surface contamination of 11.6 thousand Ci and underground contamination 12.87 million Ci.

2.4. Activity of the enterprises of mining and milling of commercial minerals containing radioactive elements

Number of Kazakhstan deposits of polimetalls, phosphors rare earth contains uranium, which at a production of ores is extracted together with main ores and, as a rule, is not divided and can be accumulated in concentrates, and more often leaves in tailing. On some coal deposits top of a part coal are also accompanied uranium. This coal will not be realised as a fuel, and is subject to radioactive waste management. During the study of the territory with oil deposits were find the areas with soil and industry equipment contamined by natural radionuclides Ra-226 and Th-232. Radioactive waste of this group makes 1.57 million tonnes with total activity of 520 Ci.

2.5. Use of radioisotopes in medicine, industry and scientific research

In Kazakhstan in many branches of medicine, industry and scientific research use a kind of radiation sources. Every year about 100 thousand of sources with total activity up to 25,000 Ci are using. Annually 10 thousand of sources more set out for storage. The radionucleads types of sources are from H-3 to Am-241.

The solution of problems of radiation safety of the population and waste safety is possible only at availability of the necessary legislative base and with system of the state regulation of radiation safety.

From 1996 to 2000 Republic of Kazakhstan participated in the Interregional Model Project on Upgrading of Radiation and Waste Safety Infrastructure in East and West Asia (RAW/9/006). The main goal of this Project was to assist the IAEA Member States in the creation of the own state system of radiation safety regulation.

3. Legislative Base

Before disintegration of the Soviet Union the documents, regulating safety of activity in given area in Kazakhstan, were the Norms of Radiation Safety NRB 76 / 87, Basic Sanitary Rules OSP- 72/ 87 and various departmental documents. State Committee on Safely Atomic Energy Use Supervision of USSR (Gosatomnadzor) executed the control in this field.

After getting of the sovereignty in 1991 to the Republic of Kazakhstan were begun and carried out till the present time work on the creation of legislative base in the field of atomic energy use and radioactive waste management based on main principles of International Basic Safety Standards [4]. Thus experience in the field of the nuclear right of a number of advanced countries, such as Germany, Finland Russia, and Ukraine was used [5]. Number of the IAEA experts in nuclear legislation visited Kazakhstan under Model Project. They represented Sweden, Switzerland, Iran, Czech Rehublic.

At the present time in Kazakhstan there is the following legislation base in this field:

In 1997, April 14 the Law on Atomic Energy Use was adopted [6]. The Act defines nuclear energy concepts, sets out a structure for the peaceful use of nuclear energy, the protection of public health and environment, the non-proliferation of nuclear weapons and nuclear and radiation safety. It authorizes the Government to designate those State Bodies, which regulate the nuclear and radiation safety and the licensing of various types of nuclear activity. That is the basic Law in the nuclear legislation of the country.

In 1998, April 23 the second Law of the nuclear legislation of Kazakhstan was adopted. It is Law on Radiation Safety of Population [7]. This Law aims to protect the population from adverse effects of lionizing radiation. It deals with the right of individuals in the context of such safety, the duties of users of lionizing radiation sources and the responsibilities of State bodies.

Others Laws of the Republic of Kazakhstan in this field are Laws on the Environment Protection, on Licensing, on the Bowels (of the Earth) and Bowel Use, on Social Protection of the Citizens Damaged from Nuclear Tests at the Semipalatinsk Test Site, on the Sanitary-Epidemiological Well-being of Population, on the Export Control of Arms, Military Engineering and Production of Double Purposes. National Regulation for the Safe Transport of Radioactive Materials was elaborated on the base of IAEA Transport Regulation, 1996 Edition No. TS-R-1, and adopted in 1999 [8]. The Norms of Radiation Safety NRB-99 [9], which were elaborated by the specialists of the Russian Federation and the Republic of Belarus taking into account the international safety requirement [6], had been adopted in Kazakhstan in 1999.

Others legislative acts in this field are:

- Decrees of the President, Decrees of Parliament and Government;
- Decrees about bodies of state management, regulation and inspections;

- System of the rules and norms of nuclear and radiation safety;
- System of state standards and rules;
- System of the documentation of ministerial regulation;

Republic of Kazakhstan have signed and joined such international treaties and conventions as Treaty on the Non-Proliferation of Nuclear Weapons, Convention on Nuclear Safety, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Thus, Republic of Kazakhstan took obligation to execute the International requirements of safe atomic energy use.

4. System of state radiation safety regulation

President, Parliament and Government of Kazakhstan, realizing the high national responsibility in discharging the functions took a decision to create a system of State radiation safety regulation.

Various State bodies are responsible for the following functions [10].

In accordance with the nuclear legislation of the country Atomic Energy Agency (since 1999 Atomic Energy Committee (KAEC)) is defined as Central regulatory body in the field of supervision for nuclear and radiation safety.

According to the provision on KAEC adopted by Governmental Decree of 23 September 2000 No.1442, it is responsible for:

- Realization of State Policy in the field of safely atomic energy use.
- State control of nuclear, radioactive and special non-nuclear materials, dual-use goods. Providing Regime of Non Proliferation Nuclear Weapons, nuclear and radiation Safety during the using of atomic energy.
- Export and import control of nuclear materials, technologies, equipment, special non-nuclear materials, dual-use goods and equipment, radioactive sources and isotope goods.
- Preparation of Annual reports connected with safety status of entities using atomic energy.
- Development of acts, regulations, standards, rules in the field of atomic energy use.
- Licensing all types of activities in the field of atomic energy use.
- Consideration and concordance of papers bottomed safety of nuclear installation during the all stages their life cycle.
- State account and control of nuclear materials and supervision for providing of physical protection during their storage, transport and use.
- Providing and Coordination of co-operation of Kazakhstan Institutions with IAEA and other International organizations in the field of atomic energy use.
- Emergency preparedness.
- Coordination and organization of research and scientific activity in the country and participation in the international co-operation in the field of atomic energy use.
- Preparation of proposals for upgrading and improvement of legislation of the Republic of Kazakhstan in the field of atomic energy use.
- Other functions.

The Ministry on Health of the Republic of Kazakhstan with its sanitary-epidemiology stations provides medical services necessary for the protection of the public and employees at risk. It is responsible in context of its competence for regulating and inspecting the manufacture, use, storage, transport of nuclear materials and radioactive sources. It also carries out the account all radioactive sources and gives the sanction to work with sources, renders the medical help to personal, which works with nuclear materials.

The Ministry of Environment Protection is responsible for protection of the environment against radioactive contamination. It co-ordinates the work on study of a radiation situation in Kazakhstan and executes the State ecological examination of the projects.

Others Ministries and Departments of the Republic of Kazakhstan with their responsibility are.

Ministry of Energy and Mineral Resources is responsible for the coordination of all scientific activity in the field of atomic energy use. It also organizes the verification of the scientific soundness of technical projects.

The Ministry of Internal Affairs verifies the physical protection standards of all facilities which use atomic energy or in which radioactive waste is managed.

The Agency on Emergency Situations is responsible for monitoring compliance with measures on the prevention of emergency situations and sets out measures to protect the public against radiation exposure in the event of such situation. The Department of Safety of Industry and Mines, within this Agency, is responsible for the regulating of industrial equipment.

All those State Bodies are the first level of the system of regulation.

The various national institutions carrying out the direct radiation control and measurements form the second level.

The institutes of the National Nuclear Centre of the Republic of Kazakhstan (Ministry of Energy and Mineral Resources) are controlling the radiation situation at the all territories of nuclear test sites and carried out the measurements of concentrations of radionuclides in soil and water here.

State enterprise "Hydromet" with its network (Ministry of Environment Protection) carried out control of global fall of the radioactive substances at the territory of the country.

Joint Stock Company "Volkovgeology" (National Atomic Company “Kazatomprom”, Ministry of Energy and Mineral Resources) executes the radiation monitoring at the objects of uranium mining and milling.

The control of external irradiation dose and levels of radionuclides in soil, water, food and other products is also carried out by laboratories under the Ministry of Agriculture and different scientific laboratories and various research institutes of appropriate profile.

Few tens peoples from those state bodies and enterprises were participate in scientific visits, fellowships and different training courses on radiation safety, which was provided under Model Project. Staff of KAEC had training in the field of authorization, licensing, registration, inspection.

5. Some specific points of safety (positive and negative results)

During the transition from the former Soviet Union to an independent state Kazakhstan encounteres some specific difficulties in safely area, which were not before. For example, the spent fuel from NPP, which before was transferred to Russia for storage, now must be storaged in Kazakhstan, because the legislation of Russian Federation forbid to storage the radioactive waste of other countries. Another problem were connected with the necesarity of regulation of personnel of nuclear facilities activity and assurance of its radiation potection.

Solution of those tasks needs to create the special institutions for design, construction and built of the nuclear entities. It is necessary to develop and implementation of licensing procedure for those kinds of activity, special requirements for personal involved in this activity. Assistance from international organizations such as IAEA, NEA OECD, regulatory bodies of USA, UK, and Sweden under different technical co-operation project is very important and topical. Kazakhstan participates in more than ten TC projects during every year. That may be a big project such as the Interregional Model Project on Upgrading of Radiation and Waste Safety Infrastructure, in which involved many governmental and research institutions, or local projects for separate organizations connected with the local specific task, which were not covered by the Model Project. We will consider some of those projects.

According to the conception of the decommissioning of the NPP BN-350 reactor, the creation of facilities for long-term storage is necessary [11]. For this purpose, we are now setting up a project to build new containers for the disposal facilities. Those containers will be connected with the operating system for the drain gully water. Waste that was collected before will be solidified with concrete and transferred for storage to the BN-350 disposal facility.

Storage equipment will be in special canyons covered by stainless steel. Into each canyon there will be a signaling apparatus for the control of the solution level.

This project provides a special complex of the measures on technical condition control of equipment during all period of operation.

In connection with the reactor BN-350 spent fuel management the dry storage method has been chosen. The choice of dry disposal is based on the conception used in Argonne National Laboratory (USA) during more than 30 years for storage of radioactive materials of experimental breeder reactor II (EBR-II). This method uses a silo in-ground configuration. The choice is based on detailed options study using the following criteria:

— Minimize proliferation and safeguards risks;
— Minimize technical risk;
— Minimize environmental and safety risk;
— Minimize political risk;
— Minimize cost.

Currently the storage sitting is carried out. The project will be realized during next 6-7 years. National company KATEP-AE was defined as a main management company on the decommissioning of reactor BN-350.

During all steps of this project Kazakhstan received the assistance from Nuclear Regulatory Commission of USA. Those were exchange of experience between the Kazakhstan's and international experts during the workshops, seminars and work meetings, technical and financial support.

One of the main encountered difficulties is the necessity of development and implementation of new regulation documents. Assistance of international organizations in this area is very important and useful. So, a good experience Atomic Energy Committee of Kazakhstan received during the participation in the IAEA TC Project KAZ/9/006 "NPP Sitting". Few regulatory documents on qualification, selection, training and authorization of personnel involved in activities connected with the use of atomic energy were elaborated under support of Division of Nuclear Power (Department of Nuclear Energy of the IAEA) in duration of last four years and now their are used in Kazakhstan. This work is very important for the present and future activity of all entities involved in the field of atomic energy use. Requirements of those documents are mandatory for all entities, involved in this activity. Big variety of Kazakhstan nuclear facilities and considerable amount of personnel involved in nuclear activities in a combination with limited resources dictate outstanding need in an implementation of thought-out, balanced and systematic approach to the development and upgrade of Kazakhstan nuclear training and qualification infrastructure. These considerations were the basis for planning and implementation of the IAEA and Kazakhstan joint activities.

Now we will describe the direct result of implementation of the IAEA Interregional Model Project on Upgrading of Radiation and Waste Safety Infrastructure. One of the important points of safety is personal dosimetry of personnel. During the former Soviet Union this service was provided by the sanitary-epidemiology departments of the Ministry of Health. Film dosimeters were used usually. Unfortunately, the power of this service was limited, and it had no possibilities of quality upgrading in this area. Currently in Kazakhstan the radiation laboratory is created under support of the Model Project. This laboratory uses the modern equipment. TLD-system HARSHAW-6600 is used for providing of personal dosimetry service. Laboratory staff had training in Germany on the base of the “Bicron” Company, which is one of the leaders in this area in the world. Now laboratory has about three thousand dosimeters, and this service covers about 50 private and state (local and foreign) companies, which conducted the activity in the different area of using of atomic energy on the territory of Kazakhstan. Activity of this laboratory will be the main part of the State System of Individual Dosimetry of the country.

As a negative result we may consider the attempt of usage of Regulatory Authority of Information System (RAIS) in Kazakhstan. Unfortunately this system cans effectively used for inventory of small number of radiation sources (a few hundred). For country like Kazakhstan, in which are used tens thousands of sources this system is difficult for using due to the internal specific of software. Therefore Kazakhstan elaborates now own system for inventory of sources with using of experience of other countries such as Czech Republic and Russian Federation. In this case very important and useful are expert mission provided under Model Project.

6. Conclusion

At the present time in Kazakhstan:

In the field of nuclear legislation the Laws on the Atomic Energy Use and on Radiation Safety of Population are elaborated with using of international experience in this area and adopted by Parliament of the Republic of Kazakhstan. National Regulation for the Safe Transport of Radioactive Materials was elaborated on the base of IAEA Transport Regulation, 1996 Edition No. TS-R-1, and adopted in 1999. Some regulation documents of the former Soviet Union, and Norms of Radiation Safety NRB-99, developed and accepted in Russian Federation in 1999, are used also.

The State system, which includes the number of Ministries, Agencies and Committees of Kazakhstan, for the supervision and regulation in the field of nuclear and radiation safety, was created. Atomic Energy Committee controlled all types of nuclear activity by means of licensing and inspections.

Some specific difficulties in safety area and the way of their solution were discribed also. As shows the experience of international co-operation the paricipation in the different projects of multi-aspect nature is very important and useful.

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Licensing and Inspection of Industrial Radiography in Sudan

I. Shaddad, A. Ahmed

Sudan Atomic Energy Commission
Khartoum, Sudan

Abstract. The use of radioisotopes in Sudan started in 1965 in the medical field, and gradually expanded in agriculture, animal research, hydrology and recently industry. During the last 4 years oil industry in Sudan became one of the biggest activity. Almost 11 foreign companies are involved in oil industry including exploration, establishment of refineries and construction of pipelines. Sudan's pipeline is the longest in Africa, about 1600 Km. The estimated number of radiation workers in these Companies are 100, some of them are locals. The country Regulatory Authority is Sudan Atomic Energy Commission (SAEC). The Commission provides personal monitoring services to all radiation workers in the country. Only about 20% of the radiation workers in these companies are under monitoring services. The total number of registered sources about 500. Number of sources used in the industrial applications of about 40% of the inventory. SAEC has difficulties in controlling the industrial radiography in the country. These difficulties can be summarized as follows:

a. Difficulties in pertaining information provided by the Companies, which include:

- not all sources used by companies are licensed and registered;
- not all workers are under personal monitoring services;
- no notification system available by the companies to the regulatory authority in case of accidents;
- no enough information available by the companies to SAEC regarding the radiation work done by them (transparency).

b. Poor communications with the companies.

c. Resources constrains: No enough resources for inspection missions (means of transportation).

1. Introduction

Quality control in industry is a vital component for marketing and competition between companies and factories.

One of the techniques used for quality control (Q.C) is the non-destructive testing (NDT) or some times it called industrial radiography, using radiation sources. The technique can be used for the Q.C of refineries, pipelines, aviation, power generation stations, transportation sector and oil industry.

In most of developing countries the Q.C business using NDT technique were carried out by foreign companies.

Protection of workers, in the field of industrial radiography, is the responsibility of the companies and should be verified through strong regulatory control implemented by the regulatory authority. The radiation doses received by workers in this field are categorized as high doses compared to other radiation techniques.

In most developing countries, the control of industrial radiography is not adequate to ensure the safety of workers, public and the environment.

For effective regulatory control to the NDT companies, licensing should include:

a. license of practice;
b. license of workers;
c. license for sources importation, transportation and re-exportation;
d. approving the safety procedures of each company.

The high economic impact of the business related to industrial radiography made the enforcement of the radiation protection regulations on these companies fairly difficult. This results in:

a. No records for individual doses for the workers;
b. Not all practices, importation of sources and workers are licensed;
c. No accidents records;
d. Difficulties in carrying on site inspections.

Sudan is one of the developing countries who started recently to have extensive industrial radiography business. The expansion on the industrial field started in 1997 due to the introduction of oil industry. All companies dealing with industrial radiography in the country are foreign companies.

The number of sources imported in the last 4 years estimated to be twice as high as the previous years.

Number of radiation workers in the field of industrial radiography is not fully known. Not all workers are under personnel monitoring even the existing data is not on a regular basis.

Beside the difficulties mentioned above in controlling industrial radiography, other factors that may affect the control are, financial constrains and lack of sufficient trained personnel.

The control of industrial radiography needs strong government commitment and full legal power to the Regulatory Authority to enforce foreign companies to comply with the national radiation protection requirements.

2. Existing situation

In the last 4 years heavy work started in the field of oil industry in Sudan. This results in a great expansion in using of industrial radiography.

New pipeline was commissioned in year 2001. It is the longest pipeline in Africa reaching a length of 1610 Km. Another old pipeline was commissioned in 1976 of length 815 Km is still in operation. The number of refineries increased to 5 as compared to two in year 1997. More than 11 foreign companies are involved in oil industry.

According to the national registry of radioactive sources, number of industrial sources registered in the last 3 years amounts to about 70 % of all sources in-use in the country. Table (1) shows the number of sources, in-use, registered in different application in the last 3 years.

Table I. Number of sources registered in years from 1998 to 2002

Field	Number of sources
Industry	129
Medical	26
Research	25

The estimated number of workers in the industrial field is about 100. Only 8 companies provided SAEC with their workers qualifications and personnel dose records.

According to the record until the year 2002, the average dose received by the workers was 5 mSv. Also the highest dose received by a worker was 7.2 mSv. Table (2) shows the number of workers in different application, the average dose and the highest doses received by the workers.

3. National Regulatory Infrastructure

In 1971 an Act ‘Regulation of use of Ionizing Radiation’ was issued, establishing a committee and empowering it the right to license and inspect diagnostic X-ray facilities.

The Atomic Energy Committee was established in 1973, the committee was given powers to oversee safety in all activities involving use of ionizing radiation.

Both Acts did not enable establishment of a radiation protection regulatory framework or a technical authority.

The Sudan Atomic Energy Commission (SAEC) Act was issued in January 1996. Under this Act, the Council of Ministers appoint a national policymaking BOARD.

The SAEC BOARD, beside its promotional function, has the mandate to establish the National Regulatory Authority (Radiation Protection Technical Committee ‘RPTC’). RPTC is a national committee responsible for:

— Preparation of drafts of Radiation Protection Regulations and field specific Technical Guidelines to be issued by the Board.
— Setting radiation protection and environmental monitoring policies and priorities and securing funds to enable implementation and promotion of these activities.
— Supervision of implementation of Regulations and Safety Guides by the designated radiation protection institution.
— Issuance of licenses for practices, importation of sources, transportation and storage.

RPTC designated the Department of Radiation Protection and Environmental Monitoring (DRPEM) to act as its technical arm and carry out inspections and regulation and safety guides enforcement and provide quality control and calibration services.

Table II. Radiation Work Force (Registered and monitored) until 2001

	Field		No. of Institutes	No. of workers	Average dose mSv	Highest dose mSv
1	Diagnostic radiology	Government	12	196	0.23	0.55
		Private	7			
2	Radiotherapy		2	59	0.41	3.8
3	Nuclear medicine		4	59	0.2	0.67
4	NDT		4	48	5	7.15
5	Research		2	30	0.33	0.4
	Total		31	392		

4. Procedures for licensing of Industrial Radiography in Sudan

4.1. Licensing of the practice

— Most of the user companies started their work before the establishment of the regulatory system. For the new companies application form for Authorization for Industrial Radiography should be filled. The following information should be provided:
  a. Name of the company, address and the radiation protection officer.
  b. Work locations
  c. Facilities and equipment
  d. Radiation protection and safety procedures.
  e. Workers qualifications

4.2. Importation license for each source:

— Following information should be provided:
  a. Sources details (half-life, serial number, activity and date, etc.)
  b. Shipment details
  c. Radioactive waste route
  d. Storage location (also to be licensed)
  e. Undertaking in case of return to supplier

Due to many difficulties, no proper evaluations in-place for the above information by the DRPEM.

5. Control of Industrial Radiography

From our experience adequate control to the industrial radiography could be achieved, only, through regular inspection missions and follow-up with the companies in the fields.

Constrains facing the control of industrial radiography could be summarized as follows:

a. **Foreign Companies**: Control of foreign companies in most cases is a difficult task. This is due to the fact that the concerned authorities in the country were not involved in the stage of setting the contracts with these companies (Regulatory Authority, Environmental Protection Authority, etc.).

b. **Licensing of imported sources**: Difficulties in licensing all imported sources due to custom officer's faults. Another factor is lack of experience in developing and improving licensing forms and applications to be made more restrictive and informative.

c. **Availability of workers records:** Not all companies provide personal monitoring services to the workers. Some of them have their own services. No records available to the SAEC. Quality of TLD results was not checked.

d. **Emergency plans**: No information available about the emergency plans of the companies in case of radiation accidents. The system of notification to the SAEC in case of accidents is not adequate.

e. **Communications**: Difficulties in communicating with these companies.

f. **Low economic resources** for the regulatory authority to carry out inspections for verification: Means of transportation – proper cars – are not available to travel to the fields.

g. Lack of enough trained personnel.

6. Efforts Made by SAEC to Control the Industrial Radiography in the Country

1st Regulations:

To control all radiation work in the country, including industrial radiography, the SAEC BOARD issued the following regulations:

a. "General Procedures for Radiation Protection, 1996";
b. "Basic Requirements for Radiation Protection and Dose Limits, 1996";
c. "Regulation on Licensing Procedures for Radiation Work, 1996";
d. "Safe Transport of Radioactive Materials, 1998";
e. "Control and Management of Radioactive Materials, 1998".

Two safety guides were issued:

a. "Protection in Nuclear Medicine Departments, 1998";
b. "Protection in Industrial Radiography, 1998".

The last guide was issued in time with the expansion of industrial radiography in the country. This guide covers the following:

a. Medical records of the workers;
b. Requirements and regular check of equipment and their specifications;
c. Requirements of facilities in closed and open areas;
d. Regular investigations of sources containers, storage and repair of its equipment;
e. Training, radiation measurements, transportation and dose limits;
f. Emergency requirements and records of accidents.

To control the import and export of radiation sources, five workshops were organized to the Custom Officers in Khartoum Airport and Port Sudan (Sudan Harbor). Officers were trained in the use of radiation monitors for the detection of unauthorized\unlicensed sources entering the country.

Movements of export\import of radiation sources are reasonably controlled. SRS software is being used for sources registration.

a. For the expansion of personnel dosimetery, the DRPEM is using now Harshow 6600 for personnel monitoring, bout 1000 TLDs are available. For calibration and quality control of TLD and survey meters the SAEC has established SSDL for protection level through IAEA assistance.

b. Training of Staff: The DRPEM recruited 7 technologists. National Training Course of two months on "Basic Radiation Protection" was organized for the staff. The total number of staff is 15. This staff is responsible of all technical aspects regarding the radiation protection in all applications in the country.

c. Establishing of national capabilities for NDT: To limit the role of foreign companies in the field of industrial radiography the SAEC is implementing now an IAEA technical co-operation national project. The objective of the project is to establish the national capability to perform non-destructive testing (NDT) for quality in industry, metallurgy and civil engineering construction with the aim of improving safety standardized NDT practices and harmonized certification schemes. The project period is 2001 to 2004.

d. Participation in the IAEA Radiation Protection Projects: To improve the skills of the radiation protection staff and to acquaint the proper measuring equipment for inspection and evaluation of radiation safety requirements of each practice in the country. SAEC is participating in the following Projects:

— National Regulatory Control and Occupational Radiation Protection Programs, RAF/9/027.
— Development of Technical Capabilities for Sustainable Radiation Waste Safety, RAF/9/029.
— Post-graduate Training in Radiation and Waste Safety, RAF/9/028.

Through these projects SAEC built reasonable technical capabilities to carry on radiation safety programs in the country.

Public involvement: Number of seminar was organized by SAEC to sensitize the higher authorities in implementing the national radiation protection regulations and guidelines needed in the oil industry sector. Two seminars were organized in collaboration with:

a. Sudanese Environmental Protection Association.
b. Institute of Environmental Studies.

7. Conclusion

Industrial radiography in most of the developing countries is not appropriately controlled.

Industrial radiography sector started to be a major user of radiation sources in Sudan. Despite the efforts done by SAEC to control the industrial radiography, still the control is not proper.

Government commitment is an important factor for proper control of industrial radiography in the country.

Strengthening of regulatory authorities, trained manpower, adequate equipment, strong legislation, effective methods for enforcement and strong government commitment are of important factors to have established system of controlling the industrial radiography in the country.

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Solution of Radiation Safety Problems in the Republic of Uzbekistan *Main approaches*

D. A. Zaredinov[a], H. R. Yunusov [b], G. V. Kazimova [a]

[a]Radiation Department
Ministry of Health, Uzbekistan

[b]Agency on Safety in Industry and Mining
Head of Atomic Inspect, Uzbekistan

Abstract. The article presents the main approaches on which the radiation safety service structures work in the Republic of Uzbekistan. There are three approaches. They have been worked out with the consideration of the real radiation situation and are oriented at the solution of the practical issues in the nuclear and radiation safety spheres. Besides, we are giving norm values – basic dose limits for professional groups and for population.

1. Introduction

The problems of radiation safety of the population of the Republic of Uzbekistan and protection of the environment from pollution with radioactive substances are key issues for development and basis on use of an atomic energy.

Wide application of ionizing irradiation in various branches of the national economy and rapid development of atomic power engineering have considerably increased probability of contact of the man with radioactive substances and their radiation. And therefore, one of the basic conditions for successful use of the new kind of energy is to maintain radiation safety.

To predict somatic and to minimize somatic and stochastic genetic consequences, it is necessary to limit external and internal irradiation dozes of the personnel, separate persons from the population at application, storage and transportation of radioactive substances and sources of ionizing irradiation.

2. National Infrastructures for Radiation Protection

By the present time there have been developed an accurate system of legislative acts that regulate the main positions of the legal regime for providing radiation safety for professionals and population. The basic legislative acts are the following laws of the Republic of Uzbekistan - “On State sanitary control”, «On Radiation safety” и “Radiation safety – regulations and norms”. The realization of the above-mentioned regulations provide a uniform approach to the application and observance of the main principles of radiation safety provision on the territory of the Republic of Uzbekistan, irrespective of the departmental belonging of irradiation source application or the character of the executed industrial operations.

There are more than 200 objects utilizing radioactive substances and ionizing irradiation sources (in industry, agriculture, medicine, research institutes, etc.) in Uzbekistan, with personnel more than 7000 people.
According to Article 8 of the “Radiation Safety Law” there are 4 Controlling Departments.

— “Sanoatkonnazorat” Agency, Republic of Uzbekistan.

- Ministry for Public Health, Republic of Uzbekistan.
- State Nature Committee.
- Customs Committee of the Republic of Uzbekistan.

Main nuclear control and radiation safety bodies are “Sanoatkonnazorat” Agency and the Ministry for Public Health of the Republic of Uzbekistan. It is necessary to mention that only in the Ministry of Health they have specialized laboratories on radiation safety, that control and assess the content of radioactive substances in environment (water, air) and food products. The personnel in the specialized laboratories measure professional loads received during contact with ionizing irradiation sources in industry, medicine, agriculture, research institutes. Head of the Radiation department is Chief Radiologist of the Ministry of Health of Uzbekistan.

3. Legislation and regulation

For today the experts of all structures in the field of radiation safety of the Republic of Uzbekistan conduct works on the following approaches:

Working out legislative documents. All countries using atomic energy, have national (regional) norms and rules of radiation safety which take into account social, economic and natural conditions of the region and are based on the IAEA recommendations [1], International Commission on Radiology Protection (ICRP) [2], United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) [3]. At the present time we have worked out and passed the following Laws of the Republic of Uzbekistan – «On state sanitary supervision» [4], «On radiation safety» [5] and 10 branch norms and rules on nuclear and radiation safety.

Radiation safety norms and rules are based on [6]:

- use of “Effective doze" concept;
- control levels system as an instrument to fix the reached radiation safety level of the object;
- quantitative regulation of the population (category B);
- use of "century dependent" models and parameters at the creation permissible load levels system (industrial norms for population);
- conducting three groups of the radiation hygienic rules.

Taking into account the above said, there have been accepted the following basic dose limits in the Republic:

- for category And - 20 мSv/year;
- for category - 2 мSv/year;
- for category In - 1 мSv/year.

4. Occupational Exposure Control

Estimation of the natural ionizing irradiation sources on the territory of the Republic of Uzbekistan. Natural radionuclides, which are present in the environment objects, are the main irradiation sources fo the population of the Republic. The components of the technological amplified radiation background are subject to strict control as well as irradiation of the people by artificial radionuclides. Natural radionuclides can irradiate people at the industryl, and in municipal spheres.

Very dangerous in the **industrial sphere** are Radon, Thoron and its decay products, which are present in the air of the underground and land structures (mines, processing factories, inhabited buildings etc. – where gas concentration reaches 500 and more Bq/m^3 at insufficient ventilation).

During processing of mineral raw material either raw material can contain significant volume of natural radionuclide impurities, or radionuclides can concentrate in final and or intermediate products, and also in manufacture wastes. Besides, natural radionuclides can sorb on the surface of the technological equipment. As a result there appears dust-radiation factor (equivalent dose for lungs reaches 3 мSv/year) and external irradiation of the working personnel (exposition doze reaches 20 мкKl./кg.year). These manufactures are the suppliers of radioactive substances for the national economy (including manufacture wastes), with increased concentration of natural radionuclides (which effective specific activity makes more than 1500 Bq/кg).

In **municipal sphere** the dose of external irradiation of the people gamma-radiation is basically determined by measuring the concentration of natural radionuclides in building materials used for construction of buildings, roads and other structures. Concentration of Radon, Thoron and its daughter products in the air of premises is determined either by emanating walls and ceilings of the premises, or by penetration into premises from the ground under the building (in exploitable buildings the equivalent volumetric activity of Radon in the air of premises makes from 10 up to 350 Bq/m^3). Use of phosphoric fertilizers with high concentration of natural radionuclides can result in the increase of radioactive substances concentration in arable land (up to 400 Bq/kg) and as a consequence, increase of radioactive substances concentration in agricultural plants and food of people. Increase of receipt of radioactive substances in human body can also be caused by the use of underground water sources for drinking water-supply (up to 75 Bq/kg).

Natural radionuclides, contained in the waste emissions of thermoelectric power stations and boiler-houses working on coal (specific activity up to 875 Bq/kg) can significantly irradiate people.

Control of artificial sources in the environment objects. All various artificial sources of ionizing irradiation can be divided into 2 main groups: those, which pollute the environment with radionuclides and non-pollutants.

To the first group we can refer atomic power engineering and fuel cycle enterprises, nuclear weapon test and industrial nuclear explosions. To the second group – we can refer ionizing irradiation sources, which are used for medical purposes, and also appropriate consumer goods.

5. Conclusion

Thus, by now there are still many unsolved tasks that require deeper study. Moreover, a wider use of atomic power engineering in the national economy, and in particular, the development of the national atomic power engineering, raises new issues, connected with the need to provide radiation safety for the personnel and population. All this creates necessary prerequisites for the further development and perfection of this field of science.

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Radiation Safety in Estonia

M. Lust

Estonian Radiation Protection Centre
Tallinn, Estonia

Abstract. Estonia has built up the Radiation Safety infrastructure since the collapse of Soviet Union in 1991. This is the overview of the present situation and the planned changes for the near future. During these year Estonia has benefitted from several projects under the Technical Co-operation of IAEA, the main achievements have presented in this paper.

1. Introduction

Estonia is a small country, which after the collapse of the Soviet Union, Estonia re-proclaimed its independence in 1991. Since January 1992 Estonia is the member of the IAEA.

Estonia presently does not operate NPP's and constructing of NPP's is not planned in the near future. Furthermore there are not research reactors or any facilities for nuclear fuel or other radioactive material production. So the main source of radioactivity are different sources used in the medicine and industry. Also there are radioactive contaminated facilities and considerable amounts of radioactive waste at few sites in Estonia resulted from the former USSR military and non-military nuclear activities up to 1991.

Realizing that only limited knowledge and expertise of radiation protection that existed in the country in the beginning of 1990-ties, Estonia seek for international assistance and support to build up the national radiation protection infrastructure. After consultations between interested parties and international oranizations we got the support from IAEA, Nordic countries, etc. This support is now the basis for ongoing work and planning future changes.

2. Radiation Safety Infrastructure

The responsibilities of the Ministry of the Environment [1] include the management of national environmental and nature protection including organizations of the radiation protection, the environmental supervision and the preparation of corresponding draft legislation. Under the Ministry of the Environment the tasks are divided between Estonian Radiation Protection Centre and Environmental Inspectorate. Other institutions involved are:

— The Ministry of Economic Affairs, who is responsible for the management of the radioactive waste through AS ALARA.

— The Ministry of Social Affairs is responsible for nuclear applications in medicine also responsible for the supervision of the health of radiation workers and persons subject to medical exposure;

— The Ministry of Internal Affairs is responsible for emergency preparedness and rescue.

The Ministry of Finance through Customs Board is involved in combating illicit trafficking of nuclear and radioactive materials.

3. Estonian Radiation Protection Centre (ERPC)

By the current Estonian legislation Estonian Radiation Protection Centre is the Regulatory Authority. Pursuant to the Decree of the Government the Estonian Radiation Protection Centre (ERPC) was established on 1st January 1996 and the responsibilities include [2]:

- issuing of licenses;
- registry of radioactive sources;
- registry of doses for radiation workers;
- radiation monitoring;
- consulting role during radiation emergency situations;
- radiological measurements.

The number of employees in ERPC is 21 and the structure consists of 3 departments: Department of Radiation Monitoring, Department of Radiation Protection and Department of Information. The Director of the ERPC reports directly to the Minister of the Environment and the budget comes directly from the National Budget. is responsible for issuing the licences. Since 20001 the Environmental Inspectorate, which reports to the Minister of the Environment as well, is responsible for the control of the issued licences and enforcement.

According to new drafted Radiation Act, which is in the process of development the Ministry of the Environment will be the Regulatory Authority, which will also be responsible for issuing the licenses. By Estonian legislation State agencies shall provide services to government agencies or perform other state functions in cultural, educational, social or other areas. ERPC, as State agency, will provide services to Ministry of the Environment and also to the Environmental Inspectorate.

4. Legislation

As with many countries of Central and Eastern Europe, Estonia has undergone significant changes in its legislative framework since regaining its independence in 1991. Radiation Act [3] was enforced in 1997. Rapid development of the Estonian national legislation since regaining its independence in 1991 was caused by the necessity to establish its national legislation and later, in connection with the Estonian application to join the European Community, to harmonize its legislation with the EU requirements. The Radiation Act is a primary legislative act covering the protection of humans and the environment against the harmful effects of radiation and encompasses radioactive waste managment issues. It is supported by secondary, implementing regulations. The legislation is based on the accepted principles - justification of practices, optimization of the protection and safety, limitation of individual doses, adoption of justified and optimized interventions, authorization of radiation practices, primary responsibility of a licensee. After gaining the experiences from the implementation of the Act, the new Draft Radiation Act and a number of secondary legal acts are presently being prepared. ERPC has prepared some practice-specific guidance and several of them are under preparation.

5. Notification and Licensing Procedure

According to the existing legislation, there is a system of notification: all users have to present all the necessary information about sources to ERPC, which keeps the registry of the sources. It was started with the RAIS program provided by IAEA. However today Estonia uses for the registry its own program, which allows to use the data over the Internet as well. This registry is expected to include all radiation sources and facilities in the country and the inventory of sources is periodically updated.

The current legislation of the Republic of Estonia clearly require that all sources, unless exempted, be licenced. This requirement also applies to facilities and practices. There are guidances and criterias for granting licences worked out by ERPC. The licences were granted maximum for 5 years.

The inspections were carried out in close co-operation with the Environmental Inspectorate and if the enforcments were needed, it will be the responsibility of the Environmental Inspectorate, which has a lot of experiences in this field. The enforcement procedure also includes the report about the corrective actions that were taken. Based on the enforcement the ERPC has the right to stop the licence.

6. Emergency Preparedness

Estonia has worked a lot on the Estonian Crisis Plan and the main parts of it are ready. In the radiation emergency filed, the ERPC will be involved as radiological assessors. ERPC is responsible also for the management of the early warning system alarming about possible radiological threat to Estonia. Main source of warning information is the automatic monitoring network, which forwards the alarm message to the server in the ERPC if the dose level exceeds preset alarm values. This information will be sent further automatically to specialist of ERPC on duty and corresponding authorities. ERPC is working on the development of its own manuals for the emergency situations and where have been several 'table-top' exercises and there is real-life situation exercise in the preparation.

7. Monitoring of Radiation Workers

Personal dosimetry for external radiation is provided by the ERPC and University of Tartu. The number of radiation workers in Estonia is about 1200. The service is provided by using RADOS TLD system with one TLD reader. However it is planned for 2003 to buy a second TLD reader, so there would be a back-up facility and that the dosemeter wear periods were followed by the requirements of the law, rather than dictated by the availability of TLD reader and dosemeters. ERPC has worked out the manuals for the TLD users and quality manuals for the provided services. The service is in the process of the accreditation. Dose results were entered into the dose registry, which is kept in ERPC.

8. Co-operation with IAEA

The first TC project involvement was TC project "Radiation Protection and Waste Management Services upgrading", which was approved for the 1994/1995 cycle. IAEA technical assistance has been provided to Estonia through several national projects, as well as through Estonia’s participation in a number of regional and inter-regional projects. Extra-budgetary resources of donor countries were also used. Country programme Framework for Technical Co-operation was signed on 23rd of October 2001 [4].

The focus of the projects with IAEA have been: radiation protection, waste management, decommissioning and QA in medicine. Estonia has benefited also from participating in the Model Project on radiation protection (RER/9/065).

9. Conclusion

The main achievements have been:

- upgrading radiation protection and waste safety infrastructure, which included also very useful review and advice on legislative framework and the drafted regulations, in order to ensure compliance with the Basic Safety Standards;
- delivery of the equipment and training on radiation protection and QA;
- expert missions on specific issues such as radiological accident assessment, retrieval of spent and abandoned sources, decommissioning and building up a new radioactive waste managment system;

— upgrading dosimetry in radiotherapy was initiated;
— establishment of an INIS Center for Estonia.

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Authorization, Inspection and Enforcement in Kenya

J. A. W. Maina[a], **D. M. Maina**[b]

[a] Radiation Protection Board
Nairobi, Kenya

[b] Institute of Nuclear Science, University of Nairobi, Kenya

Abstract. Promulgation of radiation protection legislation in Kenya dates back to 1982, was revised in 1985 and became operational in 1986. This law, the Radiation Protection Act, establishes the Radiation Protection Board as the National Regulatory Authority, with an executive Inspectorate headed by the Secretary to the Board. Subsidiary legislation on radiological practices and standards were subsequently published. The Inspectorate carries out the National programme for notification, authorization, inspection and enforcement. Budgetary constraints, insufficient human and equipment resources has placed limitations to the effectiveness and efficiency of implementation of the National programme and slowed the attainment of milestones 3 through 5 for the model project for upgrading radiation protection infrastructures.

1. Legislation and Regulation

The Radiation Protection Act [1] became law in 1982, was revised in 1985 and it became fully operational in 1986. It establishes the Radiation Protection Board as the National Regulatory Authority, which reports to the government through the Ministry of Health. Thus a system of notification, authorization and control of radiation sources as well as an inventory is well established.

The current Act is limited in scope, regulatory independence and empowerment. A new draft of the revised Act was submitted to the IAEA for review and comments in May, 2001. The revision is aimed at meeting the principal requirements of the International Basic Safety Standards [2]. The revised draft is now with stakeholders for their input before being forwarded, through the Ministry, to parliament for enactment.

Under the Board, there is established an inspectorate arm mandated to carry out radiation safety surveys and quality assurance/control programmes to ensure the safety of radiation workers, patients, the public and the environment (including radioanalysis).

Radiation facilities meeting standards as set out in regualtions published under the law, are issued with appropriate licences by the Board. Such licences are reviewed annually.

Professionals who administer ionizing radiations to persons also require a special licence. All other radiation workers requilre registration only.

The Act not only provides for prosecution of offenders but also empowers the regulators to institute legal proceedings against radiation facilities or workers who contravene provisions of the law and regulations made thereunder.

Gazettement of Radioactive Waste Management regulations is awaited in which a waste processing facility, and a temporary storage site will be officially designated.

2. Comprehensive Program and Practical Implementation

The Radiation Protection Act and subsidiary legislation provide for the following process in setting up, inspection and operation of a radiation facility.

The process starts with notification to the Regulatory Authority (Radiation Protection Board) of an intention to acquire, possess and use an irradiating device and or radioactive materials giving specific details. The intended owner makes an application on the prescribed forms for the appropriate licence.

Evaluation, input and recommendations by the Regulatory Authority is followed by construction or modification of the intended radiation premises. Once completed and inspected, a Compliance Certificate for the premises is issued. The Regulatory Authority then grants authority to install the radiation emitting device. Installation engineers must be specially licensed by the Regulatory Authority. Quality Assurance performance tests and radiation safety surveys are conducted by the Inspectorate. A Certificate of Acceptance for the radiation emitting device is issued the survey and test results are satisfactory. The owner of the radiation facility is required to appoint a Radiation Safety Officer (R.S.O.) who is to ensure that:

1. all radiation workers at the facility are registered/licensed by the Board and are provided with at least one radiation monitoring device; on a monthly basis, and a medical check-up after every six months.

2. records are maintained at the department in accordance with the directions of the Regulatory Authority.

3. codes of practice are strictly adhered to.

Once this is done, the facility is issued with an operating licence which is reviewed annually against a comprehensive checklist. Graded approach is being implemented with priority being placed on potential risk to health and safety, the environment and security.

3. Enforcement Actions

The Regulatory Authority has the legal right to enforce requirements set in legislation and regulations and authorizations as well as imposing sanctions for non compliance. Enforcement actions include, but not limited to, formal and informal instructions, restriction or suspension of operation and legal process through trained prosecutors of the regulatory authority.

Enforcement actions are graded depending on threat to health and safety or the environment. Regulatory infraction is usually regarded as of no immediate threat to health and safety while infraction on a safety condition is regarded as a potential threat to health and security.

4. Licensing of Cross Boarder Situations

Cases abound for organizations to transport radioactive materials across the boarder for road construction, industrial radiography, industrial control gauges in the event of an organization shifting its operational base or, on occasion, trans-boundary shipment.

Licensing in case of such movement is done in close collaboration with the licensing counterpart in the country into which the radioactive material or irradiating device is being exported to. The importer is required to obtain an import licence from Regulatory/licensing authority of the country in which the material/device is to be imported.

However, there are those organizations that just package their sources and ferry them across boarders without notification to the regulatory authority. Also trafficking of radioactive materials is a problem of growing magnitude for control of trans-boundary movement of radiation sources.

Draft regulations on the Safe Transport of Radioactive Materials has been made and is now awaiting deliberations at the Board's decision-making level. Transfer of disposal of radioactive material has been comprehensively covered in the draft regulations on Radioactive Waste Management now awaiting gazettment.

Mining, processing and export of radioactive ores is an area currently not covered by the Radiation Protection Act or regulations made under this act. Overlap of government agencies in this area is evident with the Mines and Geology Department, in the Ministry of Environment and Natural Resources taking the lead in licensing of trans-boundary movement of mineral ores. Inadequate subsidiary legislation (regulatory guides, inspection procedures) also hampers proper monitoring of trans-boundary licensing.

5. Correct balance between Enforcement and Cooperation

Due to budgetary and human resource constraints, the Regulatory Authority has not been very successful in its enforcement campaigns. The Radiation Protection Inspectorate, has taken radiation facilities and individual radiation workers to court for legal redress for contravening provisions of the Act. About ten (10) of these cases have been successfully prosecuted.

However, the Inspectorate is moving from 'command and control' (prescriptive) techniques of regulation and changing its regulatory approach from a policing to an advisory and a consensus building approach.

Consultative meetings and seminars are also being held regularly with representatives of various stakeholder organizations on the best way forward. The main target groups are suppliers and users of ionizing radiation emitting devices and other radiation sources, Radiation Safety Officers and other persons responsible for implementing radiation safety measures in radiation facilities.

The Regulatory Authority is also working in close collaboration with other governmental lead agencies particularly where there is overlap of duties, functions and responsibilities. As an example, the Environmental Management and Coordination Act,1999 [3] – relegates the Regulatory Authority to a lead agency as far as pollution of the environment with radioactive materials is concerned.

6. Source Iinventory

Kenya has a source inventory with over 95% of sources accounted for in both public and private practices. There are about one thousand five hundred (1500) medical diagnostic x-ray units (including CT Scanners), three (3) Co-teletherapy units, one (1) major nuclear medicine center and two (2) minor ones.

There are about ten (10) industrial radiography equipment, six (6) industrial x-ray units, fourty (40) nuclear gauges. These are scattered countrywide and most are involved in frequent transportation from site to site and sometimes in trans-boundary shipment.

Open sources and sealed sources are used in about eight (8) international research institutions, six (6) public university colleges, schools and colleges. However, activities of materials used are in the order of µCi to mCi.

Hindrances in establishing and up-to-date source inventory include non-notification, unauthorized acquisition and illicit trafficking of radioactive materials. To this end, the Regulatory Authority is putting in place, training programmes for key players vis a vis: Customs and exercise personnel, clearing agents, police and couriers.

7. Conclusion

Regulatory approach has shifted from prescriptive to an integrated method with managers and decision makers of radiation facilities being encouraged to play active roles in matters related to radiation and waste safety. This is geared towards self-regulation on the part of the regulated.

Collaborative efforts between various government agencies and key players in the field of radiation protection are on-going to come up with legislation responsive to current trends in the application of atomic and nuclear technology for peaceful purposes.

Such legislation will incorporate regulatory aspects of cross-border activities, illicit trafficking, safety and physical security of radioactive materials, and address the issue of capacity building and a sustainable radiation safety infrastructure for the current and future needs of the country.

The Regulatory Authority continues to facilitate consensus building through various fora for information dissemination. In such fora, professional bodies and corporate organizations are sensitized and made aware of their role in promoting and enhancing a radiation 'safety culture' and enforcing professional ethics with regard to radiation safety.

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Radioactive Sources Inventory in Tunisia

N. Chahed, K. B. Jemaa, M. B. R'houma, L. Lamouchi, et al.

Centre National de Radio Protection
Tunis, Tunisia

Abstract. We present the radioactive sources inventory established at the end of the year 2002. The medical installations using radionuclides are limited: 30 installations between radiotherapy and nuclear medicine. In the non medical field, the industrial sector is the most important user of radioactive sources; it represents 85% of the non medical field against 11% for the research sector and 4% for agricultural sector. The industrial sector uses radioactive sources especially in radiography application (30%), in phosphates industries (29%) and in oil prospecting (23%). During the last years the devices number using radioactive sources increased. For reduce the radiological risk inherent to this development, it needs to have a legal framework, a regulatory infrastructure and a financial and manpower resources which advance consequently.

1. Introduction

Tunisia has neither power reactor nor research reactor. Radiation sources are used for a wide variety peaceful purposes in medicine, industry , agriculture, research and education. All radiation sources are imported.

We present the radioactive sources registry established and up dated at the end of the year 2002.

Since 1981, a legal framework and a regulatory authority ,"Centre National de Radio Protection" (CNRP) established allows for the beneficial uses of ionizing radiation and regulates the introduction and conduct of any practices involving sources of radiation. [1] [2]

In 1986, the CNRP decides to set up a national inventory of radiation sources. The made investigations and the system of notification and authorization for regulatory control over sources established by CNRP served as a substantial part of the database for the inventory. The radioactive sources are classified by application sector in medical and none medical field.

2. Medical Field

There are four practices involving radioactive sources:

- Teletherapy and low dose rate (LDR) brachytherapy, using sealed sources of Co 60, Ir 192 and Cs 137;
- Nuclear medicine and radio immuno assay (RIA), using unsealed sources of Tc 99, I 125, I 131 and Tl 204.

Table I summarizes the whole medical installations and the table II presents the evolution of unsealead sources annual consumption

Table I. Radioactive sources in medical field.

Application	1988	1994 [3]	2002	Regions
Teletherapy units	2	6	7	4 Tunis 3 Middle East
LDR Brachytherapy	2	3	2	1 Tunis 3 Middle East
Nuclear medicine	2	4	6	4 Tunis 2 Middle East
RIA	2	13	15	13 Tunis 2 Middle East

Table II. Evolution of unsealed sources annual consumption expressed in gigabequerel (GBq)

Application	1989 (GBq)	1994 [3] (GBq)	2002 (GBq)
Tc 99	577,200	2 208,900	4 428,9
I 125	29,545	67,810	104,810
I 131	769,6	1 326,820	2732,820

3. Non Medical Field

There are three sectors using radioactive sources : industrial, agricultural and research or education

3.1. Industrial sector

The Tunisian industry development accompanied by using more and more radiation sources. In this field we distinguished:

— Portable industrial radiography sources using radionuclides of: Ir 192 with activities between 1,85 to 4,44 TBq and Co 60 with an activity about 0,3 GBq and in some cases Cs 137.

— Density gauges containing Cs 137 sources which activities varying from 0,3 to 74 GBq.

— Moisture gauges and well logging devices using neutronic sources of Am 241/Be with activities between 1,48 to 700GBq. Often the devices contain both radionuclides ; Am 241/Be and Cs 137. 50% of them are used for oil and natural gas exploration.

— Level gauges using Co 60 with activities between 0,3 to 1GBq.

— Thickness gauges with Kr 85, radioactive material and activities between 0,74 to 14,8 GBq. These devices are generally found in paper industry.

— Calibration sources with very low activity : Th 232 (185MBq), Co 60 (3,75MBq) and Sc 46 (555Mq).

3.2. Agricultural sector

Neutronic or gamma/neutronic probes containing Am241/Be and Cs137 with activities from 3,7MBq to 37GBq are used by agricultural institutions.

3.3. Research and education sector

This sector uses:

- Unsealed sources of C 14, H 3, I 125, S 35, P 32, Fe 59, Cr 51 and K r85 as marquors in biological laboratories.
- Sealed sources of Pr 147, Cs 137, Ca 45, Sr 90 with low level activity in physics laboratories
- Irradiators with Co 60 and Cs137 for microorganism sterilization

3.4. Other applications

Fume detectors containing Am 241 come into general use.

The tables III and IV present the non medical applications.

Table III. Radioactive sealed sources in non medical field.

Application	1998	1994 [3]	2002
Industrial radiography	35	108	413
Gauges (level, thikness, moisture,density) and well logging	225	424	511
Fume detectors	-	14 405	24 820

Table IV. Radioactive sealed sources in non medical field classified by region

Region	Inhabitants*	Sealed sources
Tunis	1 828 842	477
North-East	1 204 740	46
Middle-East	1 867 041	178
South-East	833 601	31
North-West	1 225 898	52
Middle –West	1 296 760	11
South-West	528 482	129

* 1994 Population Census[4]

4. Discussion

Statistic data analysis shows the following observations:

- During the past twenty years, the devices number using radioactive sources increased : it is a result of social-economic development, standard of living elevation, needs in term of health and introduction of new technology in diagnostic and therapy.

Moreover, the liberalization policy conducts of many participants in different fields.

- The use of radioactive sources in diagnostic and therapy is progressing but slowly.

There are few nuclear medicine services and few teletherapy and brachytherapy units. We found these expensive equipment only in three cities. The equipment distribution shows a great concentration in Tunis and Middle East regions where found the cities. The radiotherapy and nuclear medicine localized only in Tunis and East center.

— The industrial sector is the most important user of radioactive sources. It represents 85% of non medical field against 11% for the research sector and 4% for agricultural sector. The industrial sector uses radioactive sources especially in radiography application (30%), in phosphate industries (29%) and oil prospection (23%)

— The increase of these equipment accompanied by the increase of occupational exposure. The monitored workers were 1 787 in 1989 and became 2 900 in 2002.

— For appreciate our equipment degree, we must compare our present status to another African countries close social-economic and demographic situations. But we did not find accurate data in bibliography.

5. Conclusion

This study shows that radioactive sources are used throughout the country for a wide variety of application as in medicine, industry, agricultural, research and education.
The use of radioactive sources confronts us with problems like their storage, transport and waste management.

The risks posed by the use of these sources required:

— Appropriate regulation imposing severity maximum

— Regulatory authority with functions and responsibilities separated from those of institutions involved with the development and promotion of practices

— Manpower resources and adequate funds to realize all these objectives

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Regulatory Program for Radiation Safety in Cuba
Achievements and future challenges

A. Guillén, L. A. Betancourt

National Center for Nuclear Safety
Havana, Cuba

Abstract. From the beginning of the Cuban nuclear program there was established the basis for a gradual building of a national infrastructure to cover all the new responsibilities acquired in the area of nuclear and radiation safety. One of the essential parts of this national infrastructure was the creation of the Cuban Regulatory Authority in charge with the regulation and control of the use of nuclear energy in the country. Other important issues were developed successively, for example: 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. For more than 20 years the country has been making efforts for strengthening the national infrastructure for the use of nuclear energy achieving significant advances. As a result of the application of performance evaluations to determine the effectiveness of this program this paper summarizes some of the achievements and some of the main challenges that the Cuban regulatory authority has to face in the near future.

1. Introduction

The Cuban nuclear and radiation safety system was formally founded in 1982 when the Decree-Law No. 56 “On the regulation for peaceful uses of nuclear energy” entered into force. The Atomic Energy Commission of Cuba and the Executive Secretariat for Nuclear Affairs had been previously established as bodies in charge of proposing the Government the nuclear development plans and the necessary legal instruments for the regulation and control of the use of nuclear energy.

For the regulation and control of nuclear activities in Cuba was created, in 1985, the Center for Radiation Protection and Hygiene. This center was also in charge with carrying out technical services in the area of radiation safety. As a consequence of the development of the regulatory activities and the need for having and independent body for the regulation and control of the use of nuclear energy in the country, in 1991 there was created the National Center for Nuclear Safety, CNSN – initials in Spanish -.

2. System of the Regulatory Authority

The Ministry of Science, Technology and Environment, CITMA – initials in Spanish – is in charge of directing, executing and controlling the policy of the state and the government with regard to the use of nuclear energy, and performs the regulation and control of its safe use through CNSN. The Ministry of Public Health is in charge with the regulation and control of x-ray in medical radio-diagnosis, although these activities remain also under the supervision of CITMA.

The scope of the current regulation and control activities carried out by CNSN involves the areas of Radiation Safety, Radioactive Waste Management, and Transport of Radioactive Materials.

CNSN has the authority for:

- The issuance, amendment, suspension or revocation, of authorizations and corresponding conditions when required,
- Conducting the regulatory review and assessment,
- Inspection and enforcement,
- Establishing safety principles, criteria, regulation and guides.

CNSN is also the technical support for the Civil Defense in case of radiological emergencies.

For discharging its duties, CNSN is provided with technical personnel both in the head quarters and also located in other territories of the country.

3. Evaluation of the Cuban Regulatory Program

As a consequence of the transformations made in the domestic administrative structures, the national experience gained in 10 years of regulatory control in nuclear activities and, the need for reviewing the national regulations in force taking into account the international safety regulations, altogether; CNSN carried out in 1992 a self-assessment of the effectiveness of its regulatory program.

This self-assessment was mainly focused on the following areas: reorganization of the regulation and control activities, revision and improvement of the legal and regulatory framework in force with regard to nuclear and radiation safety, quality assurance in the regulatory authority, and qualification and training of the personnel with regulatory functions.

The development and implementation of all the recommendations derived from the self-assessment have been done gradually, with positive results. In addition CNSN, taking into account its main objective of ensuring protection of the workers, the public, and the environment; has taken some actions, together with the relevant national entities that provide services in the area of radiation safety and other users of ionizing radiation; that have contributed to the improvement of the national infrastructure for radiation safety.

Recently, in the last quarter of 2002, CNSN requested an external entity the conduction of an audit for evaluation of the effectiveness of the Cuban regulatory program.

The group of auditors was formed by experts in radiation protection independent from the regulatory authority, chosen by the auditing entity. IAEA-TECDOC-1217 *Assessment by peer review of the effectiveness of a regulatory programme for radiation safety* [1], was the reference document.

The results of the audit were positive. The development of the Cuban regulatory program was considered to be in an early stage of operational phase [2].

The advances achieved in improving the national infrastructure for radiation safety are given here below, together with a brief comment on the most significant outcomes. Here are also stated the future challenges for the Regulatory Authority, and other entities of the national infrastructure, to take actions against in order to achieve higher levels of improvement of the regulatory program for the use of nuclear energy in the country.

4. Outcomes in improving the Cuban regulatory program [3]

- The basic laws and rules, based on IAEA's recommendations are in force.

On February 2002 Decree-Law No. 207 "About the use of nuclear energy" came into force, thereby establishing the general precepts regulating the use of nuclear energy in the country. Conceived as the document of highest level within our Hierarchical Nuclear Regulatory System, this Decree-Law was the result of the appraisal of the national experience in the implementation of the existing regulations to that moment, of the international experience and good practices, and repealed almost the whole set of legal documents in force till then in the country in the field of nuclear energy. Some enforcement mechanisms for the regulatory authority to have are provided by this legal build.

The following Safety Rules were put into force; “For the Safe Transport of Radioactive Materials” in 2000, and “Radiation Basic Safety Standards” in 2001 and, in 2002 a Ministerial Resolution for the regulation with regard to radioactive contamination in imported or exported scrap metal to or from the country. During 2003 the following rules will be put into force; “For Safe Management of Radioactive Wastes”, “Selection, Qualification and Authorization of Personnel performing practices related to the use of ionizing radiation” and “Competence Acknowledgement of Services Provided in Radiation Safety”.

For different practices, Safety Guides have also been put into force, complementing the requirements established by the rules.

— The regulatory authority is defined and, is independent from entities responsible for promotion or development of practices subjected to control. The authority is provided with qualified personnel and main resources necessary to discharge its duties. There is a high level of personnel permanence at the Regulatory Authority.

— Decree-Law No. 207 “About the use of nuclear energy” establishes the obligation to notify any action involving radiation sources. CNSN has a database available with the updated inventory of the radiation sources, the authorizations granted, and the results of the inspections. Authorizations are required for all practices and activities involving radiation sources, depending on categories defined and on the precepts in the Rule “Authorization of Practices Involving the Use of Ionizing Radiation” put into force in 1998.

— An annual Inspection Plan is prepared an executed. The frequency of the inspections depends on the category of the practice. Check lists are available for conduction of the inspections.

— The authorization of practices and the inspections are conducted following procedures approved by the Regulatory Authority. That allowed gaining in process efficiency. Authorizations may be suspended, revoked, and the regulatory authority has the power to suspend operations, shut down rooms and facilities, as well as to seize radiation sources.

— In the country, the Civil Defense centers the actions in response to emergencies. With regard to radiation emergencies an Annex to the National Plan Against Catastrophe has been prepared together with that institution. An organization was structured and is available for radiation emergency planning and response. Drills are periodically performed both at facility level and at national scale. The Regulatory Authority conducts investigations and follow-up of events, but for these no procedure is available.

— Several technical services are available in the country such as: internal and external individual dosimetry, calibration and verification of radiation protection instruments, quality control of medical equipment, training courses for workers, centralized collection and interim storage of radioactive wastes, a network for environmental radiation monitoring, consulting in radiation protection and, control to detect radioactive contamination in food and scrap metal. These services are acknowledged by the Regulatory Authority.

— To fulfill its duty, CNSN has established work agreements with other regulatory authorities. With the Ministry of the Interior, responsible for physical security and fire protection, with the General Customs Office which controls the imports and exports at borders, with organizations that grant commercial authorizations for imports of equipment that may contain radiation sources, with the Ministry of Public Health, in charge with the regulation and control of x-ray medical diagnosis and, with the Civil Defense, concerning radiation emergencies. CNSN has also bilateral cooperation agreements with peer regulatory authorities abroad. Technical assistance projects with the IAEA have been carried out for strengthening the national infrastructure regarding radiation safety.

— CNSN approved its Safety Policy in 1998, it states the principles for the interaction with the users of ionizing radiation. This Safety Policy establishes the conduction of an Annual Regulatory Conference, as a maximum forum for exchange among the regulatory authority and the users. In this conference the safety issues of practices are discussed, lessons learned from radiation events are analyzed and newly approved safety requirements are presented. Three conferences have been held so far. CNSN promotes and organizes workshops, scientific seminars and events, and provides courses.

5. Challenges for the Cuban Regulatory Authority

— Complement the legal regulatory framework for the use of nuclear energy in the country with the approval of Safety Rules already drafted, with Safety Guides for practices and services, and with an enforcement policy empowering the regulatory authority to impose fines.

— Implement a Quality Assurance Program for the Regulatory Authority covering all regulatory areas and allowing systematic performance assessment.

— Improve the database for the regulatory control.

— Implement a licensing process of personnel involved with the use of ionizing radiation.

— Develop a strategy for information to the public.

— Improve the cooperation mechanisms with other regulatory authorities in the country, implementing appropriate procedures.

— Gradually acknowledge the competence of the technical services provided in the country in the area of radiation safety, in conformance with the relevant rules and guides yet to be approved.

6. Conclusions

For some years now, Cuba has been improving all the activities related with the regulation and control of the use of nuclear energy. Since 1992, when the *Improvement Program* for the regulatory system was started, CNSN has taken a lot of actions for strengthening the national regulatory infrastructure for the use of nuclear energy, having significant achievements. As a result of the internal and external evaluations conducted, the issues requiring improvement were identified. It is appropriate to remark the work aimed at implementing the new legal and regulatory framework in the country, at fostering safety culture in all the organizations and individuals that are somehow involved with the use of nuclear energy, and at strengthening the mechanisms for ensuring safe use of the sources of ionizing radiation.

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Radiation Safety Infrastructure in Malaysia

R. Dahalan, M. P. Mohd Sobari

Atomic Energy Licensing Board
Selangor, Malaysia

Abstract. The use of atomic energy in Malaysia is governed by the Atomic Energy Licensing Act 1984 (Act 304). The Regulatory Authority which is responsible for all aspect of radiation protection and safety in the country is Atomic Energy Licensing Board.

1. Introduction

Although activities using atomic energy have prevailed for quite sometimes, the development in the regulatory and control aspects in Malaysia were quite recent. The first legislation to control the activities using ionising radiation in Malaysia was produced in 1968 when the Parliament approved the Radioactive Substances Act 1968. Under this Act, the licensing authority was the Ministry of Health, there were only two regulations made under this Act, viz:

- Radiation Protection Rule 1974;
- Radiation Protection (Medical x-ray diagnosis) 1983.

However the rapid expansion of the atomic energy activities in Malaysia needs for more effective control over these activities. Realising the needs for an effective control on the use of atomic energy the Radioactive Substances Act 1968 was repealed and a new Bill called Atomic Energy Licensing Bill was drafted by the Government. The Bill then was approved by the Parliament in April 1984 and gazetted on June 28th 1984 as Act 304 that is the **Atomic Energy Licensing Act**. The enforcing authority of this Act is the **Atomic Energy Licensing Board**.

2. Establishment of Atomic Energy Licensing Board

2.1. Objective of the Board

Following Section 3 of the Act, the Atomic Energy Licensing Board (Board) was established on February, the 1st 1985 as the National Regulatory Authority to enforce the Atomic Energy Licensing Act. The Board consists of five members i.e. a Chairman and four others, all of whom are appointed by the Ministry of Science, Technology and the Environment. The Board's main objective is to regulate and control all activities dealing with atomic energy throughout the country in order to ensure that such activities are being handled safely and do not endanger the radiation workers, members of the public, properties and environment from radiation hazards. To achieve the objectives, the Board is responsible for the following:

- Authorising the activities related to radioactive materials, nuclear materials and radiation producing devices after appropriate review and evaluation of proposed activity.

- Conducting inspection (surveillance) and taking enforcement actions to ensure radiation safety requirements are being implemented.

— Establishing standards and regulations for radiation protection and safe operation pertaining to atomic energy.

2.2. Functions of the Board

The functions of the Board as stated in the Act 304 are as follows:

— to advise the Minister and the Government on matters relating to this Act.

— To control and supervise the production, application and use of the atomic energy.

— To establish, maintain and develop scientific and technical co-operation with other bodies in relation to nuclear matters.

— To perform or provide for the performance of the obligations arising from agreements, conventions or treaties relating to the nuclear matters.

— To do such other things arising out of or consequential to the functions of the Board under this Act.

To achieve the objectives and to run the functions, the Board has its Secretariat headed by the Director General of AELB which acts also as a Executives Secretary to the Board. The Secretariat consists of four divsions i.e. Codes and Standrds Division – responsible for development of laws and subsidiary legislations, Assessment and Licensing Division – responsible to carry out risk assessment and evaluate of license applications, Enforcement Division – responsible to carry out inspection and prosecution, and Administration Division.

3. Legal Framework Related to the Radiation Safety

3.1. Atomic Energy Licensing Act 1984

The Atomic Energy Licensing Act 1984 (Act 304) was gazetted on the 24th June 1984 and enforced on the 1st February 1985. This act provides for the regulations and control of atomic energy, for the establishment of standards on liability for nuclear damage and for matters connected therewith or related thereto. The main objective of the Act is to ensure safety of radiation workers, members of the public and the environment from radiation hazards as a result of activities related to atomic energy.

3.1.1. Licensing authority

The licensing authority under the Act 304 is the Board. However the Board grants the Director General of Health to issue license on behalf of the Board for a license to undertake any of the activities referred to in the classification of the licences under this Act where such activities are in respect of medical purposes.

3.1.2. Licensing of nuclear installation and of activities

Under the Act 304, no person is permitted to:

— site, construct or operate a nuclear intallation;

— deal in, possess or dispose of any radioactive material, nuclear material, prescribed substances and irradiating apparatus, unless he is the holder of a valid licence issued under this Act.

Dealing here is defined as any activity that involves manufacturing, trade in, produce, process, purchase, own, possess, use, transfer, handle, sell or store any radioactive materials, nuclear materials, prescribed substances or irradiating apparatus.

Act 304 gives power to the authority at any time under any of the following circumstances in its discretion cancel, or suspend for such period as it may think fit, any licence issued under this Act where:

— the licensee has committed an offence under this Act;
— the licensee has committed a breach of any of the conditions of the licence;
— the licensee ceases to work or operate the nuclear installation; or
— in the opinion of the authority it would be in the public interest so to do.

3.1.3. Disposal of radioactive waste

Under Act 304, no person is permitted to dispose of or cause to be disposed, accumulate or cause to be accumulated any radioactive material waste without the prior authorization in writing of the authority. Right now we don't have any policy regarding the disposal of radioactive waste. AELB is currently in the process to establish Radioactive Waste Management Policies. As a temporary measures all spent radioactive sources are return to the supplier or manucfacturer. Other radioactive wastes are kept or stored either at the waste center authorized by the Board or at the licensee premises.

3.2. Regulations and orders

The Minister may, for the purpose of carrying out the provision of this Act, make any regulations and orders. Since the Act came into force, the Government of Malaysia with the recommendation of the Board has gazetted several regulations and orders such as:

— Radiation Protection (Licensing) Regulations 1986
— Radiation Protection (Basic Safety Standards) Regulations 1988
— Radiation Protection (Transport) Regulations 1989
— Atomic Energy Licensing (Appeal) Regulations, 1990
— Atomic Energy Licensing (Exemption) (Smoke Detectors) Order 1989
— Atomic Energy Licensing (Exemption) (Lightning Arrester) Order 1990
— Atomic Energy Licensing (Exemption) (Leasing and Hire Purchase) Order 1990
— Atomic Energy Licensing (Small Amang Factory) (Exemption) Order 1994
— Exclusive Economic Zone (Application of Atomic Energy Licensing Act 1984) Order 1990.

The regulations are then supported by code of practices, standard and advisory materials. The hierarchy of these documents is shown below:

Atomic Energy Licensing Act

(Act 304)

↓

Regulations, Orders and Licence Conditions

↓

Codes of Practice

↓

Advisory Materials

3.2.1. Radiation Protection (Basic Safety Standards) Regulations 1988

Presently radiation protection and safety standards in Malaysia is governed by the Radiation Protection (Basic Safety Standards) Regulations 1988. This regulation was adopted from the IAEA Safety Series No. 9 i.e. Basic Safety Standards for Radiation Protection, 1982. The regulation is currently under review. The revision is mainly based on IAEA's document entittled 'International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources – 1996' (Safety Series No. 115).

3.2.2. Radiation Protection (Licensing) Regulations 1986

The regulation is also under review taking into consideration many aspects eg licence fees, classes of licence, ability to issue compunds, etc.

3.2.3. Radiation Protection (Transport) Regulations 1989

Transport of radioactive material is governed by the Radiation Protection (Transport) Regulations 1989. This regulation was adopted from the IAEA Safety Series No. 6 i.e. Regulations for the Safe Transport of Radioactive Material, 1985. The regulation is currently under review. The revision is mainly based on IAEA's document entittled 'Regulations for the Safe Transport of Radioactive Material –1996' (Safety Series No. ST-1)

4. Conclusion

As a national regulatory authority for the country, AELB is responsible to ensure that the use of atomic energy is safe without endanger the safety of the public, worker and the environment. To fulfill their responsiblility AELB countinuosly take a necessary effort to up-date the legislation and regulations in-line with the international standards as required by the International Atomic Energy Agency. Manpower and expertise to be upgraded and sufficient resources. The final goal of AELB will be towards a single and independent regulatory authority.

An Overview of National Radiation Safety Infrastructure of Pakistan with Particular Focus on Effectiveness and Sustainability

T. Hayat, S. A. Ahmad

Directorate of Safety
Pakistan Atomic Energy Commission
Islamabad, Pakistan

Abstract. With an increase in the use of nuclear energy, radiation and radioactive substances it is essential to invigorate, reinforce and enhance the effectiveness of elements of national radiation protection and safety infrastructure. This also includes the addition of feasible and affordable ways and means in the national safety infrastructure with subsequent strengthening in the future. We have presented an overview of the national radiation safety infrastructure of Pakistan with particular focus on the effectiveness and sustainability issues. In this regard following are briefly discussed: legislation and regulations, radiation and safety personnel training program, safety assessment, administrative requirements and establishment of nuclear emergency response coordinating center.

1. Introduction

The use of nuclear energy and applications of its by-products, i.e. radiation and radioactive substances, continue to increase in Pakistan [1]. In order to control risks associated with such usage, i.e. normal exposures and potential exposures, it is essential that activities involving exposures, such as the production and use of radiation sources and radioactive materials, and the operation of nuclear installations, including the management of radioactive waste, be subjected to established radiation safety measures in order to protect individuals exposed to radiation. The IAEA Safety Series presents principles of radiation protection and safety. The member states of IAEA, and particularly those receiving assistance, are expected to implement the “International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources” [2], which are commonly known as the BSS, or equivalent radiation protection and safety standards that may be applicable locally [3].

The BSS, in its preamble, delineates the essential parts of a national radiation safety infrastructure (NRSI), which are: legislation and regulations, sufficient resources and adequate number of trained personnel. It also states that a NRSI must provide for 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. Moreover, BSS also states that NRSI must also provide 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.

In Pakistan, the NRSI came into being with the promulgation of the Pakistan Atomic Energy Commission (PAEC) Ordinance 1965 [4]. Since then NRSI has gone through significant & substantial changes to meet the objectives of radiation safety of personnel and public more effectively. The efficacy of Pakistan’s NRSI can be assessed primarily by examining the effectiveness and sustainability of its elements. In the following, this is done by trying to explain the provisions available in Pakistan and subsequently address the issues relating to the effectiveness and sustainability of Pakistan’s NRSI.

2. Radiation Protection and Safety Infrastructure in Pakistan

The BSS are based on the presumption that a NRSI is in place, which enables the Government to discharge its responsibilities for radiation protection and safety. In addition to the elements stated in Section 1, the NRSI includes all persons, organizations, qualified experts, systems, documents, facilities and equipment that are in whole or in part dedicated to protection and safety. As stated earlier NRSI in Pakistan came into being with the promulgation of PAEC Ordinance 1965, which made PAEC responsible for the promotion of atomic energy including its regulatory aspects [4]. Particularly essential elements of NRSI of Pakistan are dealt with: 1) Powers to make rules and regulations were stated in Articles 19 & 20, respectively, 2) Articles 10 & 11 deal with issues relating to resources, i.e. funds, and 3) Article 14 deals with information exchange issues at international level (PAEC has created Directorate of International Affairs and Training (DIA&T) at its headquarters in Islamabad to take care of matters related to training abroad and allied fields, such as information exchange and coordination). Table 1 illustrates the NRSI of Pakistan. Resources in the form of manpower are indigenously developed by PAEC in the form of a pool of specialist expertise. It is good to mention the names of: 1) Center for Nuclear Studies (CNS), P.O. Nilore, Islamabad, Pakistan, a premier training center, now renamed the Pakistan Institute of Engineering & Applied Sciences (PIEAS) after having been accorded a degree award status, and 2) Health Physics Division (HPD) of the Pakistan Institute of Nuclear Science and Technology (PINSTECH), P.O. Nilore, Islamabad, Pakistan, a premier research, training & service center.

3. Effectiveness and Sustainability

As mentioned earlier in Section 1 the NRSI of Pakistan came into being in 1965. A NRSI will no longer fulfill the objectives for which it was created and lose its effectiveness if an efficient and functional system is not implemented for verification and compliance with the established requirements. Since 1965 the Government of Pakistan, through its organization PAEC, is striving to keep this NRSI in conformity with prevailing international practice. Collaboration with international organizations has assisted us greatly in this task. One example in this regard is an IAEA collaborated effort to enhance the NRSI of Pakistan [5]. Pakistan attaches very high hopes with the involvement of IAEA, an Inter-Governmental Organization, in building and maintaining its NRSI. In the following some of the important issues relating to NRSI of Pakistan are briefly highlighted.

3.1. Legislation and regulation

The preparation and adoption of legislation and the corresponding regulations regarding radiation protection are the basis for effective development of the national radiological safety program. To enhance the effectiveness of the NRSI of Pakistan (as per IAEA guidelines), the Directorate of Nuclear Safety & Radiation Protection (DNS&RP) of PAEC and the Pakistan Nuclear Regulatory Board (PNRB) have been transformed into an autonomous regulatory body, namely Pakistan Nuclear Regulatory Authority (PNRA) with the promulgation of PNRA Ordinance [6] in 2001. The functions of the regulatory authority have been established in Article 16-2. Similarly, Articles 19 to 23 handle licensing and authorization, while violations of these articles are punishable under Article 44. Powers to make rules and regulations are provided in Articles 55 & 56, respectively.

Moreover, PNRA has issued a set of 6 regulations to handle issues relating to safety of NPPs while another regulation is under preparation to cater to nuclear installations other than NPPs. In addition to this a series of regulatory guides are issued based on literature available from the IAEA, US Nuclear Regulatory Commission, etc. The effectiveness of these regulations can be gauged from this fact that extension in operating license for one NPP is pending with PNRA till the authority is fully satisfied. This is indicative of the fact that one of the essential elements of NRSI of Pakistan, i.e. legislation and regulations, is adequately resourced to progress rather than marginally functioning.

3.2. Radiation and safety personnel training program

In 1965, NRSI of Pakistan had only modest number of persons trained in the fields of radiation safety. However, to-date this number has swelled to 1600 trained officers (having post graduate education in nuclear engineering and allied fields such as health physics). In addition to this, about 3500 persons are trained at technician's level in the field of nuclear safety including radiation safety. The number is sufficient to take care of a radiation safety programme for, among others, two nuclear power reactors, two research reactors, three agriculture research centers and 12 medical centers that cater to over 300,000 patients annually. Pakistan's training programme is more thirty years old. It has been continually expanding in terms of resources, such as number of training centers and faculty. Moreover one training center is in advanced stages of planning, in PNRA, which can impart training in regulatory matters such as inspection and enforcement. In addition to this, temporary use of consultants (retired but having high professional qualifications and practical experience in particular subjects) is considered a cost effective way to enhance the technical level of the organisations.

3.3. Safety assessment

Safety assessments are also an integral part of an NRSI and in case of handling of sources these should be according to the Appendix IV of BSS. Operational safety analyses and assessments prior to the granting of the corresponding authorization (registration and licenses) enable not only the assessment of source safety and operations, but also the establishment of certain limits in accordance with the conditions created at the facility. PAEC has taken an initiative to update the inventory of sealed radiation sources using information technology. Till recently detailed safety assessments were carried out primarily at the NPPs. However, with an increase in number of experts, now it is planned to carry out more detailed safety assessments of nuclear installations other than NPPs also.

The number of experts available will hopefully rise with the passage of time since the training centers are producing between 50-100 persons per year at post-graduate level and a similar number at technician level. Additional courses are offered at both levels to meet the immediate demands also.

3.4. Administrative requirements

The BSS contains a number of requirements, which are known as: administrative requirements, radiation protection requirements, management requirements, technical requirements, and verification of safety requirements. In the following we present two quotes from reference [7]:

"In the light of what we have learned in recent years, it would now seem that the administrative requirements — which were previously thought to be of secondary importance, simply because they appeared to be so obvious — have become very important."

"… I feel that we were very naive in placing so much emphasis on the technical and management requirements when the basis — the administrative requirements — had not been established."

In Pakistan we have acknowledged this and to increase the effectiveness of NRSI of Pakistan, a directive has been issued which directs all administrative persons of PAEC and PNRA in senior positions (grade 20 and above) that they should pass a course from Pakistan's premier institute in administrative affairs, namely NIPA, so that they adopt standardized administrative skills. By adopting such a course of action it is shown that more effective and sustainable approaches are being integrated in NRSI of Pakistan. In addition, administrative procedures incorporating greater accountability and clearer definition of responsibility are being introduced.

3.5. Emergency response coordinating center

An important aspect of radiation safety is emergency planning and preparedness. PAEC has taken initiative in this regard and has established an emergency response coordinating (ERC) center at its headquarters in Islamabad. The ERC is being equipped with state of the art diverse and redundant communications and other equipment to coordinate nationally in case of a nuclear emergency. A database of over 500 important phones nation-wide, urgently needed during emergency, has been prepared and will be updated quarterly. Links with emergency responders are being set up.

3.6. Periodic reporting

A nation-wide incident reporting system is in place as per INES. All medical facilities using radiation sources are bound to send periodic reports to PNRA even for X-rays taken.

3.7. Waste disposal and transport

During the last several decades Pakistan had negligible radioactive waste and little to transport. Efforts are underway to increase the waste disposal and transport capability and devise a strategy for long term issues associated with nuclear waste. In this regard, guidelines are being drawn from reference [8] among others.

4. Conclusions

Essential elements of NRSI of Pakistan are in place, viz., an independent regulatory body, availability of sufficient resources and a large pool of adequately qualified and professionally trained manpower. Training and services are also being provided adequately; however, to appropriately assess the skills requirement for NRSI of Pakistan, agencies like the IAEA are being requested for assistance.

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Table I. National Radiation Safety Infrastructure of Pakistan.

Responsibility	Elements of NRSI	
	1996	NOW
Regulatory	PNRB	PNRA
	PNRA has issued 7 regulations and substantial number of regulatory guides.	
Training	CNS, PINSTECH, KNPTC, NIAB	PIEAS, PINSTECH, NIAB KINPOE, CHASCENT
	These training centers are imparting training in radiation protection and safety. One training center is also being setup by PNRA.	
Training abroad	DIA&T	DIA&T
Inspection & enforcement	PNRB	RNSD (PNRA)
	I & E and licensing issues have been exclusively a domain of PNRB and PNRA.	
Licensing	PNRB	NSD(PNRA)
Dosimetry / measurement	PINSTECH, CNS, KANUPP, NIAB etc.	PINSTECH, PIEAS, NIAB, KANUPP, CHASNUPP, etc.
	Only major centers are mentioned, all nuclear establishments have small set-ups.	
Radiation protection	RPOs and allied staff	Same
	All facilities, including medical and NPPs, have a set-up under a local RPO.	
Safety culture and Information exchange	IAEA, WANO, COG, Local fora including PNS, INSC	Same + WNA
	The Pakistan Nuclear Society (PNS) and the International Nathiagali Summer College (INSC) are among local fora for the development of safety culture.	
Safety Liaison	DNS&RP(PAEC)	DOS (PAEC), PNRA
	The safety program is expanded to include non-nuclear aspects of safety also.	
Emergency response coordination center	Not available	ERC (DOS)
	The ERC is being equipped to coordinate nationally in case of a nuclear emergency.	
Waste disposal & transport	Sufficient	Being Reinforced

Effectiveness and Efficiency of the Regulatory Body in the Czech Republic (State Office for Nuclear Safety)
In the control of manufacturing, export and import of radiation sources

I. Zachariasova

State Office for Nuclear Safety
Prague, Czech Republic

Abstract. The paper describes the Czech regulatory context, general responsibility and competency of the regulatory body in the Czech Republic. State Office for Nuclear Safety is competent for the State administration and supervision of the utilization of nuclear energy and ionizing radiation and in the field of radiation protection. The Office celebrates 10 years anniversary of the establishing this year. During past 10 years a significant progress in the field of the assurance of the radiation protection in the country was achieved. In the paper a summary of the Office role focused on the implementation of internationally recommended radiation protection principles into practices is presented.

1. Czech Regulatory Context

The Czech laws and decrees cover all the safety and security issues related to the use of nuclear energy and ionizing radiation. The related legislation – particularly the Atomic Act of 1997- has created the required legal framework for the State Office for Nuclear Safety to perform its tasks. The Office is authorized to establish detailed requirements within the individual field of its competence through implementing regulations. Permits, licenses, resolutions and other administrative acts by the Office may be revised only through a legal procedure.

2. General Presentation of State Office for Nuclear Safety

The State Office for Nuclear safety (SÚJB) was established on 1 January 1993 trough a specialized Act as and independent state administration body and the main component of the state supervision in the nuclear field in the Czech Republic. Integration of nuclear safety issues and radiation protection regulatory activities to one governmental body took place in 1995. The Office itself is a purely administrative and supervisory body with no ties to the processes of e.g. national energy policy, energy market and issues of nuclear technology development, including nuclear power engineering. The Office is funded from the state budget approved annually by the Czech Parliament. It has no legal dependence on any ministry or other governmental agencies and its chairperson is appointed by a decision issued by the Czech Republic's Government.

The SÚJB goal is to assure that peaceful utilization of nuclear energy and ionizing radiation in compliance with the requirements for health and environmental protection and with the requirements of nuclear and radiation safety. Another SÚJB task is the continual effort to further develop and deepen safety culture, i.e. nuclear safety and radiation protection in general, and therefore the Office intensely monitor activities in the above mentioned fields.

Competencies of SÚJB are defined by the Act no 18/1997 Coll., and include particularly:

- Execution of the state supervision of nuclear safety, nuclear items, physical protection of nuclear installations, radiation protection and emergency preparedness in nuclear installation premises or at workplaces using radiation sources.
- Licensing activities e.g. siting and operation of nuclear installations and workplaces with very significant sources if ionizing radiation and radioactive wastes, transport of nuclear materials and radionuclide sources.
- Approving of documents relating to the assurance of nuclear safety and radiation protection, Limits and Conditions for operation of nuclear installations, methods of physical protection, emergency codes for transport of nuclear materials and selected radionuclide sources, internal emergency plans for nuclear installations and workplaces with ionizing radiation sources.
- Establishing of conditions and requirements for radiation protection of population and exposed workers, establishing of emergency planning zones and requirements for emergency preparedness under the Atomic Law.
- Establishing of conditions and requirements for radiation protection of members of population and exposed workers.
- Monitoring of population and occupational exposures levels.
- Co-ordination of activities performed by the Radiation Monitoring Network on the Czech Republic territory and provision of international exchange of radiation protection data.
- Keeping a national system of registration and control of nuclear materials, national registration system of licensees, imported and exported selected items, ionizing radiation sources, records on population exposure.
- Professional co-operation with IAEA.
- Provision of data to municipalities and districts offices about radioactive waste management on their respective territories and provision of adequate information to general public and the Czech Government about activities performed by the Office.
- Provision of data from measurements and evaluation of the impact of nuclear, chemical and biological substances on human health and o the environment, including evaluation and collective protective means against such substances.
- Co-ordination and provision of activities to fulfil tasks resulting from the treaty about the ban on development, production, accumulation of supplies and use of chemical weapons and about their destruction.

3. Competencies and Experience

The expertise covers all aspects of the assessment of safety in nuclear power plants, research reactors, uranium industry, isotope-producing installations, medical and industrial use of ionizing radiation. The staff qualified in the field of radiation protection has to have deep knowledge of safety and security of radiation sources and radiation practices under supervision.

The main activity of radiation protection section of the SÚJB is carried out in the area of health and environment protection against adverse effects of ionizing radiation that includes state administration and supervision for the full scope of activities with radiation sources e.g. production of ionizing radiation sources, import, export, sale, distribution, installation, commissioning, use of ionizing radiation sources, servicing and maintenance, conducting of tests of ionising radiation sources including type testing, acceptance tests, status tests, the performance of personal dosimetry services and other services important from radiation protection point of view. The Office carries out inspections at the premises of persons granted a licence or registered. For violation of a legal obligation established in the Act no 18/1997 Coll., the enforcement action is taken and Office may impose penalties.

The administrative activities of SÚJB in the field of radiation protection consist mainly in the issuing of licenses for management of ionizing radiation sources and licenses for radiation practices. The procedure applies to over 5 600 legal entities in the Czech Republic, most of them in medical facilities. In 2002 SÚJB issued 7 555 resolutions (including app. 2 800 specific resolutions for radiation protection officers). Based of the results of its supervisory and assessment activities SÚJB has conducted in the field of radiation protection 1500 inspections last year.

SÚJB has a collective staff (referring to nuclear safety and radiation protection) of 187 comprising about 100 graduate engineers, many with postgraduate degrees in nuclear physics or nuclear engineering.

4. Security and Safety of Radiation Sources

In the field of the safety and security of radiation sources a special attention is given to the manufacturers, producers, exporters, importers and distributors of radiation sources mainly for those who handle with sealed and unsealed radiation sources. The Czech legislation requires to notify to SONS the number of sources manufactured (produced) imported, exported and distributed. This information shall be submitted to the Office twice a year. The data from the last notifying period (from July till December 2002) see in the following table:

Table I. Sealed radiation sources manufactured, imported, distributed and exported.

Sealed radiation sources	Manufactured (pcs.)	Imported (pcs.)	Distributed (pcs.)	Exported (pcs.)
^{192} Ir		179	176	17
^{241} Am	1374	1	60	1315
^{241} AmBe	9	2	2	9
^{137} Cs	410	19	57	372
^{60} Co	11	46	45	3
^{57} Co	3	5	7	1
^{85} Kr	236	8	10	234
^{90} Sr		28	3	25
^{109} Cd		2	2	
^{153} Gd		3	3	
^{102} Cd		1		1
^{68} Ge		3	3	
^{75} Se		2	2	
^{147} Pm		1	1	
^{55} Fe		4	4	

Referring to sealed radiation sources, there are 4 manufacturers, 6 importing, 5 exporting and 7 distributing companies in the country. In addition to it 3 companies produce smoke detectors with 241Am - approximately 248 500 pieces were manufactured from July to December 2002. 5 companies import smoke detectors (about 380 detectors in the same period), 9 companies distribute and sale smoke detectors (about 3800 detectors) and 2 companies export smoke detectors (about 244 000) mainly to Sweden, Finland, China, Norway and Vietnam. The typical activity ranges from 3 kBq to 34 kBq per one detector.

Based on the law and regulations the State is responsible for maintaining the registry of radioactive sources and the users of radioactive sources. For updating of the registries the following methods are implemented:

— Notification.
— Licensing.
— Registration.
— Inspection.
— Disposal tracking.
— Import/export distribution and tracking.

In the following tables the information about number of sealed radiation sources (SRS), radionuclide type and specific applications currently in use is presented.

Table II. Sealed radiation sources inventory.

	SRS in equipment – significant radiation sources	SRS in equipment– simple radiation sources
Medical applications	746	0
Industry and other applications	1 046	3 832
Total	1 792	3 832

Table III. Sealed radiation sources - radionuclides.

Isotope	Number of SRS
^{137} Cs	1 185
^{192} Ir	895
^{226} Ra	432
^{238} Pu including Plutonium Beryllium sources	23
^{239} Pu including Plutonium Beryllium sources	75
^{241} Am	448
^{244} Cm	4
^{252} Cf	44
^{60} Co	2 079
^{75} Se	25
^{90} Sr	157

Table IV. Typical current user applications with sealed radiation sources.

Primary use	number of users	number of SRS
Academic/research	334	36
Analytical instruments	23	64
Calibration	36	678
Fixed/portable gauges	179	2 805
Industrial radiography	75	711
Irradiators	13	220
Medical – therapy	54	793
Smoke detectors		165 000
Well -logging	12	104

We do not register unsealed radiation sources individually (in the national registry), but we do register the workplaces and their categorization in accordance with the maximum amount of activity used. In total there is 188 registered workplaces using unsealed radioactive sources.

During the licensing process for the use of radiation sources the means for secure storage of radiation sources is assessed. For final storage and disposal of radiation sources serves the National repository for radioactive material under the competence of State Radiation Waste Repository Agency. The radioactive wastes are treated, conditioned and prepared for final disposal in the organizations having the authorization from our Office.

The incidents, accidents, malevolent use of radiation sources and illicit trafficking are regularly evaluated, analyzed and remedial action taken. All unexpected events (incidents/accidents) are registered in SONS database. The information about such events is published in Annual report of the SONS, presented to the Government every year and accessible on our web side (www.sujb.cz). Up to now no accident with significant economic and social impact occurred in our country in the past.

The inspectors of the SONS can apply (in order to ensure that law and regulations are followed) as the enforcement actions:

— Notice of violation.
— Fines.
— License suspension.
— License termination.
— Facility closure.
— Confiscation of source.

In case to search for missing radiation source or to secure found radiation source the responsibility is on the side of the State in case of orphan source. SONS could contract (extra-budgetary funds) the recognized companies equipped with the necessary tolls and devices for the treatment/removal of orphan radiation source and for final disposal in the repository when necessary.

5. Conclusion

The Czech Republic State Office for Nuclear Safety has successfully completed 10 years of operation. It has made an inventory of radioactive sources, and it actively regulates their authorization, use, and disposal.

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The Procedures of Seizure System for Radioactive Materials in the Czech Republic

Z. Pašková

The State Office for Nuclear Safety
Prague, Czech Republic

Abstract. The main role of prevention, regulation and inspection full fills the State Office for Nuclear Safety in the Czech Republic. On above-mentioned duties should be based the national system of prevention the loss of control of radiation sources. The system includes also co-operation with other state authorities (Integrated Rescue System) and other countries, in the exchange of information. The State Office issued a recommendation for procedure for radioactive materials seizure. The goal of this recommendation is to specify the rules for the procedure in cases of seizure. This document is mainly intended for the customs officers, fire fighters, policemen and the persons who handle the secondary raw materials and municipal waste.

1. Introduction

The national system of preventing the loss of control of radiation sources should be based on prevention, detection system of seizures, captures, response to seizures and co-operation with other state authorities (Integrated Rescue System consisting of Police, Fire Brigades, Custom Service, Emergency Health Care) and other countries, in the exchange of information.

The prevention includes existence of independent Regulatory Authority with the legal system of authorization, registration and licensing of practices with them, accountancy of nuclear materials, the national register of radiation source and the legal system of supervision, inspection and enforcement.

The detection system involves the methodological support, support in training of custom staff and supervision the detection and following processes, especially in more complicated cases.

2. Situation in the Czech Republic

The State Office for Nuclear Safety performs state administration and supervision of the utilization of nuclear energy and ionizing radiation and supervision of radiation protection. Competencies of the State Office for Nuclear Safety are defined by Act no. 18/1997 Coll. on Peaceful Utilization of Nuclear Energy and Ionizing Radiation (Atomic Act) and include also the duty of keeping a national system of registration and control of nuclear materials, national registration system of licensees and ionizing radiation sources. The Atomic Act defines source classification as following:

(exempted) -	no provision
insignificant -	free use but production must be licensed
minor -	notified use
simple	licensed all types of practise
significant -	more sophistically licensing procedures
very significant -	EIA, sitting, decommissioning

All regulated data concerning radiation sources from industry, medicine and research are registered and continually updated. Users are obliged to inform the State Office for Nuclear Safety about changes on the sources inventory.

The main goals of national register are:

- to provide with tool for central registration of sources, to follow the changes of registered items.
- to register the each licensee having any relation to the registered source.
- the registration of reports from the side of licensees.
- to provide an effective tool for inspectors of the State Office for Nuclear Safety.
- to provide an overview of sources in the country and their actual status.
- to provide with the information on the movement of sources.
- to provide information for identification in the case of abandon sources.

The application has been in routine operation since 2000. Contemporary the central register of sources contents about 5773 individual sealed radionuclide sources and 601 facilities containing such sources.

In compliance with the Atomic Act everyone who performs the radiation practices is liable to keep such a level of radiation protection so that the risk to human life, personal health and to the environment shall be kept as low as reasonably achievable taking into account economic and social factors and to reduce the exposure of persons so that the total exposure from all radiation practices shall not exceed as total the specified exposure limits.

The radiation practices mean any activity that handles artificial ionizing radiation sources during which the exposure of persons may increase, with the exception of the activities in case of a radiological emergency, and the activity when natural radionuclides are utilized for their radioactive, fission and fertile features, and the activity that is related to the performance with either the increased presence of natural radionuclides or the increased effect of cosmic radiation, and this causes or may cause a significant increase of the exposure of persons.

In recent years, a number of radioactive material seizures has increased (i.e. the materials that contain one or more radionuclides and their activities or mass activities from the point of view of radiation protection are not negligible). This is mainly due to newly installed technical equipment (i.e. the more sensitive detection systems) that monitors metal scrap during its collection and its entry to metallurgical plants and iron works, waste that enters incinerators, and the means of transport at the state border crossings. Our experience suggests that the majority of events are related to either handling (i.e. collection, sorting and transportation) the secondary (metal) raw material or the use of the machines and equipment that are produced from the contaminated metal materials. The minority of the events relates to the illegal discharge (either intentional or unintentional) of ionizing radiation sources into circulation (i.e. import, export and distribution).

There was a reason for the State Office for Nuclear Safety to issue a recommendation for procedure for radioactive material seizure**.** The goal of this Recommendation is to specify the rules for the procedure in the above-mentioned cases. The Recommendation is not a legally binding document. This Recommendation is mainly intended for the customs officers, fire fighters, policemen, the persons who handle the secondary raw materials and municipal waste. However, the principles of this Recommendation can be applied to all other cases of the seizures of the radionuclide contaminated materials. In the Annex of this Recommendation, Figures are enclosed. Its purpose is to help the workers of above-mentioned institutions to recognize the subjects to be suspicious of radionuclide content.

The types of operating and transport containers most often used for radionuclide sources, system components and the subjects that relate to the application of radionuclides are described.

In the year 2002 there were 69 confirmed events in the Czech Republic:

- 25 cases of contamined metal scrap captured in steelworks.
- 20 cases at incinerators.
- 5 cases at scrap yards.
- 13 cases at border crossing.
- 6 other events.

3. Conclusions

The main problems connected with seizures from the view of experiences are:

- financial support in solving cases of an inadvertent movement of radioactive material (scrap, chemical agents, …).
- lack of licensed persons for performing the radioactive material (source) localization, unloading, separation from the load, identification and analysis.
- readiness of licensed persons to serve non – stop.
- radioactive source in military and defence programs.

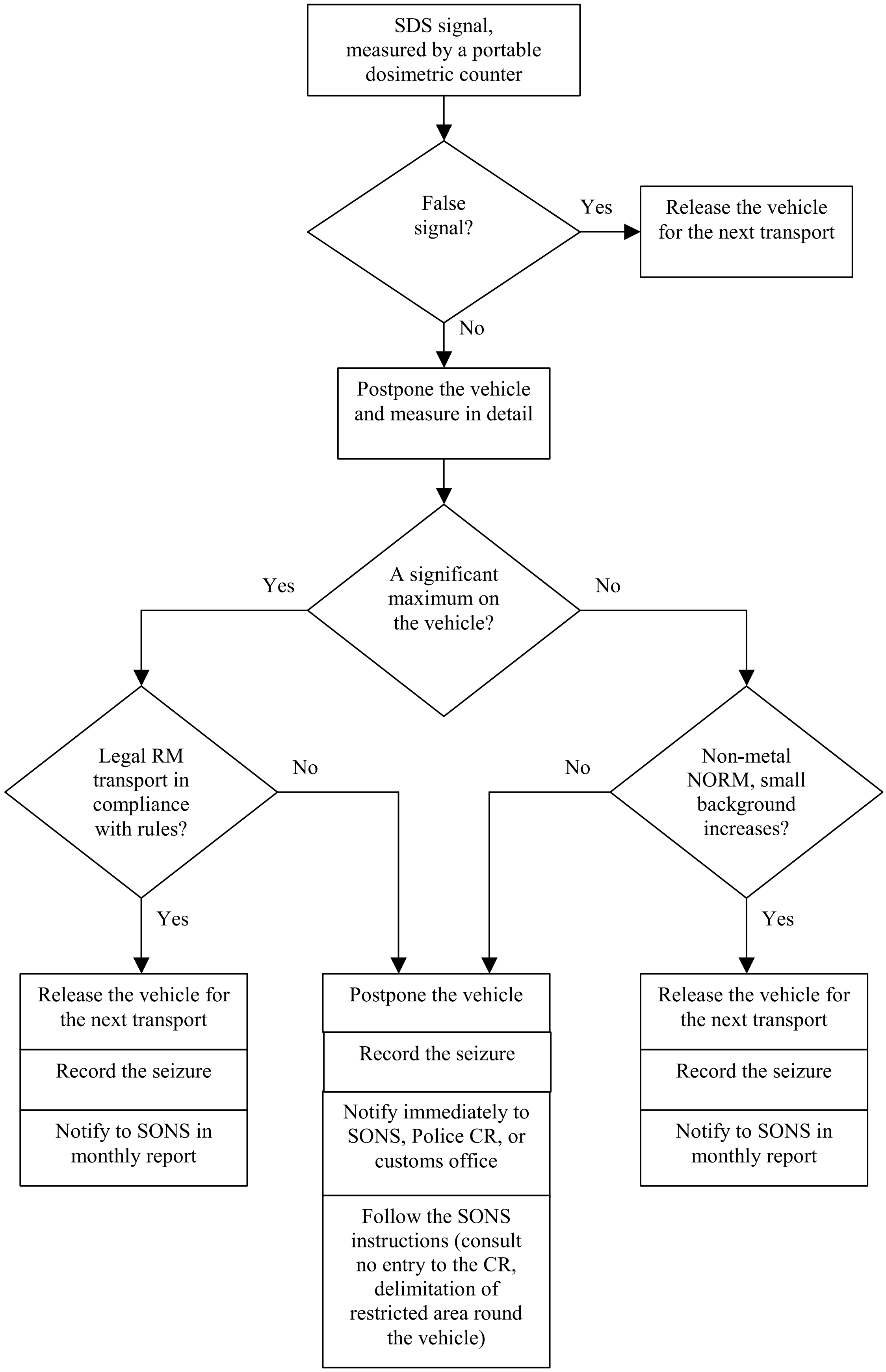
The base for solving these problems is on two levels – national and international. On the national level there is necessary to establish:

- adequate measuring system at the border, facilities
- the system of notification of the responsible authorities and persons
- the decision making scheme for different type of illicit trafficking.

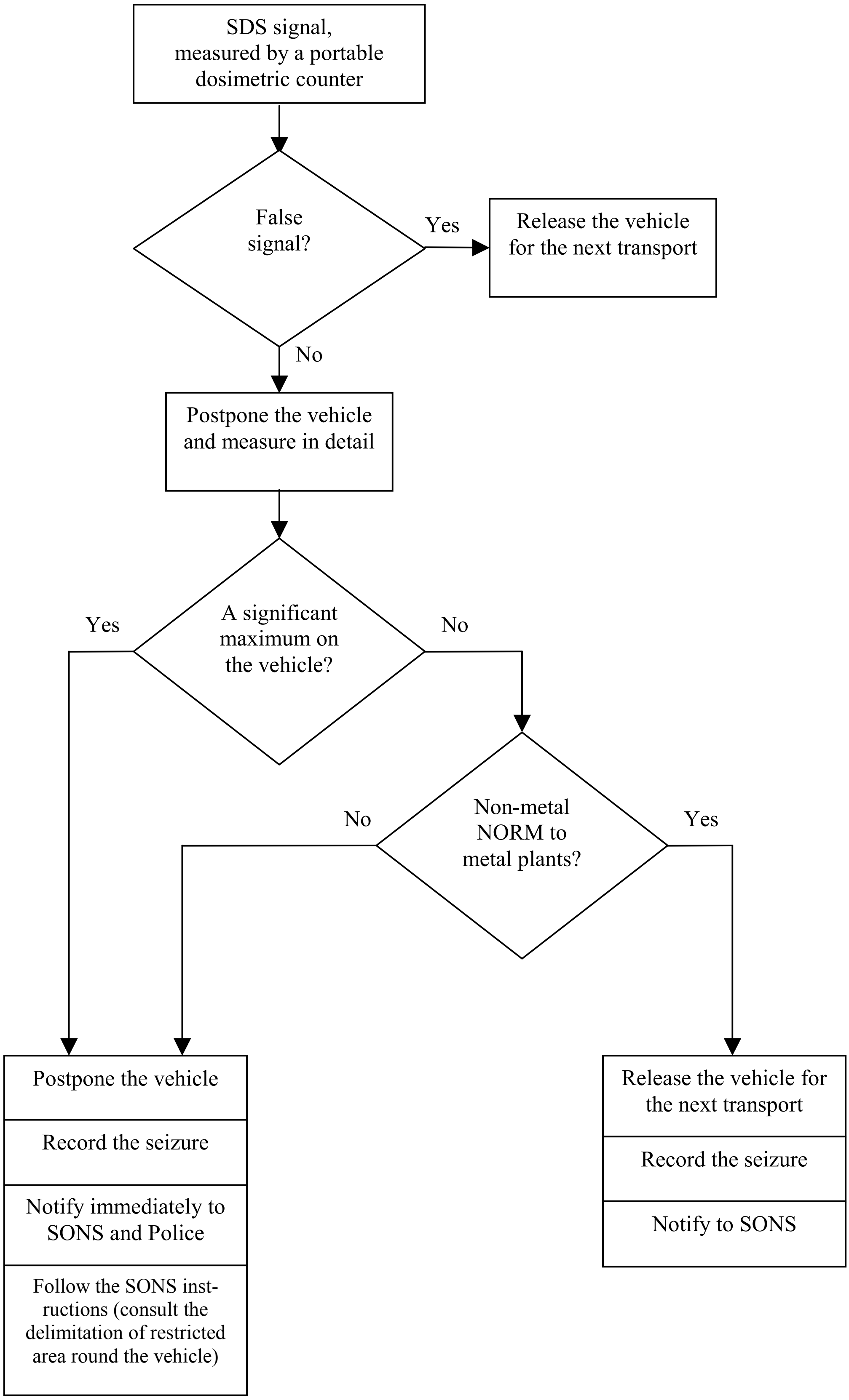
On the international level should be needed to establish a system of exchange of the event´s information and the other important data.

The examples of decision scheme:

The chart of the radionuclide material seizure procedure at a border crossing



The chart of the radioactive material seizure procedure at the entry to metallurgical works and a plant that handles the secondary raw material and waste.



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Problems Associated with Multi-competent Authorities in Implementing Old Radiation Protection Legislation in Egypt
The need to update

M. A. M. Gomaa

Atomic Energy Authority
Cairo, Egypt

Abstract. Forty years implementation of the very old Egyptian ionizing radiation and protection legislation resulted in poor implementation. The main cause of this problem is the following:
1. Multi competent authorities;
2. Improper implementation of latest ICRP recommendations;
3. Improper implementation of latest IAEA, BSS for protection against ionizing radiation and safety of radiation sources;
4. Lack of regulation dealing with intervention , and undefined practices such as the exclusion from regulatory control, transport of radioactive materials, Waste disposal Decommissioning of radiation facilities, Exemption and clearance levels.

Due to previous diagnosis, efforts to update the Egyptian Regulation is needed. The model proposed by IAEA is recommended as the updated law and regulation.

1. Introduction

Historically , Egypt was among the pioneers in introducing radiation protection legislation.

The Egyptian ionizing radiation (I R [1](law was issued in 1960. It was followed by regulation(1962 ,[2](ministerial orders[3] .The main aim of the IR law was to regulate work with ionizing radiation.

Efforts to update it since 1980. All efforts was failed. The aim of the present study is to point out of the problems associated with the multi- Competent authorities.

2. Multiple Competent Authorities

The competent authorities dealing with radiation protection according to ionizing radiation law are:

— Ministry of health.

— Atomic energy authority.

2.1. Responsibility of competent authorities

Responsibilities of the authorities in Egypt is defined according to old classification of radiation sources.

— Ministry of health responsible on sealed sources; x-ray machines and accelerators.

— Atomic Energy Authority responsible on Unsealed sources and Reactors.

3. Problems associated with dual competent authorities

3.1. The central authority for radiation protection

The central authority for radiation protection is a national committee and it is headed by the minister of health and it should conduct regular yearly meetings.

Last meeting date was 1993. Among the topics discussed in the last meeting was updating radiation protection legislation. No agreement was achieved.

3.1.1. User and regulator

The chain of command at Ministry of health of Egypt for radiation protection is

through the general directorate for therapy and not through the general directorate for protective medicine and basic care.

Within Atomic Energy of Egypt, the regulatory body is the national center for nuclear safety and radiation control.

Within both competent authorities users are regulators and regulators are users.

— lack of proper co-ordination.

In Egypt, there is two committees dealing with site licensing procedures.

Ministry of health committee (national) and the atomic energy authority committee(nuclear safety and radiation control center).

There is no direct link between these committees.

3.1.2. Regulating medical facilities

Two independent teams visit the same site one for sealed sources, x-rays and accelerators and the other for unsealed sources. No coordination.

Two inspection formats are in use.

3.1.3. Dose record

Two dose records for occupational exposure.

3.1.4. Medical records

Two medical records for occupational exposure.

4. Implementation of ICRP and IAEA Recommendations

At the ministry of health of Egypt, the current I R law (1960) and its executive regulation was issued in 1962 .The regulation may be subdivided into General . general requirements and special requirements. These requirements are based on pre-1962 ICRP recommendation. In 1989[4] radiation protection requirements for industrial radiography were issued and it was based upon Nordic countries recommendations[5] which was based upon ICRP-26[6] recommendations.

On the other hand, Egyptian Atomic Energy adopted ICRP-26 (1977) [6] recommendation and IAEA-SS-9(1982) [7]as early as 1986[8] .Furthermore in 1999, EAEA adopted ICRP-60 (1991)[9] recommendations and IAEA SS-115 (1996)[10] as a whole.

4.1. Exemption level

According to ministry of health regulation. Exemption levels and practices exempted from regulatory contral are 2 mrad/hr at the surface of devices producing ionizing radiation and

002. 0uCi/g for materials emitting ionizing radiation.

According to EAEA, the exemption criteria of International basic Safety Standards for protection against ionizing radiation and safety of radiation sources (BSS-SS-115,1996).

4.2. Personnel dosimerty

According to the ministry of health regulation (1962) ,the accumulative dose (D) to individual is govern by the relation

$D = 5 \ (N - 18)$ in rem

Where N is the age in years.

Furthermore , a quarter dose of 3 rem is allowed.

Personnel dosimetry is a must for individual doses greater than 5 rem in a year

Within EAEA standards, dose limit is 100 mSv in a five consecutive years with 50 mSv in any single Years.

5. Upgrading Legislation

In 1993 a proposal to update the ministry of health regulation anf the I R law

Was submitted to the central committee for radiation protection in Egypt.

That proposal was aimed to unify the competent authorities into one authority.

But these efforts failed to produce the proper goal.

During year 2000 an accident occurred in Egypt which lead to death of two persons and radiation injuries to 5 persons[11] , a proposal for unification of the competent authorities in Egypt was submitted to authorities,

The result was a new ministerial order from the ministry of health hoping to implement proper safety and security measures to sealed sources.

In 1994, the Egyptian Environmental law[12] was issued and its executive regulation[13] was issued in 1995.

In this law the competent authority for materials and waste emitting ionizing radiation is the Egyptian Atomic Energy Authority. Furthermore, the ministry of health issued two ministerial orders regarding:

— Radioactivity in drinking water[14] and

— Medical radioactive wastes [15]

where EAEA inspect drinking water and collect, store and treat the medical radioactive waste.

6. Transport of Radioactive Materials

In this respect both competent authorities recommend the use of IAEA recommendations for the safe transport of radioactive materials as a whole[16]. With no local national requirements, exept for the transport of radiographic radiation sources.

7. Intervention

In this respect , for radiographic radiation sources and others , emergency plan is a must in order to issue site license.

8. Lack of Regulation

For undefined practices such as the exclusion from regulatory control of, Waste disposal, decommissioning of radiation facilities, Exemption and clearance levels.

9. Future Recommendations

— Due to previous diagnosis, efforts to update the Egyptian Regulation is needed.

— The model proposed by IAEA is recommended as the updated law and regulation.

— This model was translated into Arabic.

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Upgrading Radiation Protection Infrastructure in Cameroon

A. Simo [a], **J. B. Nyobe** [b]

[a] Energy Research Laboratory
Institute for Geological and Mining Research
Yaoundé, Cameroon

[b] Ministry of Scientific and Technical Research
Yaoundé, Cameroon

Abstract. This article present the steps towards establishing a national radiation protection infrastructure in Cameroon. The legislation component is still being completed. Difficulties arise mainly from project management and insufficient government commitment at the project beginning. However the country participation in AFRA activities and the strengthening of the technical cooperation with the IAEA have allowed a significant progress highlighted by a recent decree creating the Regulatory Authority for Radiation Protection , the National Radiation Protection Agency. This Agency is seen as the control lever for the promotion of the radiation protection in the country.

1. Introduction

Up to early 1990's the conditions of preparation, holding, importation, exportation, selling and using of artificial radioisotopes were regulated by a presidential decree [1]. The Minister of Health, assisted by a technical advisory committee, was responsible for the implementation of this regulation. However, according to the IAEA and international requirements for the national radiation protection legal framework, this decree was not sufficient.

The occurrence of the AFRA Programme in 1990 served the occasion to reconsider the question with the help of regional and interregional expertises. To establish basic radiation safety infrastructure in AFRA member states, the IAEA has proposed the following areas and objectives on which efforts should be concentrated [2]:

— Facilitating the promulgation and enforcement of legislation.
This action appeals the Agency's assistance in the preparation and harmonization of national law and relevant regulations related to radiation protection, the establishment of the minimum required national infrastructure and operational services needed for enforcement of legislation;

— Management development.
Under this item appears the need to elaborate a national action plan for training in radiation protection and waste management for professionals involved in ionising radiation work;

— Improvement of radiation protection practices in medical institutions.
This action concerns the improvement of radiation protection practices through training of professionals working in radiotherapy departments and X-ray diagnostic services;

— Development and promotion of harmonized radiation protection practices in mining and milling of radioactive ores, The scope of this action covers the following issues: Regulation related to radioactive ores mining and processing, implementation of occupational radiation safety, radiation safety of the general public, waste management and remedial action connected to mining and processing of radioactive ores.

— Improvement of food contamination monitoring.

The objectives of this action include: Harmonization of experimental methods for the control of radioactivity in food, training of technical staff involved in food contamination in samples collection and preparation procedures.

The implementation of the project is under the responsibility of the Ministry of Scientific and Technical Research (MINREST), the national contact point for the technical cooperation with the IAEA. The scope of this article covers the legislation, the human resource development and the radiation protection practices in medical institutions. Here are presented the achievements gained so far, and the nature of problems and difficulties encountered in building a national radiation protection infrastructure in Cameroon.

2. Project Development

2.1. Legislation and competent authority

Generic draft regulation was proposed by AFRA/IAEA to facilitate the preparation of the law according to the national needs. Number of IAEA expert missions were provided to help drafting the law and regulation . Local jurists were involved ; they participated in meetings convened in Vienna to discuss the draft law with IAEA experts.

At the end a law was promulgated in 1995 to ensure the protection of human and environment against the potential risks arising from the utilisation of ionising radiation sources and radioactive materials, or from the activities involving the exposition to the radiations; it provides conditions for the implementation of the activities related to the pacific use of the radioactive materials and nuclear energy for the general interest. These activities include those of the fuel cycle, the acquisition, manufacture, holding, transferring, transportation, use, storage, importation, exportation, of radioactive sources and materials, and the installation of nuclear facilities [3].

After the promulgation of the radiation protection law, the regulations have been drafted and reviewed with the Agency's assistance. A number of national meetings have been organized to share the views on the role of the competent authority for radiation protection and to review the proposed regulations. Finally a presidential decree creating the National Radiation Protection Agency (NRPA) was issued on the 31st October 2002. The NRPA is the competent authority for radiation protection and waste management; the NRPA is responsible for the protection of persons and environment against the effects of ionising radiations [4]. It will house the system for notification, authorization and the control of radiation sources in the country.

2.2. Manpower development

A national Group training to sensitise the stakeholders on the importance of radiation protection and the enforcement of the law was held in 1996 in Yaoundé. Participants were selected from technical ministries, hospitals and clinics, and from specific industries. Lecturers from IAEA were involved in this national training workshop. AFRA training events offer another option for group training.

2.3. Laboratory

The *« Centre National d'Application des technologies nucléaires (CATEN) »* is the proposed dosemetry laboratory; equipment supplied by IAEA under Model Project are installed in this unit.

2.4. Source registry

Under the project ″Strengthening Waste Management Infrastructure″, a list of radioactive sources in use in the country has been established in 2002 as indicated in table 1 [5]. An inventory of radiation sources using the Agency's registry software is still to be completed.

Table I. Localisation of radiation sources in Cameroon

Institutions	Radio-nuclide	Half life	Initial Activity		Supplier
			Activity	Date	
Reference Hospital of Yaoundé Radiotherapy Unit	^{60}C Bq ^{137}Cs	5.3y 30 y	7300Bq 57 µCi	1995 1995	CEA/IAEA CEA/IAEA
Reference Hospital of Douala Radiotherapy Unit	^{60}Co ^{137} Cs	5.3y 30y	7300 57µCi	1995 1992	CISBIO/ IAEA CISBIO/ IAEA
Hydrocarbons – Analyses- Controls (HYDRAC), Douala	^{192}Ir(nb:4) ^{137}Cs (nb: 2)	74 d 30 y	1 Ci	1997 1998, 2000	South Africa South Africa
Polyclinic Bonandjo, Douala	^{60}Co	5.3 y	2130 1985	Rhm^{-1}	CISBIO
CATEN/MINREST (Reference sources, pastille form)	^{210}Bi ^{60}Co ^{54}Mn ^{22}Na	5.03d 5.3y 300d 2.6y	0.0242 nCi	1977 1982 1982 1982	IAEA

3. Problems and Difficulties

3.1. Project management

The implementation of the project is under the responsibility of the IAEA Liaison Officer. Taking into account that in average the Liaison Officer is replaced every two years, it is difficult to follow up the project work-plan, and particularly its technical component. The regulatory aspect was relatively easy to carry on through official meetings with representatives of other ministries. The project is technically understaffed , with no operational radiation protection team in place and no supporting budget. The equipment received from the IAEA to create a dosemetry laboratory have not yet been used. The understaffing and the absence of qualified personnel suggest the need to elaborate a strategic manpower development plan for the project.

3.2. Poor sensitization of decision makers on the importance of the radiation protection

A gap of 8 years has separated the promulgation of the law relating to radiation protection from the creation of the Regulatory Body. This delay supports that the decision makers and the stakeholders were probably not adequately informed on the benefits of the Nation from the enforcement of the law. However the medical and industrial applications of radioisotopes in the countries were growing , with the increase of the number of ionising sources in use, and the associated waste management problems yet to be solved.

3.3. Training

AFRA events have been fully used to get technicians trained and more professionals aware of radiation protection requirements. Unfortunately many people trained were not involved in the radioisotope applications; therefore the knowledge gained from the training courses and workshops were lost.

Hopefully the technical assistance projects with IAEA have provision for individual training ; this opportunity is always used when applicable. It was the case with NDT project at HYDRAC (4 NDT technicians), radiotherapy at the General Hospitals of Yaoundé (2 radiotherapists, 3 technicians) and Douala (3 radiotherapists, 1 radio-physic technician , 1 technician) and nuclear medicine at the General Hospital of Yaoundé (1 medical doctor, 1 technician, 1 nurse). For waste management project, 1 researcher and 1 technician have been trained in radiation protection. Other technicians (4) have been trained to operate the dosemetry unit of CATEN.

4. Conclusion

Cameroon nuclear security infrastructure is to be strengthened by staffing the NRPA with qualified personnel, completing the legal framework with regulations relevant to different issues (Waste management, mining of radioactive ores, TE-NORM, irradiation of food and products, …) and guidelines, planning the manpower development, making operational the radiation protection specialized services (dosemetry laboratory, calibration service, environmental monitoring service, emergency radiation protection service), securing the supporting budget, identifying the national needs and elaborating the action plan for training.

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A. SIMO : RAF/4/015 Annual Report, December 2002

Radiation Protection Infrastructure in The Great Libyan Arab Jamahiriya

N. A. Droughi

Radiation Protection Department
Tajura Nuclear Research Center
Tajura, Libya

Abstract. The protection of human beings, their progeny and the environment against the harmful effects of ionizing radiation requires the enforcement of rules, regulations and standards by a national competent authority on radiation protection. In connection with the introduction of nuclear research reactor technology and the rapid increase in the use of ionizing radiation sources for various purposes, the Law No.2 for the year 1982 was passed by the supreme legislative body of the country. The paper describes in some detail the infrastructure of the radiation protection, the regulatory mechanisms, enforcement and the organization of radiation protection in Libya.

1. Introduction

The radiation protection activities in Great Libyan Jamahiriya was not organized until the establishment of the Libyan Atomic Energy Commission LAEC in the early 70's. Under the Atomic Energy Act, the LAEC was set to expedite the initiation and promotion of the utilization of the atomic energy for the peaceful purposes.

The Libyan first nuclear research reactor facility at Tajura TNRC was a swimming pool type Russian reactor that became critical early 1981. One of the main operating department at TNRC is the Radiation Protection Department RPD. Previously the medical health secretariat was the only body that uses ionizing radiation in the medical field diagnostic and therapy. Therefore in order to nationally set up and organize the radiation protection and health physics aspects on the national level, a Radiation Protection Law No.2 for the year 1982 was ratified in accordance with the International Atomic Energy Agency and some other international regulations. It was approved in 1982 by the Libyan's people congress which is considered the highest authority.

2. Provisions of Regulatory Enforcement

The RP Law No.2 is called the legislations of organization of the utilization of the ionizing radiation and the protection from its harmful effects. This Law empowered the radiation protection department of TNRC with the full responsibilities to regulate, control and to enforce its codes of practices in all the aspects of peaceful application of ionizing radiation in Libya. The Law consists nineteen article and its code of practice that contains nineteen chapters divided into one hundred and twenty nine articles on the general concepts, responsibilities and licensing, supervision & inspection and sanctions & penalties which covers a broad range of radiation protection responsibilities including:

- Protection of individual human beings, their progeny mankind as a whole and the environment against the harmful effects of ionizing radiation;
- Licensing and inspection of radiation sources and facilities, procurement, import, transport, distribution, purchase and waste management as related to radioactive materials or radiation producing equipments;

- Establishment of nationwide dosimetry services for all radiation workers at research instillations, universities and medical hospitals;
- Development of criteria, rules, regulations, guidelines, recommendations and standards on radiological safety and protection.;
- Environmental protection from natural and manmade sources;
- Education and special training courses fro radiation workers and promote understanding of radiation effects to the general public;
- Enforcement of the Law No.2 by issuing penalties for violation of its codes of practices and its articles.

However, in the year 2001, a new regulatory body called the Nuclear Safety office have been declared by the Secretariat of the scientific research commission to be considered the highest authority for the enforcement of the Law No.2 and to take parts of the RP responsibilities nationally. This office once it is capable of carrying its duties ,it will be responsible for enforcing all the aspects of the Law and will be delegated with most of the responsibilities that was carried out by the radiation protection department.

3. Implementation and Enforcement

For the past twenty years the radiation protection department at TNRC have been carrying the full responsibilities outlined in the Law No.2 by a special teams of highly educated physicists and well trained personnel. The RPD composed of different sections and units as outlined in the organization chart, which are assigned for specific tasks and responsibilities namely radiation scurvies of medical X- ray and therapy units at various medical hospitals all over the country, scurvies and inspection of radioactive materials used at different departments and organizations, licensing of radioactive material import and export especially by the oil companies used for exploration and radiography purposes. Some of these duties were carried out as will be outlined in the following sections:

3.1. Medical scurvies

The inspection and survey teams are responsible for carrying out scurvies of all operating departments of X-ray and radiotherapy units on nationwide scale. The main aims were to evaluate the lay-out of the equipments, shielding of the X-ray units, performances of the X-ray machines and the proper applications of the radiation protection practices and procedures. The results were complied in scientific reports with the appropriate practical recommendation to be applied. About 95% of the operating hospitals were surveyed and were supplied with the adequate personnel film badges dosimetry. The out come of these surveys over a period of two years since its first implementation have caused a decreased in worker and patient doses to more than 60%. This was partly due to the greater awareness of the worker and the patient to the ill effects of exposing them selves to unnecessary exposures to X-ray doses and mostly to compliance to safe operating procedures that was not practiced before the enforcement of radiation protection practices by the survey teams.

3.2. Film badges

The personnel dosimetry section was responsible for distributing , collection, processing and reporting of all personnel doses to all the registered radiation workers through out the country. This practice had also reduced the personal doses to more than half of the exposure doses that were first reported to the operating personnel in the various fields of ionizing radiation. The section process more than 5000 film per year, they were collected four times per year and the final registered doses are sent yearly unless an abnormal doses were discovered, records are to be kept for thirty years according to the regulations.

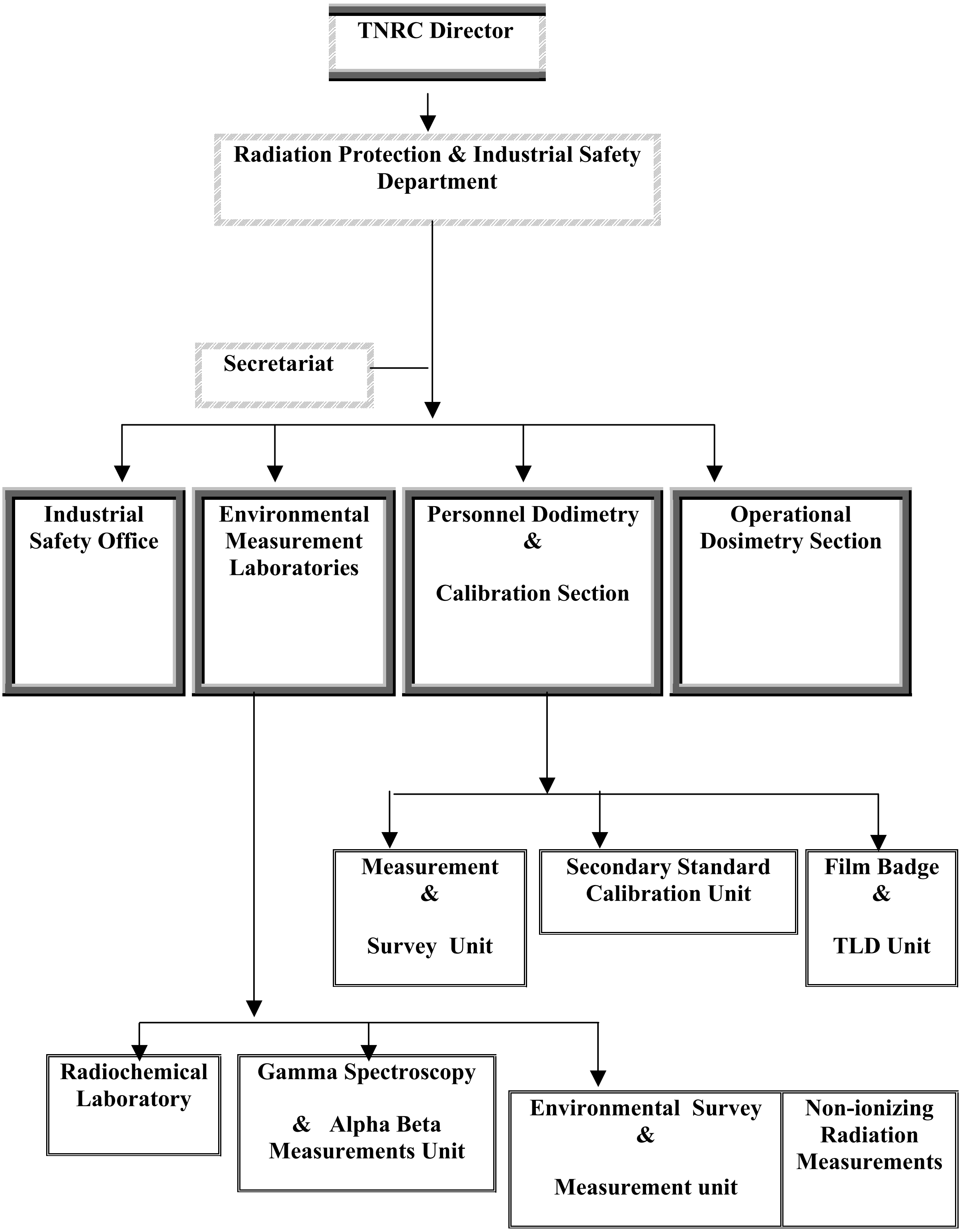

Fig.1.Organizational Chart of the Radiation Protection Department.

3.3. Food control

The environmental laboratory section was responsible for carrying out environmental radiation measurement of natural and man made sources of the area surrounding the TNRC, however after the

Chernobyl accident in 1986, the section was assigned the responsibilities of measuring all the food stuff that is being imported to the country.

3.4. Export and import control

Incompliance with the Libyan legislations of control of use, position of radioactive material, it is mandatory to get a written permission for the importation or exportation of any type of radioactive materials or any instillation that emit ionizing radiation. The department works in conjunction of with the official entry border control crossing and port of entry. The requirements are to get a permission or license of use such a material after supplying the RPD of the full information of the source certificate and adequate trained personnel to use the source. One of the stringent requirement is to export the source after completion of its use the country that was imported from. This control have made it possible to get an inventory of all radioactive material enter the country and know its place of storage in case of any loses of source or accident occurrences.

3.5. Assessment of license

The survey and licensing sections duties of issuing, renewing or amending any license, an assessment is performed to ensure that the specific usage will not pose an unacceptable risk to the staff, public or the environment. Currently there are more than 45 company licensed or permitted to import radiographic sources namely ^{192}Ir, [1]. For a new applicants, the assessment is based upon the application and any supporting documentation such as source certificate, users training credentials, but for renewals or amendments, the licensee previous performances and compliance records are also considered.

3.6. Education and training

The department of radiation protection organizes a number of training courses from introductory into high level or specialized radiation protection for radiation protection officers. These courses are outlined in the TNRC booklet for training and are held at certain dates. Some of these courses are directed toward the medical field and others are industrial fields. Some general lectures concerning specific subjects are given to the public in order to raise the awareness of their general knowledge in various topics of radiation protection and its ill effects. The department is also accepting a certain number of students from technical institutes, universities to carry out special research graduation projects utilizing the various radiation measurements equipments and detectors.

4. Conclusion

The organization of basic radiation protection infrastructure is very important for every country in this changing world. With the wide spread of different applications of nuclear technologies, it is vital for each country to take the necessary precautions and preparedness to have the minimum requirements for protection of it's population and their environment. Libya has realized these facts and in addition to the wide spread of applied nuclear technologies as a development country a basic radiation protection infrastructure was built over the last twenty years. As has been outlined in this paper, the requirements for adequate radiation protection enforcement has been provided and applied. The Libyan Law No.2 for the year 1982 has been indorsed and enforced for the safe utilization of the peaceful aspects of the nuclear technologies especially in the medical, industrial and research applications fields. The RPD at TNRC has played and important and vital role in the enforcement of the law and the protection of Libyan population and the their environment.

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Russian Federation Legal Basics for Radiation Protection Standards

A. P. Panfilov [a], O. A. Kochetkov [b], I. A. Gusev [b] ,et al.[b]

[a] Ministry for Atomic Energy (Minatom) of Russian Federation
Moscow, Russia

[b] Institute of Biophysics
Moscow, Russia

Abstract. Since 1996 the atomic legislation was initiated and six Legal Acts are in force regarding radiation protection. Basing upon these Acts, the national regulating system is elaborated. Atomic Energy Application Act determines principles to regulate relationships when the atomic energy is applied. This Act was particularly created to enforce international atomic energy safety recommendations. Population Radiation Protection Act is based upon the non-threshold concept. It is different versus previous critical organ concept regarding dose management system. Detailed issues are reflected by nationwide documents (Radiation Protection Standards and Sanitary Rules), which provide radiation protection standards for personnel, population and environment. Sanitary Epidemiological Well-being Act presumes technology addressed standards and rules. Recommendations to improve dosimetry at Minatom enterprises include routine and abnormal radiation monitoring documents, individual dose management etc. Thus, the present Russian legislation, standards and methodologies are the comprehensive system completely adequate to ICRP and IAEA documents regulating radiation practices.

1. Introduction

Within recent decades the radiation protection of personnel and population in Russia were regulated by Sanitary Rules and Radiation Protection Standards (SP-333-60[1], NRB[2]-69, NRB-76, NRB-76/87). Since 1996 the atomic legislation was initiated.

At present, six Legal Acts are in force regarding radiation protection of population:

— Radiation Protection of Population (30.03.1999);
— Atomic Energy Application (21.11.1995);
— Sanitary and Epidemiological Well-being (30.03.1999);
— Environmental Protection (10.01.2002);
— Protection against natural and man made emergencies (21.12.1994);
— Social protection of radiation exposed people affected by the Chernobyl NPP disaster (10.12.1991).

[1] Sanitary Rules
[2] Radiation Protection Standards

Basing upon these Acts and international requirements and agreements recognized by Russia (Nuclear Safety Convention, IAEA Standards), the national regulating system of nuclear and radiation safety is elaborated to develop, approve, and enforce obligatory standards and rules, to license radiation practices, to survey, expertise and inspect radiation safety, to develop and implement protective measures for population and environment.

The Atomic Energy Application Act determines the legal basis and principles to regulate relationships occurred when the atomic energy is applied. This Act was created to promote the development of nuclear science and technology and to assist the enforcement of the international regimen of safety of atomic energy.

The Population Radiation Protection Act is based upon the non-threshold concept of radiation effects related to life span effective dose. It is different versus previously adopted concept of critical organs regarding the followed system of population and occupational dose monitoring.

This Act establish numerical standards (permissible doses) of ionizing radiation source exposure in Russia (article 9), which doses correspond to last ICRP recommendations.

The detailed issues of Acts are reflected by two nationwide documents of Radiation Protection Standards (NRB-99) and Basic Sanitary Rules of Handling Radiation Materials (OSPORB-99), which provide radiation protection standards for personnel, population and environment including standards, radioactivity isolation system requirements, personnel training and health, post-accidental measures etc.

Sanitary Epidemiological Well-being Act presumes the technology addressed standards and rules for occupational and public protection (specific rules for NPP operation, radioactive waste management, nuclear fuel cycle, etc.).

Methodological recommendations to improve dosimetry at Minatom enterprises include documents on radiation monitoring at routine and abnormal circumstances, individual dose recording and management for radiation workers and population etc.

2. Conclusion

Thus, the present Russian legislation, standards and methodological basics is the comprehensive system, which is completely adequate to ICRP system of radiation protection and IAEA documents regulating radiation practices.

Establishment of Independent Regulatory Authority in Indonesia

M. Sinaga, A. S. Kustiono

Nuclear Energy Control Board (BAPETEN),
Jakarta, Indonesia

Abstract. The Act No. 31 year 1964 on Provision of Atomic Energy stated that National Atomic Energy Agency (Batan) was the prime executive and control agency of atomic energy uses in Indonesia. Some difficulties emerged from that circumstance due to promotional and control function is in one hand. Batan as Promotional Body had duty to develop nuclear technology whereas control function was rather additional job. It meant that development of nuclear technology had high priority and control function had low priority. Consequently, employees recruitment, budget for carrying out control of activity in the use of nuclear energy, radiation safety and inspection equipment, and other concern with the development of controlling was limited. Utilization of nuclear energy had to be controlled strictly in order to avoid detriment to the workers, member of the public, and environment meanwhile the facilities to do the job was minimum so that nuclear energy control was not maximum. Therefore Promotional and Control function is not really able to be in one hand because conflict of interest will occur from time to time. The IAEA recommendation through Basic Safety Standard and Nuclear Safety Convention in 1994 advocates member states to separate promotional and control body. This is the agent of change to separate promotional and control body. But the separation had to change the Act and it was not very easy because it had to be discussed and approved by parliament and before finally signed by President. We spent almost 4 year to change the former Act to the new Act. In 1997 the new Act was issued and the condition changed. Independent Regulatory Body was established in accordance with the Act and main duty of regulatory Body is only to control the utilization of nuclear energy in Indonesia and to do counseling of regulation to the users and member of the public. Making regulations, evaluation of licenses, and doing inspection as well as taking action for law enforcement must be high priority. Government provides special budget and recruitment of personals and appointment of nuclear safety inspector is done by regulatory authority independently.

1. Introduction

Utilization of nuclear technology, in fact, cannot be avoided because people need that technology to overcome some cases in Industry, Medical, Research, Agriculture, etc. It is obviously understood that people over the world have already felt the advantages of the particular technology. Some countries having no natural resources like oil or gas; they use nuclear technology to produce energy, that generating from Nuclear Power Plant. However besides the benefit, radiation also endangers human being if they receive dose exceeds from the determined dose limit.

At the beginning when the radioactivity and x-ray found, some workers got sickness because at that time the workers were not provided with personal dosimeter; there was no detector available to know how much radiation dose in work place. Due to the sickness, some volunteers met to begin discussion of the radiation effects. Radiation dose became interesting topic and from time to time that group provided recommendations to international institutions interested in radiation safety for instance International Atomic Energy Agency (IAEA). Afterward this institution is known as the International Commission on Radiological Protection (ICRP). ICRP concept is always followed by IAEA and by which proposes its member states to follow such recommendations. One of the concept is principle of the radiation safety namely justification, limitation, and optimization. According to the concept of nuclear energy utilization, it should introduce the benefits where those must be bigger than risk may impose. Dose limit means that determination of the number of dose from the regulation is not exceeded. The exposure should be as low as reasonably achievable. That is why the utilization of the nuclear or radiation technology should be handled carefully in order to avoid radiation that may be received by workers, member of the public and environment. To develop regulations of nuclear energy, any member state is advocated to harmonize the rule with the basic safety standard issued by the IAEA.

In Indonesia, experience to control the use of nuclear energy was executed since 1964 when the regulatory authority is in one root with the promotional body. Since 1997 when the new Act issued, regulatory authority and promotional body was separated. The regulatory authority was established to control the use of nuclear energy in Indonesia including facilities possessed by promotional body. In accordance with the act regulatory body is under and directly responsible to the President.

2. Control of Nuclear Energy before Independent Regulatory Body

Control of nuclear energy has been started since1964 in accordance with Act no. 31 year 1964. This act stated that prime agency executing and controlling atomic energy was National Atomic Energy Agency (Batan). The main duty of Batan, of course was to develop nuclear technology in various fields of human life whereas control function was rather additional task. A subdivision in BATAN was established to execute control of nuclear energy in which covered all utilization of nuclear energy in Indonesia including Batan facilities. At that time employees of control body were approximately 40, and some of them were assigned as administrator (last number before separating from Batan was 64 persons). To control utilization of nuclear energy, including x-ray machine in hospitals, inspector was appointed by Chairman of Batan and most of them were Batan employees. Conflict of interest would happen when inspection was executed and serious violation was found in Batan facilities. In this case, the inspector would be very difficult to make proper decision. In one side the inspector was a professional job but on the other side the inspector worked in the facility. The problem would be more serious if Batan facility was assumed not safe. If it happened, the public would not entrust Batan as pioneer of nuclear technology and they would turn down nuclear technology due to their illustration represented that nuclear technology would give detriment to the human being and environment. Deterring this situation, promotional body should maintain public opinion of the safe use of nuclear technology. For this purpose, sometimes control function could be sacrificed.

Indonesia is arch pelagic, to perform inspection it is needed a lot of money for the reason that each place using nuclear energy is far from municipals and usually able to be reached by plane and done by 2 (two) inspectors. The problem was the government provided little of money as budget was strengthened to promote and develop nuclear technology in Batan. Inspection was low priority and neither nuclear nor radiation facilities in Indonesia was properly inspected.

The number of employee in control unit as its capacity of control authority in Indonesia was not enough to develop control system including regulations provisions in order to be harmonized with the international standards. It was understood because to do such function was needed a lot of money whereas budget for the control was low priority as mentioned above.

3. Independent Regulatory Body

In 1994 when the IAEA recommended separation between promotional and control body through the Nuclear Safety Convention and Basic Safety Standard (BSS) No. 115, Indonesia began to discuss about the subject. In the same time Indonesia planned to build Nuclear Power Plant. This issue was very strong to realize the need of the old nuclear energy Act amendment at one time to pursue the IAEA recommendations. This is agent of change of old paradigm to the new paradigm in controlling nuclear energy in Indonesia. The problem raised was that to change the Act had to be discussed with the parliament. After discussing with parliament, the act signed by President and finally enacted.

Separation of the regulatory body from promotional body is supported by parliament because this is in line with the Nuclear Safety Convention and IAEA Basic Safety Standard No. 115. Therefore, Regulatory Body is under and directly responsible to the President and the Regulatory Body shall has the task to control any activity using nuclear energy (article 4). It states also that the control of the use of any nuclear energy shall be carried out by the Regulatory Body through regulation, licensing, and inspection (article 14). It means that government, private company or other institutions using nuclear energy shall be controlled by Regulatory Body.

Subsequent to issuing the act, we have also finished 5 (five) Government Regulations as follows:

1. Government Regulation No. 63 year 2000 on Health and Safety of utilization of Ionizing Radiation.

   This regulation regulates about dose limit system including dose constraint, radiation protection organization consists of Installation authority or licensee, Radiation Protection Officer, and Radiation Worker therein, Radiation safety equipment, dose evaluation, Calibration of radiotherapy output and radiation safety equipment, Quality assurance program, radiation workers training, and emergency preparedness.

2. Government Regulation No. 64 year 2000 on Licensing of Nuclear Energy.

   Content of this Government Regulation are: requirement to get license of utilization of radioactive material, radiation sources, and nuclear materials, validity of license, responsibility of Installation authority or licensees, inspection, duties and authorities of inspector. Principle of notification and authorization e.g. registration, license, exemption, and clearance is already adopted in this regulation but in detail will be arranged in chairman decree.

3. Government Regulation No. 134 year 2000 on Licensing Fee.

   This regulates about amount of license fee in the conformity of particular use such as radiography, logging, diagnostic x-ray machine, etc.

4. Government Regulation No. 26 year 2002 on Safe Transport of Radioactive Material.

   This regulation encompasses approval of transport, duties and responsibilities of consignor and consignee, packaging, radiation protection program, quality assurance program, activities of radioactive material in package, radioactive material containing other hazardous substance, and emergency preparedness.

5. Government Regulation No. 27 year 2002 on Waste Management.

   Prior to getting license from Regulatory authority the licensee candidate must submit statement that spent sources will be returned to original country or sent to promotional body. It also governs licensing, waste management including waste from non-nuclear ore mining, environmental monitoring, decommissioning program, and emergency preparedness.

2 (two) draft of GR are still in discuss successively re: Licensing of Construction and Operation of Nuclear Reactor and Licensing of Construction and Operation of Non-reactor Nuclear Installations. All the abovementioned Government Regulations have generally adopted principles provided in IAEA Basic Safety Standard since furthermore detail regulations will be stipulated in chairman decrees such as number of dose limit, exemption limit from license, clearance, etc.

At present the Regulatory Body has recruited employees concordant with the job. They can develop the regulation, licensing, and inspection system in accordance with regulatory requirements. Number of employees in regulatory body is around 200 people now.

Evaluation prior to granting license is able to be done by evaluators without vested interest of other person or institution because regulatory body is independent from conflict of interest. Inspectors are appointed by chairman of regulatory body and they do inspection without external influence and freely to decide finding of inspection. Inspection to Batan facilties is also executed periodically. Finding of inspection can be followed up clearly and forced the violent users to comply with the rules. According to the Government Regulation, if the finding is not improved by user, license can be revoked and then operation shall be terminated. Should the use of nuclear energy operated without license; the user will be condemned in accordance with the Act no. 10 year 1997 on Nuclear Energy. Government provides financial support as much as regulatory body needs and on the contrary inspection is properly scheduled.

After the issuance of Government Regulation No. 134 year 2000 on License Fees, Regulatory Body has additional fund for controlling nuclear energy uses. The budget can be allocated for regulation making, improvement of license services, inspection, and counseling of nuclear safety regulation. Regulatory Body is also governed by law to execute counseling of nuclear safety regulations to users and the public periodically in order to maintain public opinion positively.

4. Conclusion

— When the promotional body and regulatory authority is in one hand the conflict of interest cannot be avoided.

— Development of controlling aspects will not run properly because promotional body has a task to develop nuclear technology that some time can jeopardize with control function.

— Separation between promotional and control body is a way to make control of nuclear energy avoidable from conflict of interest.

— Indepedency will assure that decision making process not be influenced by person or other institution.

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Some Experiences by creating a Radioprotection Infrastructure in a Developing Country
The Case Nicaragua

F. Morales

Comisión Nacional de Energía Atómica (CONEA)
Managua, Nicaragua

Abstract. In a developing country is very difficult to introduce the concept of radioprotection because there are other big problems and few experience. However in Nicaragua was possible to create the radioprotection infrastructure headed by the government (Health Ministry) with the co-operation of the Universidad Nacional Autónoma de Nicaragua (UNAN-Managua) and strongly supported by the International Atomic Energy Agency (IAEA). It was a relative fast process because we used the regional and the international experience but considering that we are in a developing country.

1. Introduction

The situation before 1993 was the following:

- No Law about ionizing radiation.
- No Regulations.
- No Standards.
- In the past there were several attempts to create the infrastructure without effort.
- A strongly motivated group of physicists at the University with little experience in personal dosimetry.

We received the technical co-operation from the IAEA first by means a national project and later by the IAEA model projects RLA/9/041 and RLA/9/044.

2. Situation in 2003

In 1993 was approved the Law 156 “Law about Ionizing Radiation ”[1] and herewith created the National Atomic Energy Commission (CONEA) as the regulatory institution for this matter. The members are Health Ministry (President), Social Security, Labour Ministry and the UNAN-Managua.

Before enforcement of the law we defined the following principles:

- To work as good as possible only with international standards.
- To reach a high scientific and technical level enough for Nicaragua.
- To motivate the institutions to obtain the license and to use the law as the final recourse.
- To gain credibility and good reputation by all means.

To fulfill these principles we agreed the following tasks:

- To approve specific regulations together with several state and private institutions.
- To train the inspectors in others Latin-American countries with good experience in measurements and in licensing.
- To write scientific and technical information for a national basic radioprotection course.
- To prepare guides for the institutions to obtain the license.
- To study the international and national standards from others countries before the use .

For the First General Radioprotection Regulation (1998) [2] we took the proposal of a group of experts of the Latin-American Agreement ARCAL, which has considered The International Basic Safety Standards of the IAEA [3]. Our Regulation connects our law with several existing national and international standards for special problems, e.g. we recommend using the IAEA Code of Practice for the absorbed dose determination in photon and electron beams [4]. When do not exit a international standard we recommend to use some very known standards from others countries, e.g. the NCRP 49 [5] or DIN 6812 [6] for shielding. For the Guides for authorization and inspection we used as model the IAEA TECDOC –1113 [7].

We approved in 2000 The Regulation of Radioactive Waste [8] and adopted in 2002 the IAEA Regulations for the Safe Transport of Radioactive Materials (ST-1, Revised, 1996) [9]. In 2003 we will approve the National Emergency Plan together with several Nicaraguan Institutions. Before we approved these regulations we had the visit of IAEA Experts for training courses, recommendations for our reality.

Before the implementation of these regulations we sent our inspectors to others countries in Latin America and we received several experts and equipments with the co-operation of the IAEA. All our inspectors have a university degree and all our equipments are working. The UNAN- Managua do the technical matters (quality controls, personal dosimetry, etc) and the Health Ministry the legal regulatory matters.

We wrote two books for the basic radioprotection courses, Fundamentos de Física de Radiaciones, Protección Radiológica y Aseguramiento de la Calidad [10] which consider basic physics related with radiation and basic practical radioprotection recommendations and quality and Fundamentos de Radiobiologia en Proteccion Radiologica y Radioterapia [11] which consider the ICRP 60 [12] about radiobiology and some special calculations using the linear quadratic equation in Radiotherapy.

3. Conclusions and Recommendations

- The most important international partner for the CONEA was the IAEA. We are working also with WHO and other organizations. The influence of the Agency in the scientific, technological and social level was powerful. At national level the most important partner was the UNAN-Managua but we are working very good with the Labour Ministry and the Social Security because they also control some institutions. We are working also very well with the Radiological Society.
- We have tried and try to motivate the institutions to obtain the license as a symbol of quality and safety. We are doing lectures about Licensing. When an institution do not answer than we used the law.
- A positive experience was the transfer of the experiences of the Latin American countries. We saw that some of them have different points of view of the regulatory work.
- Other positive experience was the consensus between the IAEA and the national counterpart for the technical and organizational questions in the implementation of the model projects.

- A negative experience was that some special standards are no international or do not exist in Spanish (e.g. shielding and quality controls in diagnostic). It was a problem for the legal process of licensing. I recommend that the IAEA try to do the missing standards.
- It is very important to have a minimal technical level to implement the routine measurements. However for the sustainability of the infrastructure it is necessary to calibrate the national reference equipments, which cannot be calibrated in the own country. For small countries with few resources it represents an economic and technical problem to solve.
- Other parts of the sustainability are the qualified personal and low resources. Our strategy was:
  - The inspectors have to be usually physicists.
  - They have to work in two institutions: one of them for regulatory and the other for scientific work. (We know that it is not the ideal case, but it's worth!)
  - The interaction with the IAEA was and is a very good motivation for the CONEA.
- The CONEA has the group with the highest scientific level in radioprotection and quality control in Nicaragua with a very good credibility in the country.
- I recommend the peer review missions. By these missions the experts with high scientific qualification have to take into account as reference the IAEA standards and Tecdocs. That was in our case and we have learnt from their recommendations.
- The author recommends working with international standards. For developing countries it is hard but it is possible and necessary. At the beginning it was not easy but now we have the recognition of the others Nicaraguan authorities and scientific societies. The national authorities can obtain it with international co-operation.
- It is necessary in the future trainings on the job and equipments for special issues e.g. measurements of activity in contamination.

4. Acknowledgments

The author wishes to thank so much to the International Atomic Energy Agency for the very good co-operation throughout many years. Special thanks are for the Latin American Section who understood our situation and discussed with us the problems and the solutions in each step. The author wants also to give thanks to the experts all over the world who helped us to build our capacity.

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About the Infrastructure and Legislation of Radioprotection in Angola

M. C. Teixeira, J. J. Baptista

Unit for Nuclear Science and Technology
Ministry of Science and Technology
Angola

Abstract. The Republic of Angola has joined to the IAEA in September 1999. Since then, our country has started to promote and develop its programme on nuclear science and technology. The Unit for Nuclear Science and Technology has been designated as the National Authority responsible for co-operation with the Agency. In the country there are some applications of radiation sources, mostly in medicine, industries, including petroleum, diamond and breweries. Nevertheless, the national radiation safety infrastructure is greatly inadequate.

The top priority of the Agency´s technical co-operation programme is to bring the country in compliance with the International Basic Standards. The first IAEA TC Projects ANG/9/002 and RAF/9/027 are giving human and technical assistance to Angola in order to build a national radiation protection infrastructure and legislation. Together with the assistance of the IAEA´s missions we are correcting the first draft of National Law for Atomic Energy already presented to the Agency, improving the regulations and technical infrastructure for radiation protection towards the objectives of placing the Country in agreement with the international requirements.

With the help of Agency two radiotherapy disused sources existed in the National Oncology Center have been removed to South Africa for storing. The decommissioning of this Center has been carried out for establishing the favorable conditions to built up a new Oncology Center within the framework of the Agency´s Project for the cycle 2003 – 2004.

The existence of the construction of Radioprotection Laboratory will provide the necessary conditions for establishing the system for notification, authorization, inspection and occupational exposure control in Angola.

1. Introduction

The Delegation from Angola is pleased to participate in a series of international Conferences on National Infrastructures for Radiation Safety organized by the IAEA in co-operation with other international organizations.

The Republic of Angola has joined to the IAEA in September 1999.

Since then, our country has started to design, promote and develop its programme on nuclear science and technology through the Unit for Nuclear Science and Technology created by the Ministry of Science and Technology. The later has been designated by the Council of Ministers, in July 2000, as the National Authority responsible for co-operation with the Agency.

In the country there are some applications of radiation sources, mostly in medicine, industries, including petroleum, diamond and breweries. The X-ray facilities are used in medicine for diagnostic purposes, gamma Sources Cs-137, Ir-192 in industrial Non-Destructive Testing, fast neutron generators and neutron-gamma sources-in petroleum prospecting, gamma sources Cs-137-in diamond prospecting, gamma Cs-137 in breweries for production control.

Nevertheless, we have to admit that, so far, the national radiation safety infrastructure is greatly inadequate. There is an urgent need to put in place all these instruments because in the past the country has been living in a permanent conflict with the neighbour Republic of South Africa during the apartheid regimen when governing Namibia which at that time was its part and having with Angola a large common border. Considering that some unknown materials (eventually radioactive materials) were left abandoned in the country during the war, so that constitutes a concern since we do not know what it is still dangerous for human health and the environment seeing that the occurrence of cancer is growing day by day and the causes are not identified. In addition there is illicit traffic of radioactive materials at north border with Democratic Republic of Congo out of control. At same time linking with the civil war in the Country perhaps nuclear materials were abandoned in the battle fields by both military sides in an abnormal situation. These are just some premises that take us to think that in our Country will be had to develop research in the sense of finding the true causes of that concern as well as others phenomena.

2. Activities

Presently, we are carrying out some projects for capacity building and establishing technical infrastructure in the areas of radiation protection and radioactive waste management.

The top priority of the Agency's technical co-operation programme, in the near future is to bring the country in compliance with the International Basic Standards. In this regard a reserve fund of IAEA's first project ANG/9/002 and RAF/9/027 was attributed, consisting on giving human and technical assistance to Angola in order to build a national radiation protection infrastructure, which has started being implemented for some time.

Under the auspices of this Project, three IAEA's missions have been carried out to help us to set up a legal framework for conducting activities related to nuclear energy and ionising radiation in a manner which adequately protects individuals, property and the environment. The missions also, helped us to make a preliminary inventory of radiation sources existing in Angola for a regulatory framework for radiation protection, elaborating a Model Project RAF/9/027-National Regulatory Control and Occupational Radiation Protection Programmes for 2001-2002.

Together with the assistance of the IAEA's missions we are correcting the first draft of National Law for Atomic Energy already presented to the Agency, improving the regulations and technical infrastructure for radiation protection towards the objectives of placing the Country in agreement with the international requirements. These important documents will be prepared in the last step with the opinion of Agency, for the subsequent approval at the National Assembly.

Related to safety and radiation protection, we requested the IAEA to help to solve a problem of Cs-137 and Co-60 disused radiotherapy sources existed in National Oncology Centre. In response, the Agency sent to Angola three expert missions.

During the visits to the National Oncology Center it was confirmed the existence of the two radioactive radiotherapy sources (Co-60 and Cs-137), which were in bad conditions, nominally, in an advanced state of degradation. These sources have been removed to South Africa for storing. The decommissioning of National Oncology Center has been carried out for establishing the favorable conditions to build up a new Oncology Center within the framework of the Agency's Project for the cycle 2003-2004.

The existence of the construction of the radioprotection laboratory will provide the necessary conditions for establishing the system for Notification, Authorization, Inspection Enforcement and Occupational Exposure Control in Angola.

3. Conclusion

Angola is strongly interested in participating in the Model Project on Upgrading Radiation Safety Infrastructure in developing relations with African Countries-Member of AFRA and going to the AFRA regional projects to get the financial and technical assistance for establishing the adequate infrastructure and legislation for radiation protection in the use of nuclear energy for peaceful purposes, training human resources and transferring of technology in radiation protection and regulation control.

In order to reach that goal, documents like conventions, treats and others are already submitted by the Ministry of Science and Technology and Ministry of Foreign Affairs to the Council of Ministers awaiting for its approval. The first draft law and others documents which were presented and rejected by the Agency, they are now being reviewed for again after having discussed with the Agency to be sent to the Council of Ministers for its approval and enforcement.

Regulatory Control of Radiation Sources in Nigeria

S. B. Elegba, M. O. Ogharandukun, A. M. Umar

Nigerian Nuclear Regulatory Authority
Garki, Abuja, Nigeria

Abstract. Uses of ionizing radiation in the country are being brought under regulatory control for the first time in 40 years. Safety and security of radioactive sources are two of the major statutory functions of the Nigerian Nuclear Regulatory Authority (NNRA) which was established in 2001 by the Nuclear Safety and Radiation Protection Act 1995. These functions are carried out through the process of Regulations and Guidance; Authorization; Oversight functions; Emergency Planning and Response; and Ancillary Functions. A comprehensive inventory of sources and users is in progress and has proved to be a necessary condition for an effective regulatory control of radioactive sources in the country, which in turn will enhance safety and security. Some positive achievements have been recorded. But the NNRA still faces some challenges, which can be removed within the framework of the Model Project: "Upgrading of Radiation Protection Infrastructure". The most prominent of these challenges is the attainment of the "from cradle to grave" objective, arising from legacy practices and sources, which necessitate retroactive authorization.

1. Introduction

Nigeria does not have a nuclear power programme, but has a robust and rapidly growing nuclear applications. Peaceful applications of nuclear energy are carried out in about seven sectors of the national economy. These are the petroleum industry, mining industry, manufacturing industry, construction industry, agriculture and water resources, the health sector and in education and research. The petroleum industry is the largest importer and user of radioactive substances in the country. There are today in the country, a nuclear research reactor, a linear accelerator, a Tandem Accelerator, several neutron generators and x-ray analytical machines in the universities and research institutions. There are five radiotherapy centres and thousands of diagnostic x-ray units in Nigeria. There are several radioactive substances for various applications in these practices. These include nuclear well-logging, industrial radiography, nuclear gauging, radio tracing, etc.

Over the past four decades, the Federal Government of Nigeria made several attempts at controlling the use of ionizing radiation. In 1964 the Federal Government established the Federal Radiation Protection Service (FRPS) at the Physics Department of the University of Ibadan. The FRPS was established without an Act of Parliament and therefore lacked the powers to regulate and control the use of nuclear radiation. In 1971, a draft decree on Nuclear Safety and Radiation Protection was proposed by the FRPS and sent to the then Federal Military Government for consideration but was not promulgated.

Today the situation is different. In August 1995, the Government promulgated the Nuclear Safety and Radiation Protection Decree 19 of 1995[1], which provides for the establishment of the **Nigerian Nuclear Regulatory Authority (NNRA).** This was however established only in May 2001. These are two major milestones in the development of regulatory infrastructure in Nigeria, for which the IAEA can claim some credit. The **NNRA** has the overall responsibility for nuclear safety and radiological protection regulation in the country. Consequently, radiation protection, safety and security of radiation sources, safeguard of nuclear materials and physical protection of nuclear installations constitute the five major regulatory functions of the NNRA. The effectiveness of the regulatory control programme put in place by the NNRA has been well demonstrated by the London Times[2] publication of Sunday 6th October 2002. The system may be effective but is still not efficacious, as there are still several practices in Nigeria involving ionizing radiation that are not authorized by the NNRA! This is a major challenge. The regulatory system was also tested after a reported loss of control of two radioactive sources in the petroleum industry in December 2002.

2. The Regulatory Infrastructure

The Nuclear Safety and Radiation Protection Act of 1995 provides for the establishment of the Nigerian Nuclear Regulatory Authority (NNRA), which was established in May 2001.

2.1. 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:

— Regulating the possession and application of radioactive substances and devices emitting ionizing radiation;

— 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;

— regulating the safe promotion of nuclear research and development, and the application of nuclear energy for peaceful purposes;

— performing all necessary functions to enable Nigeria meet its national and international safeguards and safety obligations in the application of nuclear energy and ionizing radiation;

— advising the Federal Government on nuclear security, safety and radiation protection matters;

— liaising with and fostering co-operation with international and other organizations or bodies concerned having similar objectives;

— 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, and

— regulating, as appropriate, the exploration, mining and milling of radioactive ores and other ores associated with the presence of radioactive substances.

2.2. Powers

The NNRA is empowered by section 6 of the Act to:

— 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, transport, storage and disposal of any radioactive material, nuclear material, radioactive waste, prescribed substance and any apparatus emitting ionizing radiation;

— establish appropriate register for each category of sources or practices involving ionizing radiation;

— license operators of nuclear reactors and other critical facilities listed under Category III in section 29 of the Act;

— issue codes of practice which shall be binding on all users of radioactive and prescribed substances, and of sources of ionizing radiation:

— review and approve safety standards and documentation:

— Protect the health of all users, handlers and the public from the Harmful effects of ionizing radiation;

— provide training, information and guidance on nuclear safety and radiation protection:

— 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:

— undertake investigations and research into ionizing radiation sources and practices: and

— 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 are 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, de-commission 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 Agency [3]. 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**, **license**, **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.

3. Regulatory Control Programme

The regulatory control of radioactive sources in Nigeria is derived from section 4(1) of the Nuclear Safety and Radiation Protection Act. The main elements of the regulatory control programme are:

— Regulations and Guidance

— Authorization

— Oversight Functions

— Emergency Planning and Response

— Ancillary Functions

3.1. Regulations and guidance

In accordance with sections 47(1 & 2) and sections 6(d & e), the NNRA is empowered to make regulations, issue codes of practice, review and approve safety standards and documentations. Shortly after the establishment of the NNRA, several Technical Committees were established to develop radiation protection regulations for radiotherapy, diagnostic radiology, nuclear well-logging, nuclear gauging and industrial radiography. Similar committees were established for the nuclear research reactor involving siting, design, construction, installation, commissioning and operation. The draft regulations were later in April 2002 vetted by an IAEA expert under the Model Project. The vetted draft was then later submitted to the Federal Ministry of Justice for gazetting. The result of all these efforts led to the enactment of the *Basic Ionizing Radiation Regulations of Nigeria* ***(BIRRON)*** [4], which covers all uses of radiation sources in the country, except the research reactor. Efforts are currently in progress to develop *Guidance* for the various practices. It is important to note however, that multinational companies in well-logging and industrial radiography use the Guidance and *Local Rules* from their parent companies overseas. These are all being considered for adaptation and/or approval along with the IAEA draft Codes and published *Safety Series*. The same cannot be said for some of the indigenous companies and the radiotherapy centres. The need to standardize safety and security procedures amongst operating organizations in the same practice represents a challenge to the NNRA. With regards to standards, the IAEA standards have been adopted without any modification.

3.2. 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, manufacture, purchase, sale, import, export, handling, use, transformation, transfer, trading, assignment, transport, 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 authorization procedure involves the following stages:

- Notification/ registration by a prospective user or importer;
- Completion and submission of the Authorization Application Form, which demands specific answers to names of responsible officers, competencies, equipment, sites of operation/storage, radiation protection programme, calibration records, waste disposal agreement and local rules;
- Certificate of incorporation from the Corporation Affairs Commission;
- Certificate of registration with the appropriate trade regulatory body such as the Dept. of Petroleum Resources [5], the Nigerian Medical and Dental Council [6];
- Programme for the security of radioactive sources during use, transportation and storage to prevent sabotage, theft, fire, flooding and unauthorized use;
- Evaluation of the completed Authorization Form by the NNRA and the State Security Service;
- Pre-authorization Inspection of the premises and facilities of the registrant and transportation vehicle, where applicable;
- Review of the application;
- Issuance of the appropriate authorization for a specific period with specific terms and conditions.
- Copies of authorization are sent to the Comptroller-General of the Nigerian Customs Service, the State Commissioner of Police, the State Director of SSS and the State Commissioner of Health;
- Licensee informs the NNRA of the date of arrival of consignment or export.

The NNRA issues certificate of exemption, certificate for premises, licence to practice, licence to import radiation sources, permit to transport radioactive sources within the country and licence to export radioactive sources. Details of authorizations issued to date are contained in Table 1 below. Since the use of radiation sources in the country predates the establishment of the NNRA, retroactive authorization still occupies a major activity of the Authority and therefore a challenge.

3.3. Oversight functions

The Act empowers the NNRA to carry out certain oversight functions, which includes inspection, performance assessment, investigations and enforcement. In addition to the pre-authorization inspection stated in 3.2 above, the NNRA also carries out 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. 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 will be given in 3.4 below. Usually, this type of inspection may be carried out in the company of one or more security organizations. In this regard, the Act provides adequate empowerment for the enforcement of the law and where necessary imposition of sanctions. 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.

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.

Investigations of incidents and accidents can be carried out both by the NNRA and by the operating organization. In fact, in the event of an emergency or accidental exposure to radiation, the operating organization must not only report it to the NNRA, it must also investigate the incident and submit the report of such investigation to the Authority. Enforcement of the act is adequately provided for through several measures, such as invalidation or suspension or revocation of authorization (section 32), fine or imprisonment (section 45). Some examples in this regard will suffice.

— Based on a newspaper report [7] in September 2001, 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 here 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.
— The operating organization formally reported a fire incident, which involved a building housing two radioactive sources, 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 such a time for final decommissioning of the sources.
— A source was reported lost/stolen by an oil well-logging company. The case was investigated with the assistance of the Agency. Search for the sources is still ongoing. The operation of the company has been suspended.
— Radiological audit inspections were carried out in all the 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.
— An investigation was carried out at a radiotherapy facility on the basis of some concern over the clinical radiation dosimetry of the facility. The Agency also assisted in the investigation. The facility has now been given a clean bill of health.

3.4. Emergency planning and response

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 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 counter-measures. 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 Authority to establish in cooperation 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)[8], 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. It is envisaged that the Agency will assist the NNRA in developing the National REPP. In addition to NEMA, other regulatory bodies such as DPR, NMDC, the Nigerian Police, the Federal and State Ministries of Health, the Nigerian Fire Brigade, etc will participate in the project.

In 2001, the NNRA received one emergency call connected to a fire incident in a research facility that makes use of radioactive sources. Here 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 this time connected with loss of control of radioactive sources. In this second case, the sources were itinerant and this therefore made the incident a bit difficult for the Authority to handle. Hence, the NNRA invoked the Notification and Assistance Conventions by requesting for the Agency's Assistance. The assistance was given.

3.5. Ancillary functions

Section 11 of the Act provides for the establishment of the National Institute of Radiation Protection and Research. Furthermore, the Authority is empowered by section 6(g) to provide training, information and guidance on nuclear safety and radiation protection. Thus, the Ancillary Functions envisaged for the Authority therefore include research, training, workshops and conferences, public awareness campaigns and advisory services to government. In the last two years, the NNRA has published seven advertorials in three different national newspapers on its various activities, directed particularly at all organizations using ionizing radiation to register with the Authority. Furthermore, the NNRA in February 2003 organized a two-day workshop for Chief Medical Directors of the tertiary medical institutions. Similar workshops and training courses are scheduled for the rest of the year and beyond. The establishment of the National Institute of Radiation Protection and Research is planned for 2004.

4. Inventory of Sources

In Nigeria, peaceful applications of nuclear energy are used in the health sector, the petroleum industry, mining industry, industrial sector, education and research. In 2002, about one third of the country was covered, while the remaining part will be covered in 2003. A survey of all users of radiation sources in the country is still in progress. Data generated from the survey have been very useful for the regulatory control programme. Thus, 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 Agency, Regulatory Authority Information System (RAIS), has not been found useful. The version of the software given to NNRA has always had problem 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, the NNRA, in January 2003 also contacted the embassies of some 10 countries from which radioactive sources have been imported to Nigeria for assistance. The assistance sought was to use the good offices of the embassies to contact the respective national custom service for data on radioactive sources exported from their respective countries to Nigeria between 1995 and 2002. Unfortunately, only one embassy responded. Summary of the inventory of radiation sources is contained in Table 2. The inventory and therefore the regulatory control programme have been greatly assisted through various international cooperation programmes, such as the IAEA Model Project and AFRA. 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.

5. Challenges

Nigeria has for a very long time been engaged in peaceful applications of nuclear energy in an unregulated environment. It will require education, consultation and dialogue to enforce compliance with the new law. The NNRA needs to develop adequate physical infrastructure, train its personnel and provide the specialized equipment necessary for its operations. It needs to foster strong cooperation with the Nigerian Customs and Immigration Services since all radiation sources are imported into the country from diverse sources with different codes of practice and different levels of compliance. It also needs to foster strong cooperation with the law enforcement organs (such as the Nigerian Police and the Department of State Service). Other challenges include, wrong labeling and documentation; retroactive authorization; 'loaning' of sources and subsequent loss of control; completion of the inventory of radiation sources; provision of radiation dosimetry service; training of NCS, NP and SSS personnel; provision of Radiation Monitoring Equipment for the major port of entry as a model; Cooperation with members of the Supply Group countries; tracking of frequently imported sources such as Ir-192; Incidents of missing/orphaned sources; and adequate funding

6. Conclusion

The following achievements have been attained:

— Development of the Basic Ionizing Radiation Regulations of Nigeria (**BIRRON).**
— Limited inventory of radiation sources.
— Authorization of all activities involving the use of radiation sources.
— Licensing of the siting, design and construction of a research reactor.
— Successful intervention in cases of radiological emergency.
— Workshop for senior medical doctors.
— Training of newly recruited staff.

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TableI. Inventory of users

Practices	No of users
Radiotherapy	7
Radiology	1,304
CT-Scan	12
Nuclear Medicine	4
Industrial Radiography	54
Well-Logging	6
Nuclear Gauges	4
X-ray Analytical	1
Gamma Irradiator	3
Non-Medical Accelerators	8
Research Reactor	1

Table II. Inventory of sources

Radioactive source	Number
Cobalt-60	24
Caesium-137	94
Iridium-192	52
Iodine-131	1
Iodine-137	1
Iodine-139	1
Americium-241 Beryllium	69
Selenium-75	6
Technetium -99m	1
Radium-226	12
Strontium-90	34
Tritium-3	28
Potassium-40	1
Cobalt-57	9
Cadmium-109	1
Scandium	1
Antimony	1
Yttrium-90	1
Iron-55	1
Plutonium-239	7
Thorium-232	12
Natural Thorium	3

The Development of Regulatory Procedures in Ireland

C.P. Hone, S. Fennell, A.T. McGarry

Radiological Protection Institute of Ireland
Dublin, Ireland

Abstract. Within the framework of the IAEA Model Project on Upgrading Radiation Protection Infrastructure, the first milestone is the establishment and promulgation of laws and regulations on radiation safety followed by the establishment of an adequately resourced and staffed regulatory authority to enforce the regulations. If the Regulatory Authority is to be effective in enforcing the regulations and upholding radiation safety standards generally it must develop a set of procedures to evaluate applications for authorizations (licences) for practices involving radiation sources and to keep these practices under surveillance. This paper outlines the procedures that have or are in the course of being established by the regulatory authority in Ireland, The Radiological Protection Institute of Ireland (RPII), for this purpose The paper includes an overview of the Regulatory Infrastructure in Ireland and the procedures to be followed in assessing licence applications and for dealing with instances of unlicensed activities involving radiation sources and other non-compliances.

1. Introduction

The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources Ref. [1] mark the collimation of efforts that have continued over the past decades towards harmonization of radiation protection standards internationally**.** The requirements for implementing these standards are outlined in IAEA-TECDOC-1067-*Organization and implementation of a national regulatory infrastructure governing protection against ionising radiation and the safety of radiation sources.* Ref. [2].

This paper outlines the procedures that have been established to ensure compliance with Irish legislation on radiation protection and with high standards of radiation protection generally

2. Regulatory infrastructure in Ireland

2.1. The Radiological Protection Act

The primary legislation governing safety in the uses of ionising radiation in Ireland is the Radiological Protection Act, 1991 Ref. [3].

The Act gives the Radiological Protection Institute of Ireland (hereafter called the Institute) the functions and powers which enable it to be the regulatory body for the control of radiation sources and radioactive materials in Ireland. In particular, Section 8 of the Act requires the Institute "*to carry out a licensing system relating to the custody, use, manufacture, importation, distribution, transportation, exportation or other disposal of radioactive substances, nuclear devices or irradiating apparatus"*. Section 30 of the Act elaborates the framework for the licensing system; in particular, it provides for conditions to be attached to licences issued by the Institute, for the amendment or revocation of licences and for the charging of licence fees. Sections 28 and 29 deal with the appointment and powers of inspectors, while Sections 40 and 41 deal with offences and prosecutions.

2.2. The Ionising Radiation Order

A Ministerial Order (The Radiological Protection Act, 1991 (Ionising Radiation) Order, 2000) Ref. [4] made under the Act in May of 2000 consolidates previous regulations and, in particular, provides for the implementation in Irish law of the 1996 European Union Directive laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation [5]. This legislation designates the Institute as the competent authority.

It requires all practices, including the custody, production, processing, handling, holding, storage, use, manufacture, importing into and exporting from the European Union, distribution, transportation, recycling, re-use or other disposal of radioactive substances and nuclear devices, to be licensed by the Institute unless the exemption conditions are met. The exemption levels do not apply to disposal, recycling or re-use of radioactive substances arising from a licensed practice and, at present, there is no provision for clearance of contaminated material.

2.3. Inventory of radiation sources and radioactive materials

Currently, there are approximately 1,260 licences in force. The Institute issues licences based on the type of source to be used and the nature of the use. The number of licensees by category is given in the table below. Of the total number of licences, some 850 are in respect of irradiating apparatus only and are issued principally to dentists and veterinary surgeons. The remaining licences involve sealed radiation sources and/or unsealed radioactive substances, which are used in medicine, industry or education.

3. Licensing and Inspection

3.1. Licensing

The procedures for assessing a licence application and for issuing a licence are set out in the Regulatory Service's Quality Manual. These procedures are written to meet the requirements of the International Standards Organisation Ref. [5] and may be summarised as follows:

— A written application using the appropriate application form for a licence to the Institute must be made before possession of the source is permitted and must include all relevant documentation (i.e. risk assessment, radiation safety procedures, and, in the case of sealed sources, written assurance that the supplier will accept the return of the source when no longer required by the applicant). Depending on the licence category, licences are issued for terms of between one and four years with shorter terms applying to the more hazardous activities. An application for renewal of a licence must be submitted to the Institute by the licensee 30 days prior to the expiration date of the licence. At the time of renewal, the licensee must ensure that the inventory of sources is up-to-date and that the radiation safety procedures have been reviewed.

— A licence amendment process allows licensees to request changes to their authorisation and other licence conditions as required. Supporting documentation for amendment applications must be provided. In some instances, i.e. purchase of a new source or change in work practice, modification of the risk assessment and radiation safety procedures may be required and any revisions must be forwarded to the Institute within 30 days of the date of licence amendment.

3.2. Inspection

A routine announced inspection programme based on the licence band (industrial, medical, education/research, distribution and others) is drawn up at the beginning of each year. As a guideline, the Institute aims to inspect each licensee (with the exception of dentists and veterinary surgeons) at least once during the licence period. In the first place, the programme is designed to ensure that those licensees where the greatest potential radiological risks exist are inspected. Priority is then given to those licensees who have not been visited by Institute inspectors or who were last inspected outside the current licence period. A total of 82 inspections were undertaken in 2002. In advance of the inspection, the licence, radiation safety procedures, previous inspection reports and incident or event reports are reviewed. Standard inspection audit forms (based on the category of licence) are used to guide the inspector and document the inspection details. Approximately five to ten days following the inspection, a summary letter specifying the required actions is forwarded to the licensee with a response date of four to six weeks.

4. Enforcement

The procedures for dealing with non-compliances are set out in the Regulatory Service's Quality Manual. These procedures are also written to meet the requirements of ISO.

Options available to Regulatory Service for dealing with non-compliances include sending a letter to the licensee instructing him/her to carryout specified improvements within a prescribed time-scale, formal enforcement notices, which may include a requirement that the licensee ceases carrying on the practice, prosecution and licence withdrawal or suspension. The option decided upon will reflect the seriousness of the non-compliance. Since the Institute was established in 1992, 29 prosecutions have been undertaken for various offences, the majority in respect of failure to hold the appropriate licence.

5. Conclusion

This paper outlines the radiation protection infrastructure in Ireland. It will be noted that this meets the requirements of the Agency in that it includes laws and regulations, a national regulatory authority, an inventory of radiation sources, system of authorization (licensing), and inspection and enforcement procedures.

It is believed that the many of the attributes of the radiation protection infrastructure in Ireland provide a good model for other non-nuclear countries which are in the process of developing or establishing a radiation protection infrastructure. It should be emphasised that the licensing inspection and enforcement procedures are regularly reviewed to ensure that the Regulatory Service of the Radiological Protection Institute of Ireland remains focused on ensuring that high standards of radiation safety prevail in all workplaces where radiation sources are used

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Topical Session 8

PERFORMANCE EVALUATION

Effective and Independent Regulatory National Infrastructure *Uruguay case*

A. V. Nader

National Direction of Nuclear Technology
National Regulatory Authority Uruguayan
Ministry of Industry, Energy and Mining
Montevideo, Uruguay

Abstract. Since inception in 1986 the National Direction of Nuclear Technology has fulfilled with the assignment known as "Control of the ionizing radioactivity in its medical and industrial applications". This strategic task as far as safety, was performed with significant and crucial deficiencies which they even motivated the users to question the reliability of the institution. The deficiencies were mainly as follows: 1) absence of a regulatory frame; 2) insufficient qualification of technical human resources and 3) lack of suitable equipment. From the use for Uruguay of the Model Project and the beginning of a new management of Dinaten (October 2000), a sensible and well-known increase in the quality and efficiency of the regulating function in the country, which we can summarize in the following landmarks: regulatory frame with the use of a basic norm and eight regulating norms according to the main practices that are developed in the country; intensive training of the regulatory body staff; permanent accomplished update of the inventory of sources; beginning of licensing activities; equipment of last generation; regulation of the personal dosimetry services and management of radioactive waste and establishment of a National Program of Radiological Emergencies.

1. Introduction

The primary and superior target of the present management of Dinaten has been the upgrading of the infrastructure of radiological safety, in order to improve in sustainable fashion its assignment like Regulatory Authority. The goal is to technically consolidate the Model Project and to obtain its effective autonomy as an entity. To accomplish this, the Model Project has been created as an effective and necessary instrument by means of which the predicted strategic targets are being obtained.

2. Reached Goals

2.1. In the regulating area

It was elaborated and it was approved by ministerial resolution the basic regulations of protection and radiological security", norm uy the 100 and following applicable norms in the following practices:

- norm uy 101 "radiological safety for the operation of industrial gammagraphy".
- norm uy 102 "use of sealed sources in brachytherapy".
- norm uy 103 "operation of linear accelerator of medical use".
- norm uy 104 "operation of Co^{60} equipment".
- norm uy 105 "use of not sealed radioactive sources in nuclear medicine".
- norm uy 106 "management of radioactive waste".
- norm uy 107 "safe transport of radioactive materials".

— norm uy 108 “ radiological safety for the practice of medical and odontological radiodiagnostic” and its annexed “ radiological safety for facilities and x-rays equipment used in the control of luggage and load”.

The project of law of radiological safety was drafted and is presently under congress review. It is important to remark that the lack of a suitable regulatory frame in connection with radioprotection was detected by extensive and detailed peer review done by experts. It is so, that different and precised norms were designed ut supra, which were approved without delays and put in place. Simultaneously a law project is drafted which unifies the different norms under which the regulating institution performs and fulfills its assignment’s nouns, until and finally the project becomes a law, by means of which we will have among others the possibility of counting on the coercion power.

Once completed with the national inventory of ionizing radiation sources and settled the Regulatory Authority Information System - RAIS, which stays updated in dynamic form, having itself registered 1.313 sources in the whole country, including radiodiagnostic, x-ray, nuclear medicine, industrial gammagraphy and industrial measurers. As far as them inspection and control of the sources were carried out inspection of equipment and facilities in the following areas: brachytherapy, x-ray, nuclear medicine, medical and odontological Rx; also new areas were inspected like: industrial measurers, industrial gammagraphy, equipment of Rx for the control of people and luggage in airports. During year 2002, we were emitted 484 authorizations altogether to operate; having exceeded itself thanks to the new strong regulatory body, the effectiveness and deficiencies of previous years.

Equipment of measurement of last generation like Geiger accountants, ionization chambers, detectors of Rx, neutron sounding were obtained.

New recording equipment for each area of the regulatory division was acquired and settled as a server and internal network of communications between the different positions.

The Web page of the Dinaten has been designed to easily locate the effective norms and the different instructive forms for the activities that the division continually develops and update; providing the user the opportunity to unload directly from the Web.

They were elaborated according to the new effective regulating norm, the self-adhesive posters of identification of the areas or are controlled or supervised areas and were given to the users free.

The process of granting of licenses of operation to institutions and individual permissions to people started. First authorizations and permissions have been granted recently.

As far as the qualification and updating of all personnel committed to regulating activity, within the framework of the agreement signed by the Dinaten and the Nuclear Regulatory Authority of Argentina - ARN - one is becoming qualified to the technical and administrative personnel in the Argentina Republic, or through personal training like by the concurrence of professionals to the courses of PhD. and technical level in radiological safety.

The referred relationship between both regulatory institutions of Uruguay and Argentina was achieved via the Model Project, and has been recognized as a start-up landmark as far as the interaction between regulatory organisms in the region.

Missions of qualified experts have been received for the training of people in charge of radiological safety in the areas of nuclear medicine and external beam therapy and in management of radioactive waste.

It has been dictated of a cycle to char them on the part of technical personnel to the administrative personnel of the division, on basic concepts that do to the activities of the regulating authority gathering acquired concepts in the courses and training on the job, before mentioned.

We are working in the implementation of quality management system interested in obtaining the corresponding certification in a medium term.

2.2. In the area of control occupational exposition

The norm that was approved establishes the “indispensable requirements for the evaluation of the competent of the services of individual control of the exposition to the external radiation by photons” and culminated with the process of transference of the service of personal dosimetry to the division promotion and development, reserving the regulating authority the control of the public and private institutions that offers this service.

2.3. In the area of control of the public exposition

An agreement with the University of the Republic facilitated and allowed the entrance without cost for the user, of sources of Co-60 in disuse in the premises of storage located in the nuclear research center that belongs to the Faculty of Sciences. The Dinaten will take the control from the management of sources in disuse and radioactive waste.

2.4. In the area of answers for cases of emergency

The decree project was elaborated restoring the national plan of radiological emergencies, within the framework of the National System of Emergencies

3. Goals predicted to reach

3.1. In the institutional area

To consolidate the Uruguayan Nuclear Regulatory Authority like recognized and independently effective technical institution.

3.2. In the regulating area

— approval of the Law of Radiological safety.

— approval of the National Plan of Radiological Emergencies.

— to increase the process of licensing and the granting of leave.

— to continue with the qualification and training of the regulating staff.

— incorporation of equipment adapted to the inspectivas tasks.

— to make them inspection of x-ray with own personnel.

— ministerial approval of the second group of regulatory norms according to the following structure:

  - norm uy 109 “individual license for the use of radioactive material in human beings”
  - norm uy 110 “individual license for operators of equipment of industrial gammagraphy”
  - norm uy 111 “operation of panoramic plants of irradiation, type IV”
  - norm uy 112 “schedule for the presentation of the documentation before the putting in operation of an irradiation plant”
  - norm uy 113 “individual license and specific authorizations for the personnel, in the operation of irradiation plants”
  - norm uy 114 “design of panoramic industrial plants of irradiation, type IV, with deposited radioactive source under water”
  - norm uy 115 “requirements of psychophysical aptitude for specific authorizations in an irradiation plant”
  - norm uy 116 “industrial measurers”.

4. Effectiveness of the regulatory body

Since the approval of the basic regulation of radiological safety in June 2002, 8 regulating norms were approved for the first time in our country, which are detailed in point 2.1. Two external inspectors were contracted for the medical and odontologic radiodiagnostic practices. The inspections in all the practices increased in 27 % average. We have a new and modern protocol to make inspections in radiodiagnostic (conventional, fluoroscophy, mamography and computed tomography). Now we have an annual plan of inspection and a calendar of the new ones.

In the field of the radioteraphy, now we make the inspections with the technicians of our own regulating staff, thanks to the training received by the project model

5. Conclusion

The precondition for a suitable regulating infrastructure is the education and the training of all human resources. Through the Model project, the education and advance of our regulating staff in Uruguay is allowing us, in such a short time, to present a regulating structure well-known improved cradle in three landmarks:

— Qualification with training.

— Regulation.

— Suitable equipment.

The task is permanent. We want to obtain a continuous and dynamic improvement to approach the most efficient safety systems and protection. Our experience with the Model Project has been and is extremely positive. It became our strategic guide on which we are working and we hope to be able to consolidate an efficient regulating authority.

Regulatory Infrastructure for Radiation Safety in Belarus
Lessons learnt and a way ahead

V. A. Piotukh[a], A. V. Sonin[b]

[a]Directorate for Supervision of Industrial and Nuclear Safety (Promatomnadzor)
Ministry for Emergencies, Minsk, Belarus
[b]Division of Ecological, Scientific and Technical Co-operation
Ministry of Foreign Affairs, Minsk, Belarus

Abstract. The paper deals with assessment of the effectiveness of regulatory infrastructures for radiation safety in the Republic of Belarus. It identifies weaknesses and provides recommendations for improvement based, in part, on the findings of an IAEA Peer Review Mission carried out on October 7-11, 2002.

1. Introduction

The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS) of 1996 became a milestone in international efforts towards harmonization of radiation protection and safety standards. To be in compliance with BSS, a national radiation safety infrastructure should correspond to the level of usage of radiation and radioactive material.

Despite some progress made over the last years, numerous problems remain to be solved in Belarus to achieve a satisfactory status of the overall infrastructure, including an effectively independent regulatory body with adequately trained staff.

According to the IAEA safety standards 'a regulatory body shall be established and maintained which shall be effectively independent of organizations of bodies charged with the promotion of nuclear technologies or responsible for facilities or activities' and, furthermore, 'the regulatory authority shall be provided with adequate authority and power, and it shall be ensured that it has adequate staffing and financial resources to discharge its assigned responsibilities' [1].

Following an invitation of the Government of the Republic of Belarus, an IAEA Peer Review of the existing regulatory infrastructure for protection and safety of radiation sources in Belarus was carried out from 7 to 11 October 2002. The Peer Review Mission was based on the Agency’s service for assessment of the radiation safety regulatory infrastructure (RSRI) [2]. It was the second peer review of the radiation protection infrastructure as the first one was conducted from 10 to 13 September 1999 within the framework of the Model Project on Upgrading Radiation Protection Infrastructure (RER/9/056).

The paper is intended to address a number of issues related to the establishment and maintenance of an appropriate regulatory infrastructure implementing BSS in Belarus.

2. Current Situation

The break-up of the Soviet Union gave birth to the need to establish and/or revise legislation in many important areas. That was particularly the case with nuclear legislation, because all the activities involving nuclear and other radioactive materials had been carried out in accordance with the normative documents of the Soviet Union. It should be noted that Belarus does not have NPPs, but we have had quite a developed program of nuclear applications. Now there are about 60000 ionizing radiation sources used in Belarus, mostly in industries and medicine. They belong to about 1000 users and a license is required for the use of about 40% of them.

In the Republic of Belarus there are two main regulatory authorities in the field of radiation safety: Ministry for Emergencies and Ministry of Health. Besides, some other governmental bodies are also entrusted with important responsibilities for ensuring radiation safety (i.e. the Ministry of Natural Resources and Environmental Protection, the Chernobyl Committee and National Commission on Radiation Protection (with advisory functions to the Government).

In 2002 the former Committee for Supervision of Industrial and Nuclear Safety (so called 'Promatomnadzor') was reorganized into the Directorate for Supervision of Industrial and Nuclear Safety of the Ministry for Emergencies (Promatomnadzor). In practice it functions as an executive technical body of the Ministry of Emergencies, in particular for supervision of technical safety of radiation facilities (including the registry of sources, the preparation of regulations for technical safety, the licensing and inspection of radiation facilities). It should be noted that, as a result of the reorganization, Promatomnadzor has lost his independence and some regulatory functions have been remitted to the level of the Ministry for Emergencies (i.e. approval of regulations, co-ordination of activities with other regulatory/competent authorities in the field of radiation safety, decisions to be taken, etc.). However, it has not been so far clearly defined which divisions (specialists) at the Ministry responsible for executing these functions. The current organizational structure of Promatomnadzor is not well optimised so as to facilitate the effective performance of the functions of the state supervision of technical safety of nuclear/radiation facilities.

The Ministry of Health, through existing Sanitary Centres for Hygiene and Epidemiology (so called 'Gossannadzor'), is a regulatory body responsible for sanitary supervision during the use of ionising radiation sources (including the preparation of radiation protection regulations, the authorization of workplaces with radiation sources - through so called sanitary passports- and inspection of such facilities). However, Gossanndazor itself is within the Ministry of Health, which is a major user/licensee of radiation sources.

Two main regulations have been developed under the responsibility of the Ministry of Health: the Radiation Safety Norms (NRB-2000) and the Basic Sanitary Rules for Ensuring Radiation Safety (OSP-2002) based on national experience and BSS. However, there are old regulations and sanitary norms/rules from the former Soviet Union (i.e. for the transport of radioactive materials and standards (GOST) with technical instructions related to ionising radiation devices) still applyed.

The regulatory authorities maintain a satisfactory inventory of the radiation sources in use. However, notification (so called 'registration') by the users (in particular, to Promatomnadzor) is required in the authorization (licensing) process, but is not foreseen by the basic Law on "Radiation Safety of the Public". It is made obligatory through a Regulatory Resolution of the Council of Ministers and Resolution of Promatomndzor. In addition, Promatomnadzor does not require a licence for radiation sources with an activity or generating potential less than 740 GBq (20 Ci) or 150 kV respectively, and there are currently no formal systems/procedures for prioritising the licensing/inspection process on the basis of hazard of the sources in the registry.

The activities not exposures associated with their use or misuse. In addition, there is no procedure to check the accuracy of the notification/inventory system, with emphasis on radiation sources or practices with higher risks.

There are no inspection priorities/frequencies at the national level according to the hazard associated with the radiation practices/sources, and taken into consideration also past performance as evidenced by inspection history. The assessment of inspections is based mainly on the findings and number of penalties that the inspectors imposed.

There is no formal document describing the procedure for the inspection from its inception (e.g. announcement, beginning of the inspection with the responsible of the licensed facility, checklists of different type of inspected facility, final briefing with the responsible for the licensee) until the final conclusion of the inspection. The methodology of inspection is based on the procedures performed in the former Soviet Union. International procedures as stated in the IAEA-TECDOC-1113 are not yet adopted. The inspection reports are not subject to any legal/technical expertise and, then, there are missing the analysis of the effectiveness of the enforcement actions as a result of the inspections. In addition, there are no procedures for appeals against the inspectors' decisions during the inspections.

The inspectors from Promatomnadzor conduct the inspections mostly with respect to technical conditions of the devices used/operated. Besides, the conditions given in the sanitary passports issued by Gossannadzor are also checked. Only half of the inspections are performed together with the inspectors of Regional Sanitary Centres (Departments) of the system of Gossannadzor. Many inspections are in this sense doubled. licensed by Promatomnadzor, are subject to authorization by the sanitary services of the Ministry of Health (in the form of sanitary passport), which is requested for any activity with radiation sources, if they are not exempted from regulation according to the current regulations (NRB-2000). The sanitary passport is in a kind of authorization (i.e. licence). Firstly, it is a document required for issuing a licence by Promatomnadzor. Secondly, it is the only legal document for authorizing the possession/use of a radiation practice/source for those practices and activities where a licence is not needed. The sanitary passports are granted mainly in relation to the radiation protection and safety of the handling with radiation sources. However, medical exposure is not assessed in a full scope (e.g. patient doses in x-ray radiology, quality control of the devices) through these authorizations.

Although the regulatory authorities in principle can identify/locate radiation sources and users subject to its regulatory control through the existing registry of radiation practices/sources, there is no prioritization for maintaining control over sources in terms of the likelihood/magnitude of potential

3. Conclusions

The legal and regulatory framework for radiation safety has been established in the Republic of Belarus.The legislation in force provides basic empowerment to the national competent authorities with responsibility for regulating radiation protection and safety of sources. However, the regulatory programme for radiation safety, while formally functioning, is not as effective as it could be [2].

In particular, although the system of notification (so called 'registration'), and authorization (by licensing/sanitary passports) and inspection/enforcement is in operation, there are in practice overlaps/duplication of regulatory functions between the two main regulatory authorities involved (the Ministry for Emergencies and the Ministry of Health) during the process of authorization/inspection of radiation sources, with the potential for conflicts during the regulation of such activities and the duplication of the very limited human/financial resources in existence for such purposes.

The main reason behind it is of organizational nature. According to the IAEA safety standards 'the regulatory body shall be structured to ensure that it is capable of discharging its responsibilities and fulfilling its functions effectively and efficiently', and 'if the regulatory body consisits of more than one authority, effective arrangements shall be made to ensure that regulatory responsibilities and functions are clearly dtfined and co-ordinated, in order to avoid any omissions or unnecessary duplication' [1]. Unfortunately, in the Republic of Belarus the responsibilities and functions of the two regulatory authorities, as well as those of their subdivisions, are not properly devided, their structures are not optimized, they lack financial resources and staff, supporting infrastructures are underdeveloped. Therefore, in line with the recommendations of the IAEA Peer Review Mission, it would be beneficial to establish a single independent and effective regulatory system for nuclear/radiation safety and to enhance the licensing/inspection capabilities through a centralized/vertical state supervision of radiation protection and safety of radiation sources at the national level, joining the efforts/resources of the current authorities to this end.

International co-operation under the IAEA aegis is crucial to foster the exchange of experience on how to assess components and elements of the infrastructure, how to identify shortcomings, and how to implement required improvements.

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Implementation Experience with Model Projects

N. Kone[a], A. Dembele[b]

[a] Direction Nationale de l'Energie
Bamako, Mali

[b]Conseiller Juridique au Secrétariat Général du Gouvernement
Bamako,Mali

Abstract. According to the several applications of Nuclear Applications, The IAEA, in order to ensure the safety and security of ionising radiations sources. Thus, starting from the 80 years, the implementation of National RP Infrastructures in several countries through model projects has been engaged under the initiative of the Agency. We are going do tray an analysis of development of the activities in the field of these projects.

1. Introduction

The Republic of Mali is IAEA member state since 1961 and the TC started in 1975. Then, after 1980, began the implementation of the National infrastructure of radiation protection. Since that time up to now, we are still looking forward how to active that task.

2. Description

From 1986 to 1996, the organization and the implementation of the national radiation protection infrastructure task has been managed by the "Service de Médecine Nucléaire et de Radiologie" of the "Hôpital du Point G".

From 1996 to 1999, the management was performed by the "Direction Nationale de l'Hydraulique et de l'Energie" Then from the and of 1999 to now days, the "Direction Nationale de l'Energie" is managing that activity.

From 1986 to 1999, many thing have been done to set up a national radiation protection board, but without great success.

According to the first master plan which were given by the IAEA experts, the implementation should be done as follows :

- Radiation protection: Ministry in charge of health.
- Nuclear Applications: Ministry in charge of Energy.

Such structure has been implemented in some countries like South Africa

The countries which started up grading Boards since the years 70, have almost set up their boards from 1990 to 1999.

But up to now, there are several countries still looking forward to implementing their boards.

From 1999, the Agency has changed the strategy of implementing Radiation Protection infrastructures in member states.

Instead of having several structures sharing responsibilities in managing, the new tendency consists in having the managerial responsibility under a unique service.

2.1. Positive experiences

The model project has allowed many countries to built national boards and to up grad radiation and nuclear safety infrastructures. Thus, many countries have now days:

- Trained teams in the different aspects of radiation safety
- Wastes and sources are almost safe conditioned
- Several countries have their own secondary calibration laboratories
- Reactors are maintained in safe working conditions.

By organising regional and international meeting, workshops and symposiums, opportunities are given to countries for sharing experiences and thus to get solutions to some difficulties.

A main positive experience is the change of strategy adopted by the Agency in the way of organisation and implementation of National Infrastructures in members States. This change consists in:

- Considering radiation safety Infrastructure as a structure of control, and like so, must be independent from users, able to take write decisions.
- Considering radiological safety and sources security as parts of a unique body, a some managerial office has to be considered instead of several different services for managing the different aspects of safety and security in nuclear and radiological field.
- In relation with the world globalisation, the tendency to bring legislation and reglementations as closed as possible in their main points in the member states is of a great importance.

2.2. Negative experience

2.2.1. Inadapted strategy for implementation

- Several useless conflicts occurred in between the different departments intervening in the multy-management
- In many countries, the main users were also the radiation protection authorities. The problem of self control appeared here and there.
- The fact that users have been used or helped by the agency at the earlier time is today a very beg problem when it has come to make the radiation safety authorities independent from users. That is among the main reasons for which several developing countries have not been able to implement national infrastructures.

2.2.2. Focal points and national responsibilities

- In my own understanding, the question of radiation safety has been considered in our countries confused with the activity of the users. Thus, it has been treated as an operating subject of the different practices and not with an importance at the national level. So, the Governments have not been sensibilised to consider it as a national level subject, and that for a long time, say until 1999.

— Negative vision of nuclear application:
The peaceful nuclear applications are not known by a large part of the population as nuclear applications. People, in general, consider that there are only negative use of nuclear techniques. Such lack of information or understanding about peaceful use of nuclear application has played a great negative effect on the need of the implementation of radiation safety infrastructures in our countries.

— The miss understanding of the urgency of setting up such infrastructure by the structure in charge of its implementation.
In fact, in most departments in charge of implementing national infrastructure of radiation safety, the problem was not, for a long time, highlighted. It has been considered as a secondary task, and thus, no budget was defined for that task. And so, it is easy to think up how hard is a duty without budget.

— The lack of on efficient training:
In our countries, if any, it is a small number of persons, let us say until 1999, dealing with an understanding of radiation protection. Many persons had been trained but in the different fields of nuclear technique applications, but not in radiation protection. It is clear that people who had to implement radiation safety infrastructure in must country did not know how to do, and this one reason for which some of them have not been able to do anything others have just copied from elsewhere whiteout been able to adapt that to there reality.

We can also add the responsibility of focal points in broakasting information and the choice of persons to be trained.

2.2.3. Suggestions

- The Agency must take some measures in order to:

  i) Help latest countries to define an efficient program in training:
  ii) Evaluation of trained persons in these three last years.
  iii) Evaluation of focal structures or focal points activities in improving IAEA program
  iv) Evaluation of national homologues performance

- The agency should be able to address its appreciations to the member state Governments concerning the responsibility of the the persons appointed by the respective governments to perform the Agency Program.

Regulatory Infrastructure for the Control of Radiation Sources in Bangladesh

Present status and future direction

A. S. Mollah and C. S. Karim

Bangladesh Atomic Energy Commission
Dhaka, Bangladesh

Abstract. The Government of Bangladesh promulgated Nuclear Safety and Radiation Control (NSRC) Act in July 1993 to control and supervise the introduction and conduct of any practice involving sources of ionizing radiation. Necessary rules have also been promulgated in 1997 and efforts are now on to enforce the legal requirements. The Bangladesh Atomic Energy Commission (BAEC) has been empowered by the NSRC Act-93 to authorize and inspect regulated activities, issue guidelines and standards and enforce the legislation and regulations. The report describes the status of the radiation safety and progress made towards building an effective and sustainable national regulatory system.

1. Introduction

The Government of Bangladesh promulgated Nuclear Safety and Radiation Control Act in July 1993 to control and supervise the introduction and conduct of any practice involving sources of ionizing radiation. Before 1999, there was no significant development in building a radiation protection infrastructure; but during the last four years, Bangladesh actively co-operated with the IAEA in the framework of a regional IAEA Model Project for the development of radiation safety infrastructure. The inputs received through the IAEA Model Project coupled with demonstrated local commitment have immensely contributed to a transformation process and the current status of achievement. The paper focuses on the present status and thinking on future activities in view of the regulatory infrastructure for the control of radiation sources in Bangladesh.

2. Legislation

The Nuclear Safety and Radiation Control (NSRC) Act-1993[1] and the NSRC Rules-1997[2] are the legal basis for the control of ionizing radiation sources. Both the Act and Rules have been notified in Bangla, the national language. Authenticated English texts of the Act and Rules were also published.

NSRC Act (No. 21 of 1993) was promulgated on July 22, 1993- "to provide for ensuring nuclear safety and radiation control". The Act confers all necessary powers to the BAEC to regulate use of atomic energy, radiological practices and management of radioactive wastes. The Act requires a license to carryout any radiological and nuclear practice in the country. The NSRC Rules, in pursuant to the NSRC Act, were notified and put to force on September 18, 1997 (SRO No.205/Law'97). The Rules essentially incorporate the requirements of the International Basic Safety Standards (BSS)[3]. The Rules prescribe the manner by which a license has to be obtained.

3. National Regulatory Infrastructure and Control System

The Bangladesh Atomic Energy Commission (BAEC) is the Competent Authority for the enforcement of the law and rules. The Nuclear Safety and Radiation Control Division (NSRCD) of the BAEC is responsible for facilitating the implementation of the provisions of the Rules. The regulatory control systems are designed in the line with the main regulatory instruments such as notification, authorization, inspection and enforcement.

3.1. Notification

Users of radiation sources and equipment notify the NSRCD through application for import, export and authorization for practices. Arrangements have been made with the Ministry of Commerce so that any importation of radiation sources and equipment is subject to the clearance and approval by the BAEC.

3.2. Licensing

A set of procedural guide documents and applications forms, safety assessment protocols, and practice-specific guides has been developed and put in practice. It takes time to shake off age long inertia for enforcing licensing requirements. The licensing activities got some momentum from the middle of 1999, as may be seen in Fig. 1.

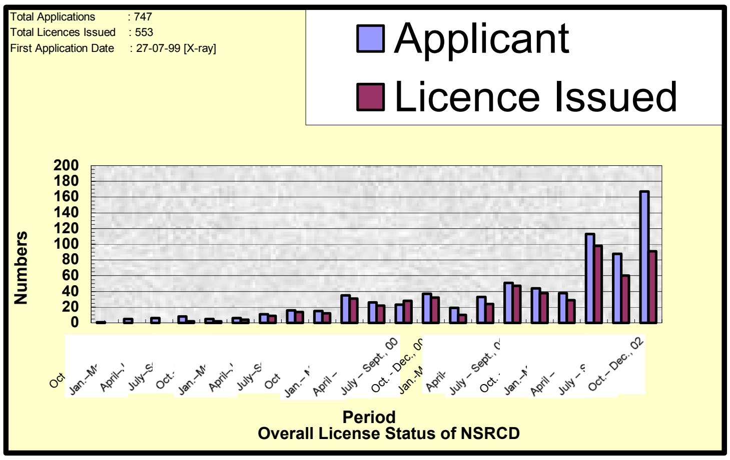

FIG. 1. Overall license status.

3.3. Inspection

In 1999, the NSRCD has established and activated an inspection plan. Now all radiation facilities (except X-ray installations) are routinely inspected once a year. Inspections are carried out according to procedural and technical guidance documents, and a system of monitoring is in place to ensure that inspection findings are communicated to the users in a timely and clear manner.

3.4. Enforcement

Some inadequacies of the existing Act have been noticed in the process of its implementation. The penalty and enforcement provisions are too severe and require amendment for quick and effective enforcement. The minimum punishment for non-compliance is imprisonment for three years with monetary penalty. Such s situation is making it difficult to impose penalties. In fact, till to date no penalty was imposed for any default.

4. National Inventory of Radiation Sources

Accounting of all radiation sources and safety assessments of the practices are the primary tasks for an effective regulatory program. But as late as April 1999, NSRCD had information on only 10% of the estimated sources. A nationwide survey-inspection program, therefore, was planned and carried out during May 1999 to July 2001. The findings of the survey were fed back to each facility for review, correction and comments.

Registration of radiation sources started in 1999 by distributing questionnaires to different institutions and departments in the country and simultaneously issuing announcements in the media. The response was significant; an up-to-date inventory now accounts for about 95% of radiation sources and radioactive sources.

The findings of all the practices were published in 78 volumes of the reports [4]. The copies of the reports were sent to the Government, concerned authorities and important libraries for appraisal and record and for use as reference.

5. Information Dissemination

The NSRCD, during the last four years, organized seven national feedback seminars. These seminars helped to create awareness, understanding and motivation among the management and the workers. To increase public awareness, besides using the mass media and targeted event-based promotion, the NSRCD is planning to create an information documentation facility, which will expand its public information outreach. A network is also planned for this purpose. Despite a serious limitation of capacity, in the past four years the NSRCD has promoted training in protection and safety among key target groups. The NSRCD during the last four years organized 15 national training workshops. Some of these training workshops were organized in collaboration with the IAEA and the WHO.

6. International Collaboration

The economic and cultural gaps among the countries even in this period of globalization and market economy are very wide and in cases widening. The situation is likely to prevail for a considerable time unless some drastic international steps are taken. Bilateral, regional and international interactions and collaborations may assist in achieving the goal. Coordination of the activities of the IAEA, WHO, ILO, and UNDP may accelerate the process of realizing the goal. The IAEA is contributing positively to this end.

7. Major Obstacles

Numerous challenges have been faced and tackled in the course of the implementation of the NSRC Act and Rules. The major ones which, reflect on its long-term performance are:

- challenges and complexity associated with retrospective licensing;
- sources imported long ago without proper documentation/license and lacking appropriate storage;
- lack of awareness among the stakeholders regarding radiation hazard & safety culture;
- lack of adequate trained manpower to run the radiation protection programmes in the radiation facilities of the stakeholders;
- lack of adequate fund for the regulatory body;
- stretching activities while developing the basic capacity.

8. Future Direction

The NSRCD has implemented with success activities pertaining to the implementation phase of the regulatory programme development. Through this exercise, the NSRCD has developed the key strategic assets and appropriate capabilities for building a credible and appropriate radiation safety infrastructure. The challenges of today and near future are:

- consolidating the current achievements and ensuring sustained operational effectiveness;
- continually ensuring appropriate performance monitoring, measurement and evaluation system;
- maintaining a continuous performance improvement;

— building a collaborative training and education programmes;
— building a national strategy for management of disused sources.

To achieve sustained effectiveness and efficiency, the NSRCD will pursue the following:

— pursuing for establishment of an independent regulatory authority;
— pursuing stakeholder involvement in building and maintaining national radiation safety infrastructure;
— continually augmenting technical competence and building credibility and confidence in different public and private sectors;
— building its ability to recruit, develop and maintain people with the required core competencies;
— ensuring adequate budgetary provision to support sustained operational effectiveness;
— maintaining dynamism and the ability to anticipate and respond to the emerging needs of the public;
— building a national training and education strategy on radiation safety;
— pursuing excellence in management and promoting professionalism.

9. Conclusions

The ionizing radiation practices are important for healthcare and economic development. The radiation sources can provide important benefits to individuals and societies when they are properly designed, safely used, and carefully managed. Effective national and international programmes are needed to ensure these characteristics, however, because these sources can represent a significant radiation hazard to public and radiation workers. Effective regulatory infrastructure is essential to ensure protection of the workers. Strong commitment, cooperation, communication and coordination of plan and activities of the concerned persons and authorities will be necessary.

The developing and least developed countries will need continued assistance from the UN bodies like the IAEA, WHO, ILO. Cooperation of the developed states, bilateral arrangements and Regional Cooperation Agreement programs will be useful to this end. International programmes to facilitate the exchange of information and experience among local, national, and international bodies are central to ensuring effective co-operation on the control of radiation sources. The IAEA has an important role to play, and it is playing it effectively. This conference is another key step of IAEA in achieving the common objective for radiation safety towards effective and sustainable systems worldwide.

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Reduction in Exposures to Radiation Workers in Tanzania

M. M. Nyaruba, A. M. Nyanda

National Radiation Commission
Arusha, Tanzania

Abstract. It is important to know the risk posed by the small annual radiation doses received by radiation workers in order to regulate exposures levels that are as low as reasonably achievable. We have conducted personnel monitoring of radiation workers in Tanzania during the period 1991-2000 and estimated the associated risk. The annual mean individual doses ranged from 1.0 mSv (research and teaching) to 2.6 mSv (diagnostic radiology) in 1991 and from 1.1 mSv to 2.0 mSv, respectively, in 2000. The corresponding associated risks of fatal cancer were 0.0004 to 0.0125 in 1991 and 0.0006 to 0.0095 in 2000. We conclude that today's radiation worker in diagnostic radiology has a 23% lower chance of radiation induced fatal cancer than he had in 1991.

1. Introduction

Personnel monitoring of occupationally exposed radiation workers in Tanzania have been systematically conducted since the establishment of the regulatory authority by means of the Protection from Radiation Act of the Parliament no. 5 of 1983. Two foreign companies (one from USA and another from UK) had been providing radiation protection services to only two centres (radiotherapy unit and diagnostic radiology unit) before, but the records of radiation workers had not been accessible. After the establishment of the regulatory authority all centres that were using ionising radiation in medicine, industry, agriculture, research and industry were registered, inspected and where appropriate, authorized. Our inventory shows that 75% of all sources of radiation in the country are used in medicine whereas only 24% are used in other fields [1].

The current study was initiated to compare the radiation doses that workers from different practices have been receiving for the past ten years and to calculate the associated fatal cancer risk to these groups.

2. Materials and Methods

Our study consisted of an annual average, over the period 1991-2000, of 117 (range 96-131) radiation workers in diagnostic radiology; 11 (8-12) in therapeutic radiology; 19 (16-23) in industrial radiography and 14 (11-16) in research and teaching both men and women over 18 years. However, the numbers became smaller (0-12) when we were looking for those who had been working continuously for the past 10 years.

Individual personnel monitoring has been employed using TLD 100 and TLD 700 cards manufactured by Harshaw Chemie Company. The TLDs are read by TLD reader system 2000 B+C (manual) and system 4000 (semi computerized) after being worn for 3 months [2]. The risk estimate of radiation induced fatal cancer was based on 4% per Sv for exposure to low doses and dose rates [3].

Hence for a dose of 2.6 mSv in diagnostic radiology in 1991 where 120 persons were monitored the risk was estimated as follows:

— 2.6×10^{-3} Sv x 4×10^{-2}/Sv x 120 = 1.248×10^{-2}, and similar calculations were performed for the rest.

3. Results

Table 1 summarizes the annual mean occupational doses for different practices during 1991-2000. The doses in diagnostic radiology were high in 1991 (2.6 mSv) but declined in 1992 (2.4 mSv) and became almost similar from 1993. The doses in each of the other practices changed little throughout our study period. Due to movement from one working place to another it was difficult to obtain cumulative doses in 10 years of many employees. The estimated risks due to radiation induced fatal cancer were calculated and we found that in diagnostic radiology the risk was reduced from 0.01248 in 1991 to 0.00952 in 2000 (i.e. 23%), whereas, research and teaching group presented the lowest risk of all the groups.

4. Discussion

This is the first study of radiation doses in Tanzania and the associated fatal cancer risks. Our results show that the occupational radiation doses for those persons who worked in diagnostic radiology facilities in 1991 were 23% higher than that in 2000. This may be due to poor radiological safety conditions in the facilities before establishment of the regulatory authority. A surprise radiation safety inspection conducted in 1992 to 35 unauthorized centres confirmed this after 80% of the X-ray machines failed the QC test and 85% of the X-ray operators were found to be unqualified. The doses however, started to become low from 1993 after the centres began to implement the recommended remedial measures. On the other hand, there have not been any significant changes of doses in other practices during the period, a situation that can be explained by availability of the skilled staffs in these facilities and repair services of the equipment that take place regularly.

Of late there has been some concern among some members of public that workers in the only available radiotherapy unit in the country receive higher doses than their colleagues in diagnostic radiology. However, from the annual doses received by radiation workers, this study suggests that there is no significant difference between the radiation workers in diagnostic radiology and those in therapeutic radiology.

According to BEIR V report [4] approximately one of five adults normally will die from cancer from all possible causes such as smoking, food, alcohol, drugs, air pollutants, natural background radiation and inherited traits. Thus, in a group of 120 (e.g. monitored radiation workers in 1991 in diagnostic radiology) we can estimate that about 24 (20%) will die from cancer without any occupational radiation. Using the risk factor of 4% per Sv for radiation induced fatal cancer [3] our data in diagnostic radiology for 1991 mean that the average radiation dose of 2.6 mSv received in 1991 may increase the risk of fatal cancer to the average worker in diagnostic radiology from 20% to 20.0125%. If one retired from working in 2000 (after ten years) and received a cumulative dose of 26 mSv then the estimated risk increases to 20.125%, which still indicates that the contribution due to radiation to the total risk is minimal.

The linear model [5] and Chadwick and Leenhouts [6] state that the radiation risk incurred by a worker is directly proportional to the amount of dose received. In this light, our findings merely suggest that a worker in research and teaching group stands less chance of developing cancer due to exposure to radiation as compared to those in the other groups. However, our future plan is to still lower the exposure to the radiation workers hence lowering the additional fatal cancer risk to the already pre-existing (normal) risk. This will be achieved through education, frequent surveillance and inspections of workplaces and enforcement actions.

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Table I. The annual mean occupation doses (mSv) for radiation workers in different practices. The numbers in brackets represent the range; SD is the standard deviation and N the total number monitored.

YEAR / PRACTICE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Diagnostic Radiology	2.6 (0.7-7.2) S.D=1.28 N = 120	2.4 (0.6-5.4) S.D=1.22 N = 105	2.3 (0.6-7.2) S.D=1.30 N = 96	2.3 (0.6-6.1) S.D=1.49 N = 124	2.2 (0.7-5.3) S.D=1.12 N = 124	2.2 (0.6-7.6) S.D=1.16 N = 131	2.1 (0.6-4.8) S.D=1.04 N = 118	1.9 (0.4-4.1) S.D=0.91 N = 116	2.1 (0.6-7.1) S.D=1.11 N = 118	2.0 (0.9-4.3) S.D=0.84 N = 119
Therapeutic Radiology	2.8 (0.9-5.2) S.D=1.49 N = 11	3.1 (1.1-5.2) S.D=1.41 N = 9	2.3 (1.1-2.9) S.D=0.67 N = 8	2.0 (0.8-3.2) S.D=0.78 N = 9	2.5 (0.9-5.2) S.D=1.34 N = 12	2.1 (1.1-4.2) S.D=0.88 N = 11	2.0 (1.1-3.4) S.D=0.81 N = 10	2.5 (0.9-3.5) S.D=0.74 N = 12	2.6 (1.1-4.1) S.D=0.95 N = 12	2.2 (0.9-4.3) S.D=0.58 N = 11
Industrial Radiography	1.9 (0.6-3.4) S.D=0.78 N = 17	1.7 (0.7-3.2) S.D=0.78 N = 16	1.6 (0.7-1.9) S.D=0.54 N = 19	1.9 (0.6-2.4) S.D=0.66 N = 17	1.6 (0.7-2.9) S.D=0.62 N = 19	2.0 (0.9-3.4) S.D=0.76 N = 20	1.6 (0.7-2.6) S.D=0.53 N = 18	1.7 (0.9-3.1) S.D=0.60 N = 19	1.9 (0.6-3.1) S.D=0.66 N = 19	1.6 (0.9-2.7) S.D=0.50 N = 23
Research and Teaching	1.0 (0.7-1.3) S.D=0.21 N = 11	1.1 (0.8-1.4) S.D=0.18 N = 14	1.1 (0.4-1.9) S.D=0.35 N = 15	1.3 (0.6-2.3) S.D=0.51 N = 15	0.9 (0.4-1.4) S.D=2.9 N = 16	1.2 (0.8-1.7) S.D=0.27 N = 11	1.1 (0.7-1.5) S.D=0.24 N = 15	1.0 (0.4-1.5) S.D=0.24 N = 17	1.1 (0.6-1.6) S.D=0.28 N = 16	1.1 (0.3-2.1) S.D=0.49 N = 13

Positive Results of IAEA Model Projects in Radiation Protection and Regulatory Control in Medical Radiology in Estonia

I. Filippova

Estonian Radiation Protection Centre
Tallinn, Estonia

Abstract. The medical use of ionizing radiation started at the beginning of the century. It has always been considered necessary, as well as for diagnostic applications where exposure to the patient is the price to pay in order to obtain useful images, as for therapy where the patient is exposed for purpose, in order to kill malignant cells. It is nowadays the major man-made contribution to the population dose. Even with the development of substitutive imaging or treatment techniques, there is still an increasing demand and many organizations are joining with their efforts to try to keep the dose to the radiation staff and patients "as low as reasonably achievable".The IAEA has encouraged and promoted over the years the use of radioactive sources and radiation devices in medicine. Through it`s Model Projects, the IAEA develops the current safety issues and the current safety infrastructures in it`s Member States.

1. Introduction

The national legislation (Radiation Act) nominates a national Regulatory Authority which is given responsibility for regulating any practices involving radiation sources. Estonian Radiation Protection Centre was established in January 1996. The general functions and responsibilities of Estonian Radiation Protection Centre in medical field are the following:

— development of guides and codes;
— assessment of applications for permission to conduct practices that entail or could entail exposure to radiation;
— authorization of such practices and of the sources associated with them;
— keeping records of all sources of ionizing radiation;
— keeping records of all radiation doses received by radiation workers and make estimates of doses received by the public;
— organization of education and training of radiation workers on radiation protection issues.

2. Legislation

During 1996 - 2002 Estonia developed national legislation concerning radiation protection in medical radiology:

— Radiation Act (was passed on 23rd of April 1997)
— Regulation No 56 of the Ministry of Social Affairs, dated November 13th, 1998 "Requirements for Use of radiation for Therapeutic Purposes and Diagnostics. Requirements for Protection of Medically Exposed Patients"
— Regulation No 68 of Ministry of Environment, dated October 1997 "Procedure for Registration of Radiation Sources".
— Regulation No 58 of the Ministry of Environment, dated July 1997 "Procedure for Issuing Licenses for Activities Involving Radiation".

Under the Model Projects we started the preparation of Radiation Protection Centre guides on radiation protection in medical field.

3. Education and Training

In the frame the IAEA Model Projects RER/9/062 National Regulatory Control and Occupational Radiation Protection Programmes and RER/9/065 Development of Technical Capabilities for Sustainable Radiation and Waste Safety our Regulatory Authority (ERPC) began the implementation of national system for training of the radiation personnel in medicine.

The first National Training Course on Radiation Protection in X-ray Diagnostic Radiology and Nuclear Medicine was held in November 2000 with the support received from IAEA. 20 radiologists and 1 medical physicist have participated in this course. The lecturers were two IAEA experts and local specialists who had taken part in more than five IAEA courses and seminars on the topics they would present.

The second National Training Course on Radiation Protection in Radiotherapy was held in September 2001. Most of the lectures were presented by IAEA experts, the rest of the lectures were presented by local specialists. 9 radiologists, 1 radiological nurse, 5 medical physicists and 5 radiation protection specialists participated on this course.

4. Licensing

Under the Model Project Estonia has developed national system of authorization. Specialists of Radiation Protection Centre worked out additional application forms for authorization and checklists for regular licensing procedure in medical radiology. When requesting a license for handling of sources of ionizing radiation, an applicant is requested to:

- ensure that radiation protection is performed during all types of relevant practices with the sources which they authorized;
- implement all measures imposed by specialists of ERPC;
- monitor, measure, evaluate, verify and record values, parameters and data with an impact on nuclear safety and radiation protection, including exposures of radiation staff and other persons, and prevent any leakage of radio nuclides or ionizing radiation into environment;
- report to ERPC any change or event impacting on nuclear safety, radiation protection, any case when limits have been exceeded or violated, and changes in any circumstances on which issue of the license was based;
- submit the following to ERPS with application:
  - QA programme;
  - QC programme and reports;
  - radiation protection programme, responsibilities;
  - monitoring (personal, working places, health) of radiation staff and reports;
  - patients dosimetry programme and reports;
  - emergency plan;
  - local rules, control and supervised areas;
  - training of radiation staff, qualification (programme, certificates);
  - radioactive waste management programme.

All of this information is being tested during the Licensing procedures . Until 1998 our licensing procedures were more formal checking only documentation in radiological departments. In the frame of the Model Project we have got equipment for radiation protection, QC and patient dose measurements. Specialists of Estonian Radiation Protection Centre participated in training courses which were held by IAEA under the Model Project on radiation protection, dosimetry and QC in medical radiology. Now licensing procedure includes dosimetry of working places and patients, QC measurements.

From 2001 the Estonian Radiation Protection Centre in co-operation with hospitals and professional societies provides activity on organization of QA system and assessment of patient doses in medical radiology. National dose reference levels are not established yet. During 2003 ERPC is planning to organize national training courses on patient dose measurements and optimization of medical exposure.

5. Conclusions

5.1. Problems in medical radiology

- practical implementation of ALARA principles on the working places, especially in interventional radiology ;
- evaluation of occupational internal exposure;
- introduction of national reference levels in x-ray diagnostics;
- introduction of maximum activities of radioactive materials which should be administrated to patient in nuclear medicine;
- introduction of QC requirements for dental radiology, nuclear medicine and radiotherapy;
- introduction of radiation protection requirements for special practices (mammography, paediatric radiology, interventional radiology, computed tomography, exposure of pregnant, health screening programmes);
- education and training of radiation staff;
- clinical audit is not established yet;
- categorisation (A and B) of radiation staff is not implemented yet into national legislation;

5.2. Positives in medical radiology

- licensing procedure in medical radiology is implemented according IAEA recommendations;
- good co-operation between Estonian Radiation Protection Centre, professional societies and radiation protection institutions of European countries;
- started QA system in medical radiology;
- started patient dose measurements ;
- started education of radiation staff on radiation protection;

5.3. Plans for 2003-2004

- training of radiation staff for new radiation protection tasks required in Medical Directive 97/43 Euratom;
- development of medical radiology QA system in co-operation with hospitals, professional societies, European collegues and international organizations;
- introduction of radiation protection requirements for radiotherapy, nuclear medicine, dental radiology, mammography and CT;
- establishment of national dose reference levels.

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RCA – A Regional Approach to the Establishment of National Infrastructures for Radiation Safety
The Philippine Perspective

E. M. Valdezco

Radiation Protection Services
Philippine Nuclear Research Institute
Quezon City, Philippines

Abstract. The Regional Cooperative Agreement (RCA) for Asia and Oceania is the first of four current regional programs of the International Atomic Energy Agency (IAEA). Organized in 1972, RCA now has 17 Member States- Australia, Bangladesh, Peoples Republic of China, India, Indonesia, Japan, Republic of Korea, Malaysia, Mongolia, Myanmar, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Vietnam. A number of projects related to applications of a wide range of nuclear technologies are conducted through RCA. In 1987, an RCA project was formulated and initially aimed at strengthening regional radiation protection infrastructures. The regional approach to addressing radiation protection issues allows Member States to take advantage of regional resources to solve common problems. The paper briefly summarizes the extent of nuclear applications in the country, which impacts directly on radiation safety, and the status of current initiatives that are being pursued to address a number of national issues in radiation safety. The Philippine participation in this project will be presented briefly with the benefits and achievements that resulted from this participation, such as; in the external dosimetry intercomparison programs, the establishment of an Asian Reference Asian Man and in the trialing of the Distance Learning training modules for radiation protection.

1. Introduction

There are two national regulatory agencies responsible for the safe utilization of ionizing radiation in the country. The Philippine Nuclear Research Institute (PNRI) of the Department of Science & Technology (DOST) is the national authority responsible for the regulation, licensing and safeguards of radioactive materials. The Bureau of Health Devices and Technology (BHDT) of the Department of Health (DOH) is the national agency in charge of radiation protection and safety of ionizing and non-ionizing radiation emitted by electrical/electronic devices.

At the end of 2002, there were about 311 facilities/hospitals authorized by the PNRI and about 3500 facilities registered and licensed by the BHDT. The use of radioactive materials and radiation-emitting devices in the Philippines has been increasing steadily over the past 15 years. The commissioning of the Gamma Knife Facility and the Medical Cyclotron/PET Facility, the increasing application of linear accelerators for medical treatment, and the introduction of a high-energy electron beam machine for industrial applications give rise to the need to further strengthen the national infrastructure for radiation protection. For this purpose, regulatory bodies have now adopted the IAEA International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (IBSS), among others into their respective regulations.

2. RCA Project in Radiation Protection

The project RAS/9/018 is one of four projects relating to radiation protection in the East Asia Pacific region. The other projects are the two Model Projects RAS/9/026, which covers Milestone 1 & 2, and RAS/9/027, which covers Milestone 3, 4 & 5 and a project on environmental monitoring RAS/9/024. The four projects complement each other and some activities are run jointly between projects. The RAS/9/018 project was initiated in 1987 and was implemented in three five-year cycles. The first phase was fully funded through extra budgetary contribution from the Japanese Government and was participated by 13 countries in the region. Since then, other countries, such as Australia and the other countries have made extra budgetary and in-kind contributions to the RCA. Phase III was completed in 2002 and a final meeting report was produced in the Final Coordination Meeting held in Hanoi in February 2003. A new RCA regional project RAS/9/029 on Harmonization of Radiation Protection is now being implemented beginning of 2003.

The RCA project RAS/9/018 is focused on regional training, workshops and Expert Advisory Group Meetings (EAGMs) relevant to the 5 milestones of the IAEA Model Project in Radiation Protection. The Philippine participation in the project activities has provided training opportunities to its technical staff that resulted in the updating and upgrading of their skills and knowledge and the opportunities for the exchange of technical knowledge and experiences among counterparts. Enhanced knowledge and skills of technical staff has resulted in the preparation of several regulatory documents, notably our standards for radiation protection consistent with the International Basic Safety Standards. The Philippines also hosted a number of training events under the framework of this RCA project and these hostings provided us the opportunity to provide training to a number of technical staff much more than if these were undertaken in foreign countries where nominations are rather limited. A Philippine Action Plan for the Safety of Radiation Sources has been formulated and its implementation periodically reviewed and revised accordingly. This action plan involves regulations, technical services, manpower training, and agreements with other concerned national agencies of government as well as collaborative efforts with professional societies and/or organizations.

3. Reference Asian Man

A Coordinated Research Programme (CRP) on Reference Asian Man was conducted in two phases. The Philippines participated in this coordinated research program in both phases. In the first phase, all necessary data on physical parameters for reference man were collected for setting up the Asian Reference Man. The second phase involved the collection of autopsy specimens and diet samples for the analysis of important elements in radiological protection such as cesium, calcium, iodine, potassium, strontium, thorium and uranium. These elements were measured by nuclear and complimentary techniques and 10% of these samples were analyzed in Japan for cross checking.

The NIST Reference Materials for bone, total diet and muscle were distributed by Japan to participating countries in the CRP for the internal quality control. Typical Japanese Diet material was also developed by Japan to supply reference materials of Asian composition to all participants for the certification for the elements mentioned earlier. Chemical analysis was made available by the laboratories in Austria, China, India, Japan and the USA. In addition to the CRP, training of technical staff was undertaken in Japan under the STA scientist exchange program.

The CRP provided data for the Asian Reference Asian Man that is used for the dose calculation for radiation protection purposes. A more important benefit to the Philippines is an improvement of measurement techniques in view of the cross checking of 10 % of the samples that were analyzed in Japan and the provision of high quality reference material for quality control. Results of Phase 1 and 2 were published in IAEA TECDOCs.

4. Distance Learning in Radiation Protection

The Philippines participated in the Phase 1 trials of the distance learning modules in radiation protection. In Phase 1, there were a total of twelve (12) participants from the Philippines, all from the Philippine Nuclear Research Institute. All the participants graduated from the Phase 1 trials, which covered the modules up to “Protection from Internal Radiation Hazards”. For Phase 2, the Philippine trials included participants from the Open University of the University of the Philippines, as well as from Cebu Doctors College in Cebu City. Fifty-four (54) students from seven (7) RCA countries, including Australia, participated phase 2 trialing of the training modules in radiation protection. The Philippine participation involved 17 students and three trial supervisors. The comments and suggestions on the distance learning materials gathered during the Phase 2 trials were used in the revision of the modules. The materials have been completed and sent to the IAEA for publication. Once these are published by the IAEA, any country can avail and use these materials freely. An initial step to transform these materials into electronic format is to put this into a CD-ROM for use on a computer.

The different countries participating in the trials have recognized the importance of this distance learning modules for training purposes and capacity building. These modules even in draft form can already be used, as long as the word “DRAFT” is shown on each page of the modules. The Philippines started to use these materials in the retraining of Radiological Health and Safety Officers (RHSOs) in hospitals, industrial companies and institutions authorized to use radioactive materials. This was also used in the training of new RHSOs who cannot come to the PNRI to participate in organized training courses in radiation protection, which are run periodically. Secondary school teachers to upgrade their basic knowledge in nuclear science to be more confident in teaching nuclear science topics in the high school curriculum will also use this. It is planned to explore the possibility of using these materials to train radiological technologists and nuclear medicine technologists based in hospitals in the provinces.

5. External Dosimetry Intercomparison Programmes

Harmonization and upgrading individual monitoring programs for workers occupationally exposed to radiation is a major objective of the project on radiation protection. To ensure the validity, reliability and comparability of measurements, an intercomparison program in several phases were planned and organized by the Japan Atomic Energy Research Institute within the framework of this RCA project in radiation protection. These intercomparison programmes were participated in by all RCA Member States.

The field reference value check was initially conducted during the first phase of the intercomparison run and the results proved to be very useful in terms of validating the good quality of our basic calibration system. Initial results however, of this first phase intercomparison showed our inability to evaluate with reasonable accuracy, exposure doses in the diagnostic x-ray energies due to an inherent lack of appropriate calibration facilities covering these x-ray energies. Collaboration with the Korean SSD laboratories yielded positive results during subsequent phases of the intercomparison run. Additionally, collaboration with Malaysian SSDL enabled us further to improve the overall accuracy of our dosimetry service which provides monitoring service to all authorized users of radiation and radioactive materials in the country.

The second IAEA/RCA personal dosimeter intercomparison program was conducted from 1995 – 1996. The intercomparison was performed in two irradiation phases in order to investigate whether or not the operational quantity for individual monitoring in terms of the ICRU operational quantities for photons, Hp(d) can be used successfully by the personal dosimetry service organizations in the RCA Member States. During the first phase of this program, set of dosimeters from participating dosimetry providers in the region were irradiated for 6 photon energies (4 x-ray energies, Cs-137 and Co-60) with single quality and conducted at perpendicular incidence. In the second phase, two of the six categories were performed with mixed qualities (multiple energies) and a third category using non-perpendicular incidence. Based on the result of the Philippine participation in all of these phases, it was shown that the accuracy for Cs-137 is much better than for the other categories. This is expected, as calibration of dosimetry systems is solely performed/based on high gamma energy such as Cs-137 or Co-60. The limitation in terms of an appropriate calibration sources and facilities is the main drawback in achieving the required level of accuracy for dose measurements. The results of these exercises have allowed us to make a strong justification to get funding support from the national government to upgrade our calibration facilities. The necessary funds have now been committed and the commissioning of the upgraded facility is planned before the end of the year.

In summary, our participation in the external dosimeter intercomparisons has continuously improved the accuracy and reliability of measurements of personal dosimetry using film badges, among others. The Philippines has initiated the gradual shift to using TLDs for personal monitoring and we look forward to more intercomparison programmes to be planned in the future to check the validity of our measurements.

6. Peer Review Mission

Peer review mission was conducted in the Philippines in December 2001 to assess the effectiveness and efficiency of the regulatory infrastructure in the country. The Peer Review was undertaken as part of the Regional Cooperative Agreement (RCA) programme and was based on an established service of the IAEA for assessment of the effectiveness of the radiation safety infrastructure (RSRI).

Following the receipt of the Peer Review Mission Report, an Action Plan to address the issues raised in the report as well as the implementation of the recommendations, was put in place and periodically reviewed for monitoring purposes and for revision, if found necessary.

The Peer Review Mission conducted under this project was very useful in identifying areas of strength as well as weak areas that needed to be upgraded and/or established, if not yet in placed to enhance regulatory effectiveness. A long-term strategy to address the recurring issue of effective independence is currently under discussion including the practical implementation of recommended measures to address this issue in the short term. The decision to separate the regulatory function from the promotional work of the Philippine Nuclear Research Institute has been endorsed by higher authorities and consequently a draft bill is being crafted for consideration of the legislative body in the country. In the interim period, administrative procedures will be strengthened and a memorandum of understanding between the two regulatory authorities will be formulated to further delineate regulatory functions relative to existing regulations. These moves are intended to ensure efficiency and effectiveness of the regulatory infrastructures in place.

7. Overall Impact of the RCA Project

RAS/9/018 has been successful in addressing the radiation protection needs in the Philippines. It has enabled the country to maintain a core of highly trained professionals in radiation protection and has provided our radiation protection specialists the opportunities to share their experiences with counterparts in the region. The regional project on radiation protection is complementary to the Model Project and provides a unique mechanism by which countries with more advanced infrastructures can provide assistance to those countries with less mature infrastructures, thereby enhancing the regional capability in this important area.

The Nuclear Safety Council actions to reduce the evolution of the operational doses from the industrial radiography (using mobile gammagraphy equipment) in Spain

D. Aguado Molina, E. Rodrigo González, L. Urteaga García, et al.

Nuclear Safety Council
Madrid, Spain

Abstract. Since 1993 the Nuclear Safety Council has been making efforts for the reduction of the doses in the mobile gammagraphy industry, by means of a greater control of the operation of these facilities, the improvement of radiological protection equipment and the operational and emergency procedures.

The enclosure of this paper will be to present:

— A summary of the actions that have been carried out from 1993 promoted by the Nuclear Safety Council with the purpose of the progressive reduction of the doses.
— First Radiological Protection Improvement Plan (1993-2000).
— Audits program to facilities with highest gammagraphy activity to detect problems.
— Sending Technical Instructions and recommendations.
— Development of Safety Guide 5.14 "Safety and Radiological requirements in the industrial gamma radiography facilities".

The study of doses evolution from 1993 to 2000 showed the need to elaborate a Second Radiological Protection Improvement Plan (approved in 2001) to reduce doses and to enforce ALARA principle.

In this Plan CSN through complementary technical instructions (CTI) request to the licensees the establishment of:

— An Inspection program.
— A gammagraphy operation task plan.
— A continued training program.

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[3] Transposition of the 80/836/EURATON and 84/467/EURATON Directives "The Regulation on Sanitary Protection against the Ionizing Radiations"

Effectiveness and Efficiency of the Activities of the Mexican Regulatory Body in Radiological Matters

J. L. Delgado-Guardado, H. Maldonado-Mercado

Comisión Nacional de Seguridad Nuclear y Salvaguardias,
México, D. F., México

Abstract. The Comisión Nacional de Seguridad Nuclear y Salvaguardias, will arrive to the first quarter of a century next year (2004), and as part of the strategic planning program, has been initiated a systematic evaluation process to qualify the role performed by this regulatory body in this period of time, taken into account different parameters established to evaluate the global performance of the body. The historical performance, the establishment of the regulatory framework, the parameters and the expectations of the goals in a country with shrinking budget and a proposed reorganization and modernization of the rules and regulations for the immediate future, is also discussed.

1. Introduction

The Mexican experience related with the regulation and control of radiological matters, comes formally since 1979, with the inauguration of the Comisión Nacional de Seguridad Nuclear y Salvaguardias (CNSNS), which started operations with one of the three technical divisions devoted to the regulation and control of the users of radioactive materials.

In the beginning, the first objectives of this division were:

- Consolidation of the incipient framework of reference for the regulation of the radioactive material applications, taking into account the approaches followed by different countries and international organizations; one set of regulations which were widely studied was that from the USA, Spain and the other with wider scope, the set of recommendations proposed by the International Atomic Energy Agency (IAEA).
- Collection of the data of all the radioactive material users in the country with the purpose of identify by applications the main characteristics of the sources in their domain.
- Establishment of all the procedures of evaluation, inspection and enforcement actions.
- Effective control of the import and export of radioactive material, and
- Development of the accountability system for the special nuclear material.

After almost 24 years of work, all of the primary objectives have been reached, but new goals and standards are from time to time reviewed within the process of continuous improvement.

At present, this regulatory framework has been useful to regulate the activities developed in Mexico for different applications, Medicine: 540 licensees, Industry: 530 licensees, Industrial X Rays licensees 36 and licensees with authorization to provide services to nuclear installations, 10, one license for the operation of one research reactor, two subcritical assemblies used for training and one licensee for a nuclear power station.

The law and the regulatory framework it is considered enough to give the regulatory body authority to performs the basic functions in an appropriate way:

- Regulation on the use, storage, ownership, transportation, import and export of sources,
- Control of the dosimetry for all the occupational exposure personnel (OEP), through the National Data Base for the OEP,
- Authority to grant licenses for Radiological Protection Supervisors,
- Authority to regulate the scope and duration of radiological safety courses oriented to Radiological Supervisors,
- Authority to suspend, revoke licenses and to ensure installations and sources and even nuclear installations.
- Administration of the National Accountability and Control System for special nuclear materials.

2. Consolidation of the Mexican Regulatory Framework

Since 1979, the CNSNS has pushed a program to produce their own standards (adopted, adapted or written based on experiences) in order to reach the regulatory proficiency. The CNSNS has issued up to now, 38 standards, devoted to different aspects of the radiological safety, under the general framework of a General Code for the Radiological Safety. The participation of different society sectors, particularly such related with the use of radioactive materials, has been crucial for the success of this task.

The standards have been developed taking into count the experiences from different countries like USA, Spain and also the IAEA; the General Code of Radiological Safety was issued for the first time in 1985 and was based on the IAEA Code.

According with this policy, CNSNS is now in the route to modify the existing Code, based on the Safety Series 115-I from the IAEA (Ref. 1), dressed with the experiences of regulating the above mentioned universe of licensees:

Rules and regulations cover the protection of the public, to occupational exposure personnel, to the protection of the environment, security of radioactive sources and radwaste management.

3. The process to measure the effectiveness and efficiency of the Mexican Regulatory Body

There are different indicators used to measure the effectiveness the work performed by the regulatory body. In Mexico it has been decided to use the followings:

- Number of inspections by month/ 1000 licensees. Objective: To know the scope of the supervision activity for the regulatory body.
- Number of radiological events/ month. Objective: To know the degree of radiological safety in the radiological installations and physical security control of sources.
- Number of annually complains/1000 licensees. Objective: To know the degree of satisfaction of the licensees with the work performed by the regulatory body in different aspects.
- Number of licences and/ or authorizations per working day. Objective: To know the degree of efficiency of the evaluators during the analysis of the documentation.

Achievements of goals for the past year:

— An average number of inspections ranging around 520 inspections/ year, for a universe of about 1300 licensees; about six incident related with lost or stolen sources; cero complains, about five licences or authorizations (operation, import / export, etc) related with radioactive sources, etc. per working day.

Additionally during past years it has been implemented a strategic plan for to establish the vision, the mission, the strengths and weakness of the regulatory body, whose administration has been very favourable to improve its working processes inviting international experts to contribute through missions like the International Regulatory Review Team (IRRT).

4. Changes in the Regulatory Body

In order to improve the control and supervision of licensees, and recent event related with inappropriate use of Iodine - 131, lack of coverage of licensees in remote places in the country and the granting of a license without the proper verification of the functionality of the equipment, together with the opinions of the users that frequently there are different resolutions for same issue, was the amber light alarm to make the administration look for a reorganization in which main functions of inspection and evaluation merge together in a single branch and distributing the rest of the human capabilities and expertise in areas up to now not attended, like the enforcement action branch and those of the analysis of operational experience.

5. Conclusion

The regulatory activity is an never ending story, particularly for those countries with an incipient infrastructure, but also it is very exiting, taking into count that small organizations are always in the procedure to learn from others, the important thing is not to be to much disconnected of the advances in the sciences in the field or radiological safety; in Mexico is the hope of the regulatory authority to keep working as close as possible at the same level of well developed countries, innovating and developing new ideas on the improved performance of all the members of the organization.

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"Radiation Sources" How to reconcile Safety with Security within the framework of Radiation Protection

M. Bahran

National Atomic Energy Commission (NATEC)
The Republic of Yemen

Abstract. Since Sep.11, 2001, the radiation protection professionals in the world community and at the IAEA have been faced with the challenge of how to insure the Physical Security of Radioactive Materials (PSRM). In particular, they are challenged to reconcile the long time principal of Radiation Safety with the new concept of Security of sources. In this paper, we propose a simple but powerful and cost effective scheme to join Security and Safety together within the framework of Radiation Protection Infrastructure (RPI). This aims to allow for both the safety of people and the environment as well as the Security of sources, preventing any malevolent use.

1. Introduction

This paper describes how National Competent Authorities can incorporate the Security of sources within the RPI. Although the paper is a how to approach, it rides on a theoretical background in which Security is integrated within the Radiation Protection Principals - namely: Justification, Optimization and Limitation - in coherence with international requirements.

Basic Definitions: For a clear understanding of issues discussed in this paper and for the purpose of standardizing the terms Radioactive Materials and Nuclear Materials, two definitions are presented:

Nuclear Materials: ***Materials associated with the Non-Proliferation Treaty (NPT) and hence are covered by the IAEA Safeguard Agreements and Additional Protocols with Member States.***

Radioactive Materials: ***Any radioactive substance that is not a Nuclear Material and of a quantity consistent with IAEA categorization of sources [1]. This includes the so-called Orphan sources.***

Orphan Sources: **A strange term appeared at the end of the 1990's.[1] This term is defined in the Draft Revised Code of Conduct on the Safety and Security of Radioactive Sources [2] as: "*a source which poses sufficient radiological hazards to warrant regulatory control but is not under regulatory control, either because it has never been under regulatory control or because it has been abandoned, lost, misplaced, stolen or transferred without proper authorization*."**

The Concept: The Physical Security of Radioactive Materials (PSRM) has become a subject of topical interest. It is different from the Physical Protection of Nuclear Materials (PPNM), which is an NPT concept. As defined above, Nuclear Materials are legally covered by a number of international treaties agreements and conventions (NPT, CTBT, CPPNM, Transport convention, Safeguard Agreement, Additional Protocol). The similarity of the two concepts comes from the need for protection of both type of materials. Also, the concept of the PSRM is different from the IAEA old standing concept of Radiation and Waste Safety (RWS) as well as the very famous IAEA term of RPI.

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[1] This term is misleading and inconsistent with life. The reason is that an Orphan is a being that happened to be orphaned because of the death of the parents (i.e. the parents did not abandoned him by choice) while the source in this case happened to be criminally abandoned.

Both RWS and RPI are based on the thesis that people and the environment must be protected from the hazard of ionizing radiation. Both RWS and RPI are in need for modernization to accommodate the Security of sources. After all, Security of sources will greatly help the cause of safety of people and the environment, and at the same time will address the current and urgent need to prevent any malevolent use of these sources.

The Urgency: Millions of sources are around and a fraction of them is either uncounted for or not well protected. This picture must change and the international community needs to deal with it. This paper proposes to improve the System of Notification, Authorization, Inspection and Enforcement (SNAIE) within the IAEA framework of RPI to incorporate the new concept of the PSRM.

The History of the Subject: Prior to the year 2000 not too many people were talking[2] about how important is caring for the radioactive sources to insure their Security and Trace-ability. By then much talk was centering on Orphan sources. In Dec. 2000 in the Buenos Aires Conference, we raised a new flag of danger that Radioactive Materials pose [3]. In May 2001 in the Stockholm Conference, we proposed what we called the International Tagging System for Radioactive Materials (ITS-RM) as a possible international solution to the problem [4]. During the 45th session of the IAEA General Conference, right after the 11th of September 2001, we reminded the international community that we had been calling for more attention to be given to the issue of the PSRM. By the beginning of the year 2002, the Republic of Yemen negotiated with many Member States a new proposed resolution addressing the PSRM to prevent the possible use of Radioactive Materials as elements of terror. During the 46th Regular Session of the IAEA General Conference, the Republic of Yemen in cooperation with the European Union and the United States of America co-drafted and co-sponsored the current adopted resolution GC/46/Res/13 [5]. The IAEA GC/46/Res/13 represented the minimum that was agreed to, within the spirit of international consensus, but it didn't address all of our concerns. Thus, we believe that the International Community can do better. NATEC also participated in the International Conference on Security of Radioactive Sources, Vienna – 2003 [6. We think that the conference outcome wa good particularly, the recognition of the problem, its scope and urgency which was reflected in the first two lines of the finding as follows: *"High risk radioactive sources that are not under secure and regulated control, including so-called "orphan" sources, raise serious security and safety concerns"*. The conference in its outlook stressed the need to revisit the revised action plan for the Safety and Security of Radioactive Sources. NATEC agrees, in addition, it would like to revisit the current IAEA GC Resolution on the Subject. In this regard NATEC proposes to improve the current IAEA resolutions on the subject. Recently, the best action at the international level regarding the PSRM has been that of the recent Evian summit of the G8 countries [7]. The summit agreed to improve the Security of radioactive materials. The participating countries committed their selves to employ high standards that reduce the vulnerability of radioactive sources to malevolent use. They adopted recommendations on elements that should be applied at the national level to insure the PSRM. In this paper we present a further development if adopted it would significantly improve the status of the PSRM. In fact, we believe that the adoption of the proposals of this work would revolutionalize the RPI to make Security and safety compatible.

2. RPI Theoretical Background

The internationally recognized RPI regime is reflected in many IAEA publications such as Safety Series No. 110,111,115,120 [8] and Safety Standards Series No. TS-R-1 (ST-1 Revised) [9]. In particular, the Safety Standards Series No. GS-R-1 [10] spells out the Legal and Governmental Infrastructure for Nuclear, Radiation, Waste and Transport Safety Requirements within which a System for Notification, Authorization, Inspection and Enforcement (SNAIE) is presented. The extensive Safety Standards reflected in the excellent works of the IAEA are based mainly on the recommendations of the International Commission on Radiological Protection (ICRP) [11] in which

[2] There were some discussion on this issue but not as a standalone in its own right and not within the current focus and understanding. One of the articles prior to 2000 was "Gonzalez, A.J., Strengthening the Safety of Radiation sources & the Security of Radioactive Materials: Timely Action, 41 IAEA Bulletin no.39 (1999).

Radiation Protection (RP) is the science whose aim is to minimize the risks (for people and environment) generated by the use of ionizing radiation by eliminating its deterministic effects and reducing the probability of its stochastic effects. The framework of RP is based on three plus one principles (as will be seen later we have chosen to call them 3+1 rather than 4).

The Three Principals:

Justification: ***"No practice or source within a practice should be authorized unless the practice produces sufficient benefit to the exposed individuals or to society to offset the radiation harm that it might cause; that is: unless the practice is justified, taking into account social, economic and other relevant factors."***

Optimization: ***"In exposures from any particular source within a practice, except for therapeutic medical exposures, protection and safety shall be optimized in order that the magnitude of individual doses, the number of people exposed and the likelihood of incurring exposures all be kept As Low As Reasonably Achievable (ALARA), economic and social factors being taken into account, within the restriction that the doses to individuals delivered by the source be subject to dose constraints."***

Application of limits: ***"The normal exposure of individuals shall be restricted so that neither the total effective dose nor the total equivalent dose to relevant organs or tissues, caused by the possible combination of exposures from authorized practices, exceeds any relevant dose limit".***

The Plus One Principal (Intervention):

In some situations, the sources, pathways and exposed individuals are all in place when a decision on control has to be taken. In this case, the reduction in dose is achieved by intervention. An important group of such situations is the exposure from natural sources of radiation (e.g. radon daughters in homes). Accidents and emergencies will already have been considered as sources of potential exposure when assessing a practice but, if they occur, they may call for intervention.

3. The IAEA Model Projects RAW/9/006,008,009

According to the Statute of the Agency [12], Member States need to be assisted through technical cooperation programs. The Statute emphasizes and ensures the "*adequacy of proposed health and safety standards for holding and storing materials and for operating facilities*". To achieve the above, one of the most important assistance is in the establishment and strengthening of the RWS infrastructure. In the early 90's, it was found that many national RP programs were not up to the IAEA standards. Therefore, the Secretariat of the Agency developed a strategy endorsed by the 1994 Technical Cooperation Policy Review Seminar for establishing and strengthening radiation protection programs in many of its Member States [13]. Two Interregional Model Projects (INT/9/143, "Upgrading Radiation Protection Infrastructure", and INT/9/144, "Upgrading Waste Management Infrastructure) were launched in 1993. Later on it was discovered that large number of countries (About 50 more than originally estimated) needed to establish or strengthen their radiation protection programs. Fifty-three countries were targeted under the INT/9/143. INT/9/143 later carried new title "Upgrading Radiation and Waste Safety Infrastructure". These countries were grouped into 4 regional groups: Africa, West and East Asia, Latin America and Europe. For West Asia (our region), the project name was RAW/9/006. It was targeted that this project is to achieve its goals by the end of 2000. However the project could not achieve all the goals in all the targeted countries by then and hence has continued with a new target date of 2004. By the end of the year 2000 the project was split into two different projects. For Wes Asia the two new names are the "National Regulatory Control and Occupational Radiation Protection Programs (RAW/9/008)" and the "Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure (RAW/9/009)".

The Five Millstones

The Model Project on upgrading radiation protection infrastructure has been excellently structured to fulfill five Milestones. Namely:

— 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.

For a given participating Member State an action plan is developed for each Millstone for a specific timeframe. Once Millstone one is achieved and the Regulatory Authority is established the SNAIE is created. SNAIE is the mechanism by which the radioactive sources become under regulatory control. The purpose of such control is to achieve Milestones 2,3 and 4. That is compatible with the above listed three RP principles, namely: Justification, Optimization and Limitation, while the fifth Millstone is compatible with the plus one RP principal, namely: Intervention.

Yemen joined the Model project in 1996 at a time in which there was no RPI in the country. It is widely known that because of this very Model Project as well as a strong national will, today, NATEC is in control of radioactive sources in the country through an excellent SNAIE. That is to say, Radiation Protection Infrastructure in Yemen has been built from scratch and is functioning successfully. This paper is guided by the success and experience of NATEC.

4. Reconciling Security with Safety

As Clarified above, the RP principals and the RPI systems are based on the concept of safety (of people and the environment including the safety of sources[3]). Only recently the concepts of Security of sources and PSRM have immerged. As advertised earlier, we believe it is possible to reconcile these two concepts within the framework of the RPI. In this section, a how to approach to that is given.

System of Notification, Authorization, Inspection and Enforcement (SNAIE):

The central concept in the RP regime is certainly the SNAIE. It is the mechanism through which the Regulatory Authority exercises its authority to control radioactive sources and therefore insures the safety of people and the environment. Through notification, once a given use (practice) for a given source is justified, it is authorized by being licensed. The licensing is complemented by inspection and enforcement. This maintains the spirit and the letter of the RP principles. At the center of this system is the Licensing Procedure and Requirements (LPR). Among the typical LPR for obtaining a license to use a radioactive source in a given practice is an application form that includes items such as:

— Information: The application form must contain detailed and technical information about the licensee, the source, the intended use, the location, the storage, the radiation protection officer, the personal monitoring service and the emergency planning. But it does not require information about the Physical Security of the Source (this is the current state in many countries and at the IAEA). In this paper we propose to add in the application form provisions to supply detailed and technical information about the Physical Security of the Source. These provisions are to insure that proper Security arrangements for the source are made. This means that the application form will be changed slightly to include these provisions. This will only amount to a small change in the application form.

[3] The reader needs to differentiate between safety and Security of radioactive sources. Safety addresses maintaining the sources from being lost, misplaced or even stolen for a purpose other than malevolent use. Security on the other hand means maintaining the source such that it cannot be used for any malevolent purpose. The term malevolent here includes any use of radioactivity as element of terror.

— Obligations: The application form will carry the official signature and/or stamp of the licensee obligating himself or itself to the National/International Law(s) and Regulations applicable to the source to be licensed as well as to the correctness of the information supplied in the application. In this paper we propose to add obligations to the Security of the source in the general obligations by the licensee. That is to say, the licensee when signing the application form will oblige himself or itself to the provisions for Security.

— Acceptance: With the application for license the licensee is accepting all terms and conditions of the license including all legal penalties and punishments for any wrong doing according to the Law(s) and Regulation in place. In this paper we propose to add the acceptance by the licensee of all legal ramifications that are due to any violation of the Security of arrangements as per the application form. The licensing system is reinforced by the inspection system. The inspection system insures that the licensee obligations under the license agreement are properly kept in accordance with the Law(s) and Regulations. In this paper we propose that the inspection system includes inspection provisions for the Security of the source. This is to make sure that the agreed to Security arrangement are adhered to and therefore the source is always secured.

To completely integrate the concept of Security in the RPI, the licensee will be legally required to notify the Regulatory Authority of any breach of Security within an agreed time. The licensee will also be subject to the system of enforcement. This means that the Law(s) and Regulation must reflect these needs of Security integration. The code of punishment must reflect this fact.

Figure (1) shows a sample application form for a license consistent with the proposal of this paper to integrate Security within the framework of RPI (Courtesy of the RLRIGD, NATEC, Rep. of Yemen 2003). Figure (2) shows a sample license consistent with the proposal of this paper to integrate Security within the RPI (Courtesy of the RLRIGD, NATEC, Rep. of Yemen 2003).

Security regulations

The legal framework of RP includes many regulations, guides and codes of conducts. Models of such regulations guides and codes of conducts have been developed by the IAEA and distributed to Member States [9]. The question is do we need to develop specific regulations for the PARM. In our opinion, the answer is yes! Therefore, we call upon the Agency to develop in cooperation with Member States Model Regulations titled: "Physical Security of Radioactive Materials Regulations (PSRMR)". To do this the Agency can make use of the Code of Conduct that has been developed [2].

The final picture

If the proposals of this paper are implemented, then one can see the picture as follows: Every radioactive source is duly licensed and since every license requires appropriate Security arrangement, then, every source is well protected and hence Security is taken care off. Of course, the outstanding issue of the need for every non-exempted source in the world to be licensed (to be under regulatory control) is still outstanding and must continue be addressed by the IAEA and Member States. Clearly, this approach will cover known sources. For unknown sources or Orphan sources, every time one is discovered it will undergo the same system and becomes secured. For spent (used) sources, they naturally go to an appropriate waste facility consistent with the national waste disposal and safety regulations. Clearly the waste disposal facility is supposed to be licensed and hence secured because of the Security provisions provided in the licensing system detailed above.

The system detailed above has been implemented in the Yemen by NATEC and proven successful. The proposals of this paper are to work at the national level while the proposal in 2001 to establish IST-RM [4] is to work at the international level. Both schemes complement each other. From our experience at NATEC, the Republic of Yemen, the cost of adding the Security requirements to our SNAIE was minimal. The reader should realize that the success in Yemen is proportional to the relatively small number of sources and applications in the country. We can say with certainty that this system will work in any similar circumstance. We also hope that it works in other circumstance such as in counties with large number of sources and applications.

5. Conclusions

Based on the theoretical aspects of the Science of Radiation Protection and our own experience at NATEC, the Republic of Yemen, it is very possible to reconcile both Security and safety of radiation sources to allow for both the safety of people and the environment as well as to insure the Security of sources to prevent any malevolent use. In particular, this can be done and has been proven successful within the SNAIE. The central action is to integrate Security by:

- Adding provisions for Security in the Licensing Requirements.
- Adding provisions for Security in the Inspection Process.
- Adding provisions for Notification of any breach of Security.
- Adding provisions for punishment and liabilitie for any violation of the above provisions.
- Developing Model Regulations on the Physical Security of Radioactive Materials similar to other adopted regulations developed by the IAEA.

Since the current international RPI requires that all non-exempted sources must be authorized, if these new provisions are added and implemented, we will end up with Safety and Security joined together successfully. This paper presents a new slogan:

"A LICENSED SOURCE IS A SAFE AND SECURED SOURCE"

6. Acknowledgments

The author acknowledges the great work of the men and women of NATEC of the Republic of Yemen for the tremendous achievements they have done in a very short time by international standards. In particular, thanks are due to Dr. M. Sarhan for his assistance in preparing this Manuscript.

7. Figures

Figure (1), Page 1/4

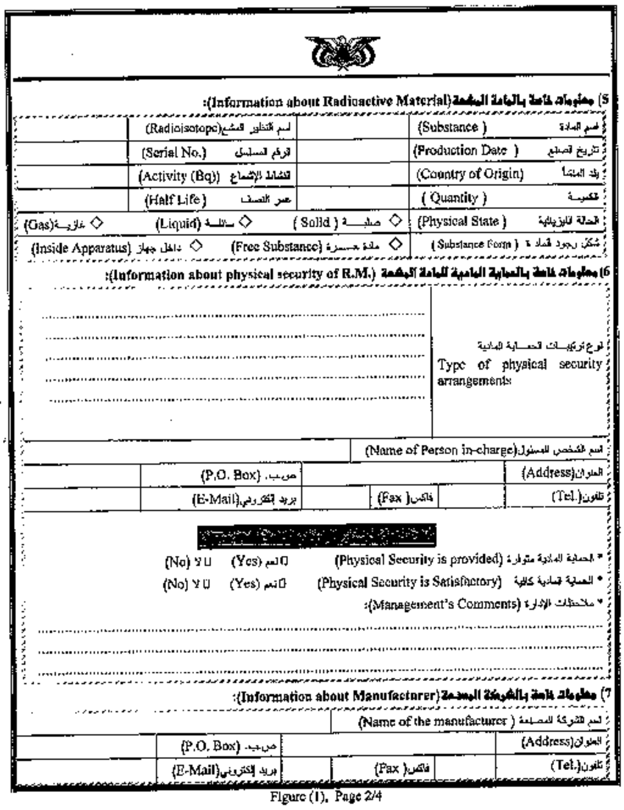

Figure (1), Page 2/4

Figure (1), Page 3/4

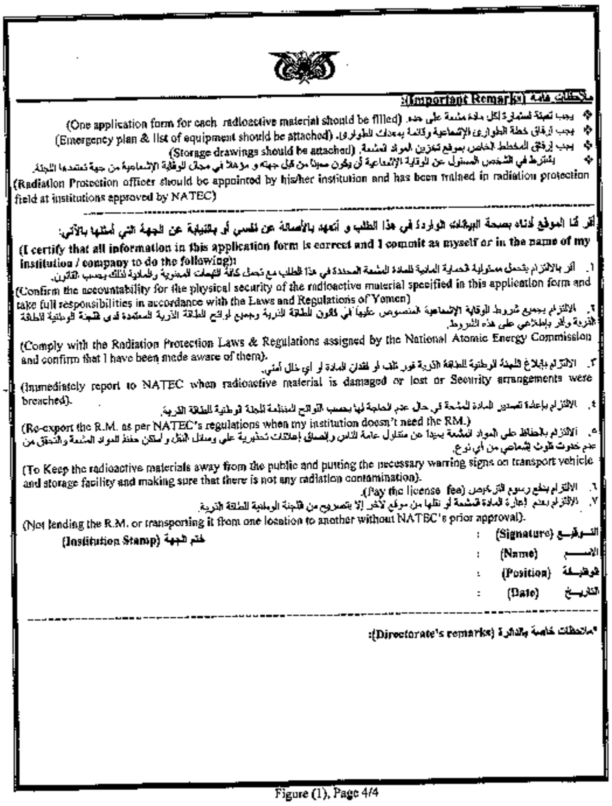

Figure (1), Page 4/4

Figure 1. Application form.

Republic of Yemen
Presidency of the Republic
National Atomic Energy Commission (NATEC)
Registration, Licensing & R/Inspection Dir.

بسم الله الرحمن الرحيم

الجمهورية اليمنية
رئاسة الجمهورية
اللجنة الوطنية للطاقة الذرية
دائرة التسجيل و الترخيص و التفتيش الإشعاعي

ترخيص حيازة واستخدام مادة مشعة
LICENSE for POSSESSING & USING RADIOACTIVE MATERIAL

تسمح اللجنة /........ بحيازة واستخدام المادة المشعة المحددة في هذا الترخيص حسب المعلومات المبينة أدناه
(The National Atomic Energy Commission permits .... to possess and use the radioactive material specified in this license as per the information listed below):

معلومات خاصة بالترخيص (Information about License):

رقم الترخيص (License No.):	تاريخ الإصدار (Issue Date):
رقم الملف (File No.):	تاريخ الانتهاء (Expiry Date):

معلومات خاصة بطالب الترخيص/ضابط الحماية الإشعاعية (Information about Licensee/RPO):

1- اسم المرخص له (Name of Licensee):
العنوان (Address): رقم التلفون (Tel. No.):

2- اسم ضابط الوقاية الإشعاعية (RPO Name):
رقم البطاقة / الجواز (ID Card/Passport No): الجنسية (Nationality):

معلومات خاصة بالمادة المشعة (Information about Radioactive Material):

اسم المادة (Substance)		اسم النظير المشع (Radioisotope)	
الرقم المسلسل (Serial No.)		النشاط الإشعاعي (Activity)	
الكمية (Quantity)		عمر النصف (يوم) (Half Life (Day))	
الحالة الفيزيائية (Physical State)		حالة المصدر (Source State)	
الغرض من الاستخدام (Purpose of Use)			
موقع الاستخدام (Location of use)			

معلومات خاصة بالحماية المادية للمادة المشعة (Information about Physical Protection of Radioactive Material):

نوع ترتيبات الحماية المادية (Type of physical security arrangements)	○ حكومي (Governmental)	○ خاص (Private)
اسم الشخص المسؤول (Name of person in-charge)		

* يخضع هذا الترخيص للقوانين واللوائح للجنة الوطنية للطاقة الذرية ويعمل به حتى تاريخ الانتهاء المبين أعلاه
(This License is subjected to National Atomic Energy Commission regulations and conditions and it is valid until the expiry date).

الختم (Seal) التوقيع (Signature)

د.مصطفى يحيى بهران
رئيس اللجنة الوطنية للطاقة الذرية
(Chairman-National Atomic Energy Commission)

* في حالة غياب ضابط الحماية الإشعاعية المبين أعلاه تتحمل الجهة المرخص لها مسؤولية تعيين ضابط حماية إشعاعية آخر توافق عليه اللجنة الوطنية للطاقة الذرية ويعتبر هذا الترخيص ملغيا في حالة عدم وجوده
(In case of the disappearance of the Radiation Protection Officer, the licensee is responsible to appoint another RPO who is well qualified and approved by NATEC; otherwise, this license is not valid)

* يعتبر هذا الترخيص لاغيا في حال أي كشط أو تعديل عليه (This license is invalid in case of any scratch or alteration)

Figure (2)

Figure 2. License.

Topical Session 9

SOURCE SECURITY AND EMERGENCY PREPAREDNESS (INFRASTRUCTURE REQUIREMENTS AT THE INTERNATIONAL, NATIONAL AND USER'S LEVEL)

Nuclear Emergency Plan
The state of the art

M. El Messaoudi, A. Chouak, M. Lferde

Laboratoire de Physique Nucléaire
Département de Physique, Faculté des Sciences
Rabat, Maroc

Abstract. As in all other industries, the nuclear facilities can be the object of accidents whose consequences go beyond the limits of their site and consequently radioactive releases would be issued in the environment justifying the protection measures of population. Even if all the precautions were taken during the stages from the design to the operation, to reduce the risk of accident in nuclear installations, this risk cannot be completly suppressed. The serious dysfunctions observed at Tokai-Mura, for example, would recall the necessary of a constant vigilance and severe controls. The nuclear emergency plan, established mainly in view of evolutive events needing modulated response, gives the opportunity to have a quick appropriate reaction to a sudden event, which has (or might have) direct consequences for the population. The aim of this paper is to give a review of nuclear emergency plan aspects and to present a corresponding organization which could be applied by national authority.

1. Introduction

For the nuclear installations currently in operation (nuclear power plants, facilities involved in the nuclear fuel cycle, research reactors), various accidental situations were studied and the means of prevention and limitation of their consequences were set up by the operators to obtain an acceptable level of safety. An emergency plan should be established at all facilities and activities where physical protection measures are required by the competent authority. This plan should provide guidance to licensee personnel for accomplishing specific defined objectives in the event of threats, thefts or sabotage relating to licensed activities involving nuclear material or nuclear facilities[1].

Serious accidental situations, being able to lead to a more or less significant exposure of the people present on the site and the bordering populations, could be induced by an accumulation of material and personnel failure. Such a situation necessitates the setting to work of direct protection measures of the people concerned. The means and the actions to engage to protect the populations from the short-term effects of the significant radioactive releases are defined in the intervention particular plans (IPP) suitable for the site concerned.

Thus, the authorities must have a plan which covers all the activities which must be followed out- site in an urgency event. In view of significant evolutions related to nuclear management of crisis on an international scale and of the new threats, many works aiming to evolve the management of a nuclear crisis are to be engaged or continued. It is the case of the revision of the Intervention Particular Plans (IPP) which have committed the prefects and should allow them to have the plans really operational and adapted to the nuclear installation risks.

It is also the case of revision of the regular texts, of taking into account of the interdepartmental dimension of such a crisis, of reflexion on the improvement of national and international exchanges by using new technologies of communication. Indeed, so early the emergency phase of the accident finished, and even if the radioactive releases were very low, difficult questions are to be considered such as the medical follow-up of the exposed populations, the rehabilitation of the grounds, the compenzation for the damages and more generally the return to conditions considered to be normal in the touched zones.

The nuclear crisis exercises are absolutely necessary as complement of nuclear safety. The exercises are one of the means to test the organization, to involve the teams to be analyzed, to act, to co-ordinate, to communicate, to improve unceasingly what can be it. They are also an advisability of disseminating information on the nuclear power and the control of its risks[2]. Emergency planning for radiological accidents could be found elsewhere[3] and in other papers presented in this conference.

2. Nuclear Crisis Organization

The National Emergency Plan (NEP) for nuclear risks on the national territory requires that each organization (licensees, authorities, national institutes) involved in a nuclear emergency describes its own internal EP-organization and submits it to the competent authority (Ministry of Internal Affairs).

The off- site operations are led at the central level by a " Governmental Crisis Centre " (GCC). The implementation of local operational actions and intervention teams is managed at the provincial level. The licensees remain responsible for the operation of their installation and for the safety of all the people on the site (site personnel as well as contractors or visitors).

The GCC is composed of several units, called cells which operate under the responsibility of the emergency director of the authorities (minister of the internal affairs or his representative): the "restricted or extended co-ordination and crisis committee" called hereafter the "Decision Cell", the "Evaluation Cell", the "Measurement Cell" and the "Information Cell". The GCC provides also the logistical support to the different units (in terms of personnel and materials, such as communications means,.....).

The Decision Cell is the official leader of the conduct of the operation in case of an emergency. On basis of the advices from the Evaluation Cell and taking into account other aspects (feasibility, efficiency, socio-economic impacts,....), the decision cell decides then upon the countermeasures and their extents to be taken in order to protect the population and the environment. Such decisions are then transmitted for practical execution to the Provincial Crisis Centre, managing all the multidisciplinary intervention teams (fire brigades, civil protection, police, medical emergency services,....).

The Evaluation Cell, composed of representatives of experts from ministries (in charge of nuclear topics and state organizations) as well as weather and other technical experts, proposes countermeasures for protecting the population and the environment. Therefore, this Cell gathers and evaluates all information received from the affected installation and the off-site radiological measurement results received from the Measurement Cell. It evaluates the installation status and its estimated time evolution in order to assess the real or potential impact of the event. The scope of the countermeasures strongly depend of the emergency phase. Three specific phases can be taken into consideration:

— The urgent phase (or short-term phase), where protective actions for the population should be considered: sheltering, evacuation, iodine prophylaxis, access control and food bans;

— The intermediate phase (or mid-term phase), where, in addition to protective actions of the urgent phase, relocation, decontamination, water and food controls, medical care should also be considered;

— The recovery phase (or long-term phase), where access control, relocation, water&food controls and environment decontamination should be considered.

The Measurement Cell co-ordinates all the activities related to the gathering of field radiological information (external radiation of the air and of the deposits, samples measurements) transmitted either by the automatic radiological measurement networks, or by the field teams. The Measurement Cell works in close collaboration with the Evaluation Cell.

The Information Cell is in charge of communications with the media and the population as well as with the international organizations (IAEA, EC,) and the neighbouring countries. The content of the information transmitted is supervised by the Decision Cell, in collaboration with the Evaluation Cell[4,5]. The general structure of the NEP is given in the fig.1 hereafter.

Since 1959, the IAEA has had a relatively simple action plan by which it would. Upon request, arrange to provide assistance to any member state following an accident involving radioactive materials. Chernobyl resulted in the adoption in 1986 of the convention on assistance in the case of a nuclear accident or radiological emergency and the convention on early notification of a nuclear accident[3].

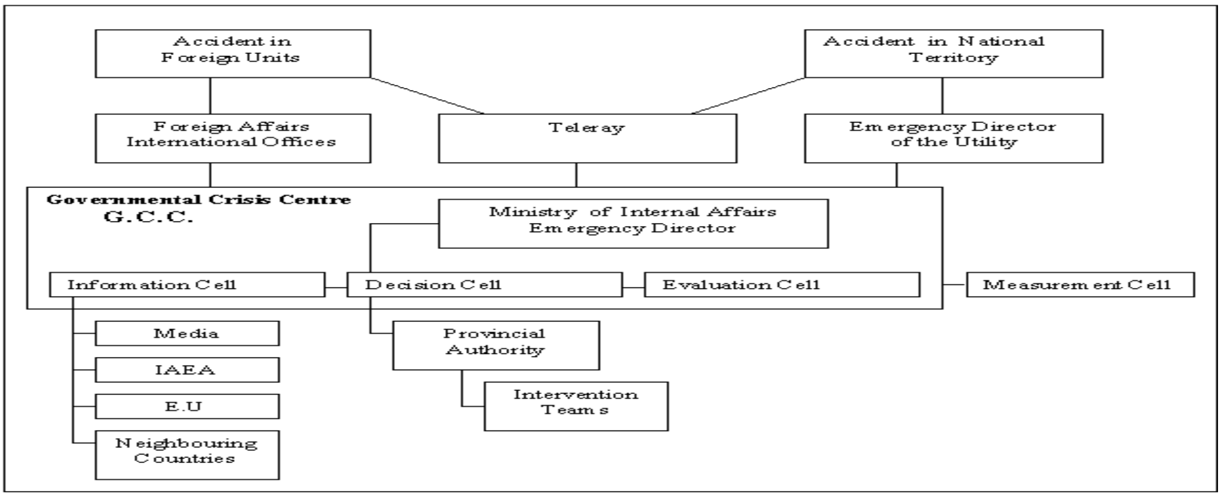

FIG. 1. General NEP structure

3. Emergency and Post-accidental Phases

For any nuclear accident involving the significant releases in the environment, it is advisable to distinguish the short-term consequences of the releases for the populations, requiring emergency actions, and those which involve significant doses only at means and long terms.

In the event of accident at nuclear installation (nuclear power plants, facilities involved in the nuclear fuel cycle, research reactors), two phases are well identified:

— The emergency phase during which the provisions are taken to control the accident, to ensure the protection of the personnel of the site and the neighbouring population, to maintain the law and order;

— The post-accidental phase which aims at making so that the populations and affected zones find a new balance of life, sufficiently stable to allow an acceptable social development.

The authorities and the operator defined an organization in order to face such situations.

3.1. The internal emergency plan

In the event of accident, the direct manager of this plan is the director of the installation, this one being generally responsible for the control of the installation[6]. This plan contributes to:

— To ensure the control of the accident.

— To ensure the protection of the personnel of the site.

— To evaluate the radioactive releases in the environment.

— To transmit any required information to the competent authority.

3.2. The intervention particular plan

This plan is the response of the authorities in the event of nuclear accident in order to ensure the protection of the population around the site and the law and order. It is the prefect of the department where is located the nuclear installation which has the responsibility for its setting to work. When that starts the IPP, it joins together around him, in what one calls the fixed headquarters, the representatives of the local administrative services most concerned (police force, fire-brigade, authority of safety, health, licensees). It also installs close to the broken site an operational headquarters. Naturally, the mayors of the concerned cities are firstly informed: they will play an essential role to protect the population.

3.3. Actions of protection of the population in the event of nuclear accident

Protection against radiation in accidental situation evolved considerably in consequence of the lesson drawn from various accidents, and particularly from that of Tchernobyl which has occurred in 1986. Face to a nuclear accident, two consequences of nature and completely different size would be to manage: the protection of the population on the one hand, the care with the victims on the site on the other hand. The protection of the population is above all of preventive nature. The intervention guidance criteria for the off-site emergency plan taken into account the general internationally recognized principles can be found in ref. [7].

The emergency actions replace those of the levels of intervention, in terms for example of dose or concentration rate of radioactive products. In practice, it is necessary to regard these levels as orders of magnitude. An international consensus exists overall on the values of these levels and the actions of health protection which it would be advisable to carry out in a nuclear crisis. The recommendations of the International Commission of Radiological Protection (ICRP), International Atomic Energy Agency (IAEA) and the World Health Organization (WHO) are coherent [8]:

— Sheltering, if the estimated effective dose amount exceeds 10mSv;

— Evacuation, if the estimated effective dose amount exceeds 50mSv;

— Stable iodine administration when the estimated dose equivalent to the thyroid risks to exceed 100mSv.

These interventions could be accompanied by a restriction or a prohibition of the sports activities or professional of full air, and later on consumption of water and food produced inside the perimeter where the interventions are exerted. The measures and actions of intervention are illustrated in ref.[9].

3.4. Post-accidental phase

With the end of the releases outside the site, a new phase starts, aiming at restoring a framework of acceptable life for the population and the economic activity, as soon as possible.

One can however notice that the national organization of crisis would be different in this case from that which one has during the emergency phase for three reasons : broader geographical area; different objectives (the consequences of the accident are less penalizing) and evolution of the actor roles.

4. Conclusion

The safety bases distinguish the practices and the interventions and sight that the interventions play a significant role since one cannot authorize practices without associating corresponding plans of intervention. The interventions in the nuclear industry concern the protection of the population and the environment since the range of an accident covers broad geographical areas. The setting to work of a plan of intervention out- site during a nuclear accident or a radiological emergency situation requires an organization established with the pre-defined clear responsibilities and actions planned according to level's of intervention recommended by international organizations on the matter. In case of Morocco, a new structure of safety and radiation protection regulatory will be set up to ensure normal legal missions and to assume its role in nuclear or radiological crisis organization. Periodic nuclear crisis exercises implying the operator and the authorities are of great importance in order to confirm the intervention plans effectiveness and to improve them. The external assistance constitutes a complementary tool.

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National Infrastructure for Radiation Protection and Nuclear Safety in Republic of Moldova

F. Ilii

The Parliament of the Republic of Moldova

Abstract. The national radiation protection and safety infrastructure has been created in Republic of Moldova in order to ensure radiation protection and safety and to comply with the IAEA requarements and recommendations regarding radiation protection and safety. The Law on Radiation Protection and Nuclear Safety, nr.1440-XIII and Gorenment Ordinance "Concerning the activity of the Regulatory Authority in field of radiation protection and nuclear safety" No. 1225 from 22.12.98 were approved. The Law on Radiation Protection and Nuclear Safety nominates Ministry of Health, the State Department of Emergency Situations and the State Department of Standardization, as regulatory authorities responsible for radiation protection and safety in the country. According to the Law on Radiation Protection and Nuclear Safety the Regulatory Authorities exercising State supervision and regulatory control of Radiation protection and safety and monitoring of professional and public exposure. Problems connected with the national regulatory control in field of radiation protection and safety in Republic of Moldova are presented and their solution is discussed.

1. Introduction

The Republic of Moldova is a landlocked country situated at South-East Europe and bounds with Romania at the West and Ukraine at the North, East and South. It occupies a territory of 33,7 thousand square km and has the population of 4 million 353 thousands inhabitants. The country acquired independence in 1991 and established the constitutional and legal framework for transition to market economy.

The infrastructure of radiation protection and safety of the radiation sources in Republic of Moldova was created and based on recommendations of IAEA. Infrastructure was created and based of the existing Ministries and departments which activity in field of radiation protection covered a lot of domains like security of the radiation sources, protection of personal, technical supervise, environment protection, protection of health.

2. Activities

Thus, the above mentioned Regulatory Bodies was main initiators concerning fulfillment of the Model Project RER/9/056 (INT-9/143), RER/9/062, RER9/065 and developed the main measures to execute the experts recommendations and the Plan of Technical Cooperation and the BSS recommendations.

According to the Decision of the Republic of Moldova "Concerning the activity of the Regulatory Authority in field of radiation protection and nuclear safety " No. 1225 from 22.12.98, the responsible institutions for management of National register of evidence of the sources of ionizing radiation is the Department of Standardization and Metrology of the Republic of Moldova. Each year at 1 February Department of Standardization and Metrology summarize information in field of radiation protection in the country and present a report to the Government.

Moldavian Basic Law - Constitution prohibits any activities related to nuclear, chemical and biological weapons and adherence to any kinds of military alliances.

There are no nuclear power plants, research reactors, critical assemblies or reprocessing plants in the Republic of Moldova. But around the borders of country in range of 120-400 km are 8 Nuclear Power Plants with 24 working reactors. However, about 7000 radiation sources are used at more than 800 agricultural, industrial, medical and scientific facilities and laboratories. At the same time, the geographical position of our country periodically obtrudes necessity to transit nuclear materials trough its territory.

In 1997 the Republic of Moldova became a full IAEA Member State.

Actually my country is in the process of improvement of its necessary legal base ensuring radiation protection and safety. At this moment is in final stage new project of Law of Radiation Protection and Safety - aim to establish One Regulatory Body.

The dated with 14 April 1994 Decree No. 59-XIII of Moldavian Parliament ratified the adherence to the Treaty on Non-Proliferation of Nuclear Weapons which came into force in our country on 10th November 1994.

Republic of Moldova has also international obligations based on five international conventions:

— Convention on Early Notification of a Nuclear Accident;

— Convention on Physical Protection of Nuclear Materials;

— Convention on Assistance in Case of a Nuclear Accident or a Radiological Emergency;

— Convention on Nuclear Safety.

Moldavian Parliament ratified adherence to all of them and they came into force in 1998.

A 24 hours operating Official Contact Point was established under these Conventions at the Moldavian State Department of Emergency Situations.

On December 24, 1997 the Law on Radiation Protection and Nuclear Safety, nr.1440-XIII was adopted by the Parliament. It nominates Ministry of Health, the State Department of Emergency Situations and the State Department of Standardization and Metrology, as regulatory authorities. Ministry of Environment and Territorial Development has also some attributions in the field of radiation protection and safety.

The Regulatory Bodies establish new normative according to the new requirements of IAEA and was established and published Fundamental Normative for Radiation Protection of Radiation Safety (NFRP-2000). These Fundamental Normative for Radiation Protection was coordinated with all interested institutes in scope to strengthen radiation protection infrastructure in republic. In cooperation with IAEA and EUROATOM the existing standards and normative need to be improve to international standards for protection against ionizing radiation and for the safety of radiation sources in frame of IAEA Model Projects.

The Law nominates also and competence of each regulatory authorities.

Law "On licensing of certain kinds of activities" no. 451-XV from 30.07.2001 was adopted by Moldavian Parliament. Import, storage, using of radiaoactive materials as well as its transportation is subject of this Law. A special Licensing Chamber was created for coordination of licensing process.

Licensing of import, export and transit of dual use goods is the competence of the Governmental Commission for Regulation of the Import - Export of Special and Dual Use Goods that has been created under the chairmanship of the State Minister. Commission includes a group of experts on the mater from different State Institutions.

Several governmental structures are aimed to supervise nuclear materials illicit traffic control and ensure adequate physical protection of nuclear materials. The elements of the Moldavian system of physical protection of nuclear materials are divided among the Ministry of Interior, Information and Security Service, the State Department of Emergency Situation and Ministry of Transport. The competence of each of them is determined in a special Regulation. The case of contraband with nuclear materials, which periodically are registered in different parts of the world, emphasize the presence of this problem, being also the subject of anxiety of our country. It is also important to take into consideration the fact of the relative transparency of USSR countries borders in the framework of CIS.

Actually a part of customs checking points of the Republic of Moldova were equipped with the stationary devices for automatic control of passing transport on the subject of presence of nuclear materials and different kinds of radioactive sources. These years we've equipped on mobile laboratory with a set of mobile radiation monitoring equipment having the purpose of emergency assistance and consultation for custom points according to their request at any time.

In domain of ensuring physical protection of radioactive sources, at moment it's working for strengthen whole infrastructure in republic. Practical, all facilities in republic that use radioactive sources didn't correspond with new requirements for ensuring adequately physical protection. Consequently made inspections by the Department of Standardization and Metrology, at some facilities witch use the radioactive sources in different branches was found some breaches concerning physical protection of the radioactive sources. The most frequently breaches are: missing guarding, alarm systems and necessary technical and dozimetric equipment.

Thanks to cooperation with International Atomic Energy Agency and due to events, which happened at 11 september 2001, during april month flowing year, in Republic of Moldova arrived delegation composed of experts from International Atomic Energy Agency and from United States of America. The main goal of this expert mission was to inspect how is carrying the physical protection of radioactive sources in the country. Was inspected the main facilities witch use in their process radioactive sources (Co-60, Cs-137) with high activity.

Administration of each inspected facilities signed separately a bilateral agreement (contract) with USA side. The Government of USA will finance all action for strength physical protection of radioactive sources at each separately facilities.

Due to a special assistance from IAEA and Government of USA, in this agreement, the waste disposal facilities received funds for upgrading radioactive wastes infrastructure. Thanks to this agreement were built a new on ground storage (warehouse) for waste storage and for the future is planning to construct the building for conditioning of waste.

One of the most important aspects to ensure emergency preparedness is ability to promptly and adequately determine and take action to protect members of the public and emergency workers, due to that a few specialist was trained in this field at training courses organized by IAEA. Now is in developing practical establishment of IAEA TECDOC’s for strengthen and upgrading system of emergency preparedness and practical response. We adapted and apply in practice the main tools, generic procedures, practical guidance's for emergency response.

3. Conclusions

The best outcomes in the module project were:

— Training and improvement of personnel, inspectors, physicists, engineers, hygienists-experts radiologists, ecologists and other specialists;

- Access to international information, experience of other countries dealing with problems of radiation safety and protection of sources;
- Optimization of radiation protection and safety in medical practice;
- Optimization of management with radioactive wastes and a qualified evaluation of radioactive situation and working out of measure to liquidate the consequences of the accident at the storage facility.

Complications for implementation of planned measures:

- Technical assistance of IAEA doesn't cover real needs to improve material and technical base of the Regulatory Bodies regulating problems of radiation safety and protection of sources.

Domains of radiation safety in which our country would like to get assistance from IAEA:

- Improvement of the infrastructure and the system of management of radioactive wastes at the storage facility;
- Optimization of radioactive safety of the personnel and patients in medical practice according to the existing program;
- Training and extension courses for specialists-physicists, engineers, doctors specialists in radiation hygiene, metrology and waste management;
- Providing with technical assistance from IAEA to strengthen the infrastructure of regulatory authorities.

Spanish Inventory of Industrial Gamma Radiography Apparatus and Monitoring for Radiation Devices attending to their special characteristics.

B. Tamayo, L. Urteaga García, B. Alfonso Nicolás, et al.

Nuclear Safety Council
Madrid, Spain

Abstract. The practice of the industrial gamma radiography where portable or mobile apparatus are used, supposes a considerable radiological risk. From the point of view of the gamma radiography apparatus and monitoring for radiation devices used in these operations, it is necessary to consider:

— These apparatus must be designed to allow the controlled use of gamma radiation emitted by a sealed radioactive source for industrial radiography purposes in order that persons will be safeguarded when the apparatus is used in conformity with the regulations in force regarding radiation protection. International Standard ISO 3999 (1977) "Apparatus for gamma radiography" establishes the security requirements that must be considered in their construction. ISO 3999-1 (2000) has increased the requirements of security of these apparatus, in order to reduce the operational incidents.

— This Nuclear Safety Council demands that during the use of these apparatus, each professionally exposed worker will have to carry: a gamma survey meter, a thermoluminiscent dosimeter (TLD) and a direct reading dosimeter, better if it has an acoustic alarm.

The enclosure of this paper will be to present the actual Spanish stock-taking of the apparatus referred based on their characteristics.

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Safety Guide nº 5.14 issued in Spain by the Nuclear Safety Council *Security and radiological requirements in the industrial gamma radiography facilities*

E. Rodrigo González, B. Tamayo, B. Alfonso Nicolás, et al.

Nuclear Safety Council
Madrid, Spain

Abstract. Radioactive facilities where industrial gamma radiography equipments are used, require a use authorization in accordance to the Spanish regulations. In order to get authorized the person in charge of the installation has to display a set of documents; among them two of the most important attending to radiological safety, are the "Operatory Manual" and the "Emergency Procedures". The fulfillment of these documents is essential to get, from the radiological point of view, the optimal conditions for the running of the installation. The Regulation on Sanitary Protection against the Ionizing Radiation, transposition of Directives 80/836/EURATON and 84/467/EURATON, provides certain targets to be reached and a set of radioactive protection measures, applied, in general terms, to this kind of installations. The experience gathered on the running of these specially radioactive risky installations demands special attention to the fulfillment of the security and radiological protection measures. The Nuclear Safety Council issued in 1998 the safety guide 5.14, in order to help people in charge of those installations to fulfill the security and radiological requirements, as well to became the guideline in the writing of obligatory documents, specially those referring to the " Operationy Manual" and the "Emergency Procedures", where the safe operational procedures of this kind of equipments are described.

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Protecting the Human Health and the Environment from Sealed Sources

K. El-Adham[b], A. A. Hasan[a], M. R. El-Sorougy[b]

[a] Sandia National Laboratories
Albuquerque, NM 87185, U.S.A.

[b] Egyptian Atomic Energy Authority
Cairo, Egypt

Abstract. The radioactive materials in "public" locations are typically contained in small, stainless steel capsules known as sealed radiation sources (RS). These RS are used for a wide variety of applications at hospitals, medical clinics, manufacturing plants, universities, construction sites, and other facilities in the public sector. Radiation sources are readily available, and worldwide there are hundreds of thousands of RS. *The accidental mismanagement* of RS has caused a large number of people to receive very high, and even fatal The *deliberate mismanagement* of RS is also of growing international concern. Because of their small size, potency, availability, and "nuclear" nature, there is concern that a terrorist could use a radiation source to create a "radiological weapon," or "dirty bomb." The ruthlessness of the Sept. 11 attacks makes it clear that the risks of a nuclear terrorist act are higher than previously thought, says Mohamed El-Baradei, Director General of the International Atomic Energy Agency (IAEA). The IMPRSS Project is a cooperative development between the Egyptian Atomic Energy Authority (EAEA), Egyptian Ministry of Health (MOH), Sandia National Laboratories (SNL), New Mexico Tech University (NMT), and Agriculture Cooperative Development International (ACDI/VOCA). SNL will coordinate the work scope between the participant organizations.

1. Introduction

In the spring of 2000, three people died in Egypt because of a sealed source that came into the possession of a farmer. As this incident illustrates there is possibility of death and injury to the public due to sealed sources. Other incidents around the world show the possibility of sealed sources adversely affecting the health of hundreds or thousands of people and causing very large environmental contamination problems. Maliciously used sealed sources pose an even greater risk. Therefore a program is needed in Egypt, which leads to the safe and secure management and use of sealed sources. Almost all IAEA Member States use sealed sources in medicine, industry, agriculture, and scientific research, and these countries remain responsible for safe handling and storage of both the sources themselves and all radioactively contaminated waste that result from their use.

Sealed sources must be managed and disposed effectively in order to protect human health and the environment. Effective national safety and management infrastructures are prerequisites for efficient and safe sealed sources transportation, treatment, storage, and disposal.

Mismanaged sealed sources could result in severe environmental degradation; affect the quality of water, and over-expose humans to radiation. Egypt's Environment Law 4 of 1994 specifies a process and timeframe for meeting air and water pollution standards. Other recent policy reforms directly address Nile water quality, the reuse of drainage water, improved irrigation practices and other critical water management improvements. Despite these advances, poor enabling conditions and weak implementation detract from even greater regulatory applications, and the current laws that regulate the handling and managing of sealed sources are not strong enough. The current responsibilities for sealed sources are divided between the Ministry of Health that awards the licensing for importing sealed sources, and the EAEA that handles unwanted sealed sources.

In order to address issues related to the effects of sealed sources management on the environment, the IMPRSS Project is aimed at helping the Government of Egypt formulate policies and regulatory standards as well as increase institutional capability for monitoring and tracking all operational and unwanted radioactive sealed sources. The Project will also help promote the adoption of best practices and technologies to perform the work. A far-reaching goal is cost recovery of management services for sealed sources, which is an important process to ensure the sustainability of the work in the future.

2. Background

2.1. Peaceful application of sealed sources

2.1.1. Medical applications

Hospitals and medical clinics are among the largest users of RS. Radioactive sources are typically used for teletherapy and brachytherapy. Until the 1950's, the only significant sealed RS produced were the radium-226 sealed RS that were used for brachytherapy. Most of the old radium sources used in brachytherapy have been replaced by cobalt-60, cesium-137 and iridium-192. Cobalt-60 is the most common radionuclide used in teletherapy, although some cesium-137 sources are also in use. The cobalt and cesium teletherapy sources are some of the largest curie sources in public use [1]

2.1.2. Research and educationa applications

Hospitals and medical clinics are among the largest users of RS. Radioactive sources are typically used for teletherapy and brachytherapy. Until the 1950's, the only significant sealed RS produced were the radium-226 sealed RS that were used for brachytherapy. Most of the old radium sources used in brachytherapy have been replaced by cobalt-60, cesium-137 and iridium-192. Cobalt-60 is the most common radionuclide used in teletherapy, although some cesium-137 sources are also in use. The cobalt and cesium teletherapy sources are some of the largest curie sources in public use [1]

2.1.3. Industrial applications

Irridium-192 is typically used in for industrial radiography, such as the non-destructive imaging of pipe welds. Cobalt-60 and cesium-137 sources are also used for industrial radiography. Large neutron and gamma sources are used in mining oil and gas "well logging." These neutron sources contain either plutonium-238 / beryllium or americium-241 / beryllium; there are also a few radium-226 / beryllium neutron sources. The U.S. americium neutron sources have maximum activities up to 60 Ci [2]. The most common industrial RS are in level and thickness gauges. If these gauges are not removed when a factory is closed, the gauges can, and have ended up in metal recycling facilities.

Radioisotope thermoelectric generators (RTGs) use heat generated by decay of radioactive isotopes to produce electrical power. RTGs have no moving parts and can operate for over a decade without refueling. They are used as a power supply where frequent maintenance, or refueling is expensive or impossible. Most terrestrial, U.S. RTGs are fueled with strontium-90. The largest known U.S. RTG (the BUP-500) was fueled with 685,000 curies of strontium-90; however the typical U.S. RTG contains about 50,000 Ci of strontium. Industrial irradiators, containing americium-241, cobalt-60 or cesium-137 RS are used to sterilize medical products, as well as meat, fresh vegetables, and other foods. Although physically small (say 40 cm^3), the RS in irradiators are high-activity. The highest activity cesium irradiator in the U.S. contains 213,000 Ci of cesium-137 [3], although most contain less than 12,000 Ci.

2.2. Number of sealed sources

Sealed sources are commonly available and are used daily in the public sector. The IAEA estimated that there are approximately 500,000 sealed sources worldwide (IAEA, 1991, p. 12). Of the 500,000 RS, the IAEA estimates that approximately 100,000 are "excess." (IAEA, 1991)

Table I, lists the inventory of unwanted sources in Egypt, Algeria, Tunisia, and Ghana As in all countries, the actual number of RS in Egypt is not known, and is probably much higher than what is reported in official records. For developing countries, the IAEA estimates that the total number of RS may be ten times the official, recorded inventory.

2.3. Accidental misuse of radioactive sources

Accidental misuse of RS has caused significant environmental contamination, thousands of overexposures, and many deaths. The high specific activity of the material in many RS means that the spread of as little as microgram quantities of its contents can generate significant risk to humans and inhibit the use of buildings and land. The cost of decontamination can be very high.

Because sealed RS are small, steel, and appear harmless, a significant number are accidentally melted in steel recycling operations. In 1983, a steel recycling plant in Juarez, Mexico accidentally melted a cobalt RS during steel recycling operations. The recycled steel products were not immediately identified as being contaminated.

Because recycled steel is traded internationally, the recycled steel was sold in Mexico and the U.S. The accident caused significant pollution in both countries. Although there were no deaths, the pollution was estimated to affect the health of several thousand people and tens of millions of dollars were spent cleaning up contaminated soils, and buildings on both sides of the border. The contaminated steel was used in the manufacture of furniture. All of this furniture had to be managed as radioactive waste, and some houses had to be demolished because of their construction with contaminated steel rebar.

In Brazil in 1987, a sealed RS containing cesium-137 was stolen from a closed medical clinic and deliberately cut open. In 1997, eleven Georgian border guards had to be hospitalized after being exposed to radiation from hidden RS at a military site. [3] In the summer of 2000, Egypt has witnessed one of those incidents where an Ir-192 source was mismanaged and resulted in the death of three persons and radiation over-exposure for many other villagers.

An additional goal of the project is to help create a mechanism by which a routine disposal option is available in Egypt, such that future unwanted sealed sources will have a direct disposal path at a cost that encourages appropriate management by source owners.

2.4. Deliberate misuse of radioactive sources

A water cooler at the National Institute of Health in Bethesda, Md. was deliberately contaminated with radioactive large curie phosphorous in 1995. Twenty-six employees were exposed [4]. Just before Christmas 1995, dissidents from the breakaway republic of Chechnya sought to strike terror in Russia. They took a cesium RS and planted it in Moscow's Izmailovsky Park, a popular marketplace. Their plan was foiled when Russian authorities were tipped off and recovered the RS. [5]

In addition to causing overexposures by hiding a potent RS in a public location, there is also concern that a terrorist could attach a conventional explosive to a RS and create a “radiological weapon,” or “dirty bomb.” A RS, coupled with conventional high explosives, or incinerated, could be used to radiologically contaminate a large area or building, resulting in human exposures and costly cleanup activities.

3. Work Activities

Because of the real threat of accidental or deliberate misuses of RS, we are working on a comprehensive project to manage RS in Egypt. The program plan for the IMPRSS Project in Egypt contains four major tasks with nine subtasks. These elements and their goals and proposed activities are listed below:

3.1. Safe management of -in-use sealed sources

3.1.1.Tracking and inventory control

GOAL: Comprehensive database on the kinds and locations of all sealed sources in Egypt.

3.1.2.Awareness

GOAL: An informed public and sealed sources owners who understand the benefits and hazards of sealed sources.

3.1.3.Security

GOAL: Upgrades to security for high-risk RS at the EAEA storage facilities and evaluate the security arrangement of high-risk RS in the public sector.

3.2. Safe management of unwanted sealed sources

3.2.1. Sealed sources recovery

GOAL: Equipment and trained manpower to recover unwanted sealed sources in Egypt.

3.2.2. Storage and conditioning of sealed sources

GOAL: A safe conditioning and storage facility in Egypt for recovered sources.

3.2.3. Recycling

GOAL: Recycling of unwanted RS to minimize the need for importing new ones and limit the problems related to their storage, conditioning, and disposal.

3.2.4. Disposal of sealed sources

GOAL: A licensed facility in Egypt for disposal of unwanted sealed sources.

Table I. Summary of the unwanted sealed source inventories of a number of African Countries

Source Type	Egypt		Algeria		Tunisia		Ghana	
	Number	Total Activity (Ci)	Number	Total Activity (Ci)	Number	Total Activity (Ci)	Number	Total Activity (Ci)
^{60}Co	266	2.22E+1[a]	2	2.00E-1	60	70	5	6.55E+3
^{57}Co	-	-	4	2.00E-5	-	-	-	-
^{137}Cs	44	3.17E+1	36	9.44E+0	100	60	23	4.15E+2
^{241}Am/Be	40	3.05E+2	5	2.50E-1	-	-	-	-
^{241}Am	-	-	569	2.94E-3	30	150	9	6.17E+0
^{226}Ra	124	536 (mg)	9	6.09E-4	13	13E-3	8	80 (mg)
^{192}Ir	-	-	22	2.20E+3	-	-	2	3.61E+3
^{238}Pu	-	-	1	1.00E-1	-	-	-	-
^{226}Ra/Be	-	-	6	4.20E-1	1	5.00E-3	-	-
^{241}Am/Be	-	-	-	-	8	3.36E-1	-	-
^{226}Ra/Be-	-	-	-	-	1	3.10E-3	-	-
^{169}Yb	-	-	-	-	1	3.10E-3	-	-
$^{137/147}$Pm	-	-	-	-	3	7.50E-5	-	-
^{90}Sr	-	-	-	-	-	-	29	5.61E-1
^{109}Cd	-	-	-	-	-	-	4	1.20E-2

[a] Corrected for decay

Note: the number of sources in actual use is not known but is expected to be much higher than the number of spent sources.

3.3. Emergency response

GOAL: Capabilities for immediate response to breached or uncontrolled sealed sources in Egypt and remediation of the consequences on human health and the environment.

3.4. Policy and regulatory reform

GOAL: Policies and regulations governing all aspects of sealed sources management in Egypt.

4. Sustainability

The IMPRSS project is designed to assure self-sustainability after funding from the USAID ceases. These design elements include:

— Human capacity development.
— Infrastructure development.

— Disposal path.
— Recovery fee.
— Regulatory reform.

5. Summary

The key points for the proposed IMPRSS Project in Egypt are the following:

— Sealed sources enhance human welfare.

— Many sealed sources are excess, and the number is increasing - most are properly managed.

— However, if mismanaged, sealed sources threaten human health and the environment.

— If stolen, they could be used for making a dirty bomb

— Improve physical security is needed to prevent unauthorized removal.

— The proposed IMPRSS Project is an integrated program. It incorporates

  - An integrated project approach
  - Partnership among interested parties

— The proposed IMPRSS Project would transfer skills and technologies - human capacity development.

— The intent of the proposed IMPRSS Project is to develop a sustained program for radioactive sealed sources management in Egypt.

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National Programme for Security of Radiation Sources and Nuclear Materials

E. O. Darko, C. Schandorf, J. Yeboah, et al.

Radiation Protection Institute
Ghana Atomic Energy Commission
Legon, Ghana

Abstract. Nuclear security has become a major emerging key issue in the global community in recent times. Many countries have implemented programmes to deal with the problems of nuclear terrorism and illicit trafficking of nuclear materials and other radioactive materials. In Ghana, specific programmes in these areas are being pursued. The already existing national regulatory control infrastructure established over the years with the assistance of the IAEA under various technical co-operation projects is being used in the interim to deal with some of the challenges of nuclear security. The AFRA project RAF/0/021 "Strengthening National and Regional Capacity of AFRA Member States in Nuclear Security "is envisaged to enhance the nuclear security system in Ghana to cope with emerging issues of nuclear security and foster regional cooperation .This paper gives an overview of the present status and future programmes that would be pursued to complement regional and international efforts to establish effective global security network.

1. Introduction

Considerable efforts have been made to establish basic infrastructure in Ghana with the assistance of the International Atomic Energy Agency (IAEA) for the protection and safety of radiation sources and radioactive materials [1]. Some progress has also been made in the area of emergency response to deal with radiological emergencies.

Lessons learned from IAEA Illicit trafficking of nuclear materials and other radioactive materials database and the 11 September 2001 terrorist attack in the United States of America, have underscored the need for effective control measures in order to avert imminent catastrophe from terrorist activities. The possibility of diverting nuclear materials by some countries can also not be ruled out. Terrorist activities could also cover targeting of nuclear installations or use radioactive material to incite panic, contaminate property and even cause injury or death among the civilian population [2, 3].Because of these global emerging issues on nuclear security the International Atomic Energy Agency has come out with its nuclear security action plan which cover eight pertinent areas:

— Physical protection of nuclear materials and nuclear facilities.
— Detection of malicious activities involving nuclear and other radioactive materials
— State system for nuclear material accounting and control.
— 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; and
— Nuclear security co-ordination and information management.

The IAEA expects all Members States to give priority attention to theses actions plans, which have been approved by the Board of Governors of the IAEA. Because of the urgency and seriousness of this phenomenon to global peace and security ,the Government of the United States of America in Collaboration with IAEA organized an intensive two week workshop at Argonne National Laboratory on the theme 'Emerging Nuclear Security Issues for Decision Makers ", 7-18 October 2002. Ghana was represented by the Director General of Ghana Atomic Energy Commission. There is going to be a follow-up International Conference on Security of radioactive Sources, 10-March 2003 in Vienna, Austria. This conference is expected to foster a better understanding of nature of the threats of potential malevolent use, on ways to diminish the likelihood of such threat occurring and on the necessary measures for preparedness and response in case they do actually occur. One decision-maker and two prominent experts the national Regulatory and customs authorities respectively in Ghana have been selected to attend this conference.

Ghana's participation in all these activities is providing the environment for informed decision making and implementation of programmes relating to security of nuclear materials and radioactive sources, including those of posed by their malevolent use.

The national nuclear security system envisaged will be a collaborative effort between the National Regulatory Authority, the Security Agencies, the Customs and the law enforcement agencies. This paper gives an overview of Ghana's approach to security of radioactive sources and nuclear materials [4].

2. Present Status

Three Francophone African countries neighbours of Ghana, namely, Togo to the east, Cote d'Ivoire to the west and Burkina Faso to the North and the Atlantic Ocean to the South. The extent of nuclear and nuclear related activities in these neighbouring countries is not known and no exchange of information or collaboration exists. On the average about nine (9) radioactive sources are imported into the country annually since 1993. Disused sources under regulated control are planned to be returned to the supplier. Radiation sources whose supplier cannot be traced are managed by the National Radioactive Waste Management Centre.

The major facilities of nuclear security significance in Ghana, which could have potential for accidents resulting in serious health effects but insignificant off-site risk, include:

- A 30kw Miniature Neutron Source Reactor (90.2%) HEU with total 25U loading <1kg
- One 1850 TBq ^{60}Co gamma irradiation facility.
- Two 1850 TBq ^{60}Co Radiotherapy sources.
- Two 1850 GBq ^{137}Co Brachy therapy sources; and
- 740 GBq Am/Be neutron source

The basic infrastructure developed over the years includes [1, 5-8]:

- Legislation and regulations governing protection and safety. Currently no specific legislation on physical protection and nuclear security in place;
- Administration system for notification, authorization to possess radiation sources and radioactive materials, and enforcement of the regulations;
- Technical capability for occupational and workplace monitoring. There is, however, the need to develop the technical capability for a national system for accounting and physical protection of nuclear materials and other high risk radioactive sources;
- Technical capability for environmental radioactivity measurements;
- Education and Training capability in Radiation Protection and Safety at both national and international levels;

— National level response to radiological emergencies;
— Participation in IAEA Illicit Trafficking database programme; and
— Human resources for most of the activities.

3. Future Projections

In the light of the above analysis of key issues on nuclear security, Ghana will expand its programme of activities to cover the following priority areas.

— Extend the legal framework to include nuclear legislation and regulation;
— Identification and retrieval of high risk vulnerable radioactive sources that could possibly be orphaned;
— Develop surveillance system at the borders for combating possible illicit trafficking of nuclear materials and other potentially hazardous radioactive materials.
— Strengthen the national capability to deal with radiological emergencies arising from accidents/incidents, and that due to malevolent use of nuclear materials and other radioactive sources;
— Develop human resources to cope with the challenges posed by nuclear materials and radioactive sources security issues. Appropriate memorandum of understanding will be established between all stakeholders which will prescribe levels of responsibilities, authority and accountabilities to response actions;
— Utilize fully the education and training opportunities offered by the IAEA and other organizations in cost effective and timely manner;
— Pursue regional and international co-operation to minimize any weakness in the global effort to deal with nuclear security threats;
— Make appropriate budget request to government as well as other development partners locally.

Appropriate strategic plans was developed at the regional and national level during the coordination meeting of the AFRA Project on Nuclear Security , held in Accra, Ghana, 20-24 January 2003 [9]. Implementation of the project action plans in collaboration IAEA and collaborators in the region will upgrade and strengthen Ghana's Nuclear security system to deal with any foreseeable nuclear security threat.

4. Conclusion

The basic infrastructure established in Ghana for Radiation Protection and Safety does not provide adequate framework for effective implementation of programmes related to nuclear security in Ghana.

Implementation of the five year workplans (2003-2007) under the new AFRA project on "Strengthening National and Regional Capacity in Nuclear Security "will assist to upgrade and the expand the existing facilities, and improve the technical capability to respond to the challenges posed by emerging global issues on nuclear terrorism and illicit trafficking of radioactive sources and nuclear materials.

The nuclear security programme is envisaged be a collaborative effort between the National Regulatory Authority, the National Security agencies, the National Disaster Management Organization, Customs and Civil Aviation authorities and the law enforcement agencies.

Because radiation knows no frontiers every country need to appreciate the importance of safety and security of nuclear materials .Countries must demonstrate not only to their own populations, but to their neighbours and the world that strong and effective security systems are in place.

Therefore regional and international cooperation and collaboration will be pursued to minimize any weakness in the global effort to deal with nuclear and radioactive sources security threats.

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Strengthening National Radiation Protection Infrastructure under the Model Projects IAEA

S. Kakushadze, L. Chelidze, G. Nabakhtiani

Nuclear and Radiation Safety Service of Ministry of Environment of Georgia
Tbilisi, Georgia

Abstract. Georgia became a Member State of the IAEA in February 1996 and has been receiving Technical Assistance since 1997: several important steps have been accomplished due to this assistance. Georgian Law "On Nuclear and Radiation Safety" entered into force on January 1, 1999. In order to implement that Law No.1674, a number of regulations, addressing radiation protection issues in specific areas of the use of ionizing radiation and radionuclides have been prepared. The national regulations are based the International Basic Safety Standards for the Safety of Radiation Sources (BSS).

A potentially hazardous radiological situation developed in Georgia with orphan radiation sources in the late 1990s and 2001: the discovery of high-activity radiation sources (Strontium-90) from thermo-generators in Tsalenjikha district. Eight such generators were brought to Georgia in 1984, and four of them have been found in Svanety mountainous region in addition to the two found in the Tsalenjikha. Initial activity of each one was 129.5 TBq. Special containers were constructed for the safe transportation of those sources to secure storage.

Over the past few years several incidents of illicit trafficking were reported.

Taking into account the geopolitical location of Georgia it is important to strengthen the radiation protection infrastructure in a country.

The first step was to provide an appropriate legal framework for the safety management in the country and clearly identify the regulatory body. Georgia has established an operational system of notification, authorization, inspection and enforcement for the control of radiation sources.

The Agency's Model Project has been effective in improving the situation in Georgia.

1. Introduction

Georgia became a Member State of the IAEA in February 1996 and has been receiving Technical Assistance since 1997: several important steps have been accomplished due to this assistance.

The Ministry of Environment of Georgia is the authorized state body in the field of state management. It is responsible for the State Control and Protection of Environment and Natural Resources from the effects of radiation, ecological safety and Nuclear and Radiation-related activities.

For the purposes of organization, direct co-ordination and management of State control, a nuclear and radiation safety service is to be set up within the Ministry.

2. Legislation

2.1. Georgian legislation

Georgian legislation in the nuclear and radiation safety field consists of the constitution of Georgia, international treates and agreements signed by Georgia and Georgian Law No.1674 on Nuclear and

Radiation Safety. The law entered into force on January 1, 1999. According to this law the Ministry of Environment Protection of Georgia is the authorized state body in the field of state management, responsible for the protection of environment and natural resources from radioactive effect, ecological safety and nuclear and radiation-related activities.

Competent State bodies in the nuclear and radiation safety field are as follows:

- The Ministry for Protection of the Environment and Natural Resources of Georgia with regard to State control of protection of the environment and natural resources from radioactive effects, ecological safety and nuclear and radiation-related activities;
- The State Technical Supervision Inspectorate of Georgia – as required by law with regard to supervision of the technical safety of nuclear and radiation related activities;
- The Ministry of Labor, Health and Social Affairs of Georgia – with regard to State health supervision with a view of preventing harmful effects to a man caused by breaches of health and hygiene regulations and standards;
- The Ministry of Urbanization and Construction of Georgia – with regard to state expert appraisal of nuclear and radiation facility construction projects, State engineering activities;
- The Ministry of Internal Affairs of Georgia – with regard to the prevention and elimination of fires, including industrial fires, instructing citizens on emergency situations, planning and control of prophylactic measures, approval of emergency action plans, physical protection of nuclear and radiation facilities;
- The Ministry of State Security of Georgia and Ministry of Defense of Georgia – with regard to physical protection of nuclear and radiation facilities
- State Department of Standardization, Metrology and Certification of Georgia - with regard to nuclear and radiation safety, State control and supervision in compliance with State standards.

The legal and statutory framework for the protection against radiation risks is provided through:

- Decree No.90/1999 on the establishment of the Nuclear and Radiation Safety Service;
- Decree “On licensing the Nuclear and Radiation-related activities.” (2002);
- Law No.3/1998 on Health Care;
- The Hygienic Normative Radiation Safety Limits-2000.

To regulate transportation of radioactive materials and waste management drafts of laws have been prepared:

- On Radioactive Waste and Management of Radioactive Waste
- On Transportation of Radioactive Substances

They are under proceeding of adoption.

2.2. Regulatory infrastructure

Nuclear and radiation activity in Georgia shall be carried out in accordance with a license granted by Ministry for Protection of Environment and Natural Resources of Georgia, which is the only official document approving legitimacy of any nuclear and radiation practice.

According our legislation for receiving License applicant must collect permissions from organizations pointed in frame law as responsible bodies in their activities. The Licensing council has been established at the Ministry for Protection of Environment.

The initiator of activity must attach to the application all permits granted by relevant state bodies. The licensee shall notify the Ministry in the written form on any changes regarding information. It has to be noted that the large majority of facilities to be regulated are medical facilities. The dosimetry service established at the National Cancer Centre covers the radiation workers from public hospitals.

The ministry shall take a decision on suspension of a licensee violates licensing conditions. Or other requirements of nuclear and radiation safety regarding specific character of the licensed activity.

A licensee must be immediately notified on the decision of suspect ion of the license. Notification should include reasons and necessary grounds of such suspension. Suspension of a license shall be recorded in the Register of Licenses. Suspension of a license means prohibition of licensed activity until its renewal. Only Ministry defines the terms of such suspension. The validity of the license is suspended until fulfillment of the requirements set out in the provision but not more than three month.

The decision on the suspension of the license shall be recorded in the Departmental Register of Licenses.

The ministry shall abolish a license upon the submission of the draft decision prepared by the Safety Service.

Manufacturers or vendors are required to notify the NRSS of new source 30 days earlier for consideration the notification.

2.3. Management of disused sources

Follow the technical passport of source it has its own working potential and if exist agreement between manufacturer and user, the source should be returned (Batumi oncological centered). Regulatory authority assists the legal person after notification, considered the question at council and follow developed recommendations the source should be store or dispose.

Georgia has not centralized modern disposal in accordance with BSS. Security over stored disused sources maintained by user, Are inspected the appropriate the parameters, signalization by NRSS.

2.4. Country program framework

TC activities mainly address the strengthening of radiation protection, nuclear legislation, waste safety, and human health. Georgia is participating RER/9/062 “National Regulatory Control and Occupational Radiation Protection Programs” in RER/0/015 “Legislative Assistance”, RER/2/003 “Marine Environmental Assessment of the Black Sea Region”, RER/9/060 “Physical Protection and Security of Nuclear Materials”, and RER/6/012 “QA in Radiotherapy”

Results related to the implementation of the model Project RER/9/062 in Georgia:

- Sub-Regional Training Courses on Radiation Protection in Diagnostic Radiology, safety culture in Medicine Practice held in Tbilisi in 23-27 October 2000 and 8-11 October 2001 were so successful. The participation of colleagues from Armenia and Azerbaijan contributed to the promotion of exchange of experience and regional co-operation.
- Experts visits assisted the implementation of Georgian regulatory program particularly in controlling medical radiation sources.
- Many participants from Georgia attend training courses.

Georgian Regulatory Authority has begun with licensing and inspection procedures. Two licenses were issued

The compliance with the Model Project milestones allow Georgian Regulatory infrastructure will be able to met principle requirements of IBSS.

2.5. Response to abnormal events

Follow Georgian law "on Nuclear and Radiation Safety " Article 5 paragraph (e)- emergency action plans must be in place, i.e. preliminary planning on essential actions in the event of an emergency situation and implementation of pre-planned measures to prevent or mitigate radiation damage during possible abnormal events.

The ministry of Internal Affairs of Georgia responsible with regard to the prevention and elimination of fires, including industrial fires, instructing citizens on emergency situations, planning and control of prophylactic measures, approval of emergency action plans, physical protection of nuclear and radiation facilities;

Several difficult radiological incidents have been developed in Georgia since 1997. Often there was orphan sources found. A radiological accident took place at the military base in Lilo, when 11 soldiers were irradiated by caesuim-137. In the scope of TC project GEO/9/004 "Radiological Emergency Assistance to Georgia" some analytical and monitoring equipment was provided to Georgian specialists to enable them to locate any additional sources left behind by the former Soviet Army on the territory of Georgia.

A notable case refers to thermoelectric generators containing huge amounts of the radioactive element strontium –90. The activity of each radioactive source in the mountainous region of Svaneti is about

35 000 Ci. The immediate response of the Ministry of Environment of Georgia prevented the ecological catastrophe. TC project, GEO/9/006 "Assistance for safe disposal of SR-90 the thermogenerators" was started in March 1999. In scope of this project, 56 hours of airborne gamma survey of a large territory of the western part of Georgia and around Tbilisi was carried out. The outcome of the mission was not only the finding of orphan sources, but also a radiation contamination map of the western part of Georgia.

Last December, a similar radiation accident took place involving two orphan sources (Sr-90) found in Tsalenjika region, when three inhabitants were irradiated and received heavy radiation burns. In February 2002, a Georgian team supported by the IAEA successfully recovered this two powerful radioactive sources.

Among the latest steps, agreement was reached on a multi-step action plan to conduct IAEA-supported radiological surveys of selected areas in Georgia. The plan was put into place at three-day IAEA Technical Meeting concluding 11 April, in Paris, France. The action plan covers two phases of a search campaign to survey selected areas of Georgia with sensitive radiation detectors and instruments to locate radiation sources that are outside of regulatory control.

The first phase specifically seeks to recover two strontium-90 sources known or suspected of being at large. The survey is planned over a two-week period in June.

The second phase, details of which are being worked out, provides assistance to locate and recover other known or suspected orphan sources in the country.

3. Conclusions

The corresponding national regulatory infrastructure has been created for controlling the powerful radioactive sources to protect them against terrorism and theft on the territory of Georgia.

Under the model projects NRSS has an established and effectively functioning inspection program.

There are some real general hazards connected with abandoned radiation sources, and illicit trafficking that became very significant due to geopolitical position of Georgia.

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First Steps in cCreation of the Infrastructure on Radiation Safety of the Republic of Tajikistan

U. Mirsaidov, J. A. Salomov, M. Khikmatov

Nuclear and Radiation Safety Agency of
the Academy of Sciences of the Republic of Tajikistan
Dushanbe, Republic of Tajikistan

Abstract. This paper describes shortly present situation in the field of radiation protection in the Republic of Tajikistan and the measures, which are being carried out jointly by IAEA and the Commission on Cooperation with IAEA of the Republic of Tajikistan to improve this situation.

1. Introduction

Tajikistan is not a nuclear state, though the scientific world knows well that Tajik uranium had a big contribution in creation of the first Soviet atomic bomb and in creation and development of Soviet nuclear power engineering.

Mass media wrote and writes a lot about uranium deposits, their exploration, development and mining in Tajikistan. Sometimes in mass media penetrates information as if in Tajikistan there was illicit trade of radioactive materials, even as if there were cases of illicit trafficking of enriched uranium from Tajikistan. During many years Republican factories and plants on uranium enrichment have not been functioning because of lack of raw material.

Having gained independence, the Republic of Tajikistan was involved in inter-Tajik conflict, which turned into Civil war (1992-1997). Many specialists, who worked in the field of nuclear technology (mostly in plants of Tajikistan worked the visiting experts), have left Tajikistan during this period. The result of it was that a number of shops and plants in cities Chkalovsk, Taboshar, and Adrasmon (Northern Tajikistan) were almost halted.

It is well known that during Soviet period the mining industry proceeded only a small part (5-10 %) from a large amount of raw material and minerals taken from mines. The larger part of them was accumulated in tailing dumps and waste fields. As a rule, stored wastes contain a number of chemical elements and compounds having harmful effect on environment, including people’s health, animals, and plants. Tailing dumps and waste fields of mining industry of Tajikistan, where the main radionuclides-pollutants in wastes are uranium, radium, polonium, thorium, antimony, mercury, etc., are in critical state.

2. Present Situation

According to data of the Ministry of Nature Protection of the Republic of Tajikistan, the amount of accumulated (conserved and active) “tails” for present period consists of 210 million of tons. They are stored in the area of more than a thousand hectares. Radioactive gamma-radiation of just one of functioning tailing dumps (the Degmai-settlement), which occupies the territory of 90 hectares and where stored 39,8 million of tons of radioactive wastes, reaches 200-250 microroentgen per hour. Most of "tails" do not have proper cover and are very dangerous for the environment.

Tajikistan received these "tails" as heritage from Soviet period. In that period, the Radiation Safety Service kept in secret from society many negative data. Today, when we are building a democratic state in Tajikistan, we are reforming the Radiation Safety Service of our country along with other institutions.

3. Cooperation with IAEA

Tajikistan became the Member State of IAEA in 2001. At present the President of the Republic of Tajikistan empowered the Minister of Foreign Affairs of Tajikistan to sign the Safeguards Agreement and Protocols Additional to the Safeguards Agreement. According to the instructions of the Government of the Republic of Tajikistan, the Academy of Sciences of Tajikistan became the Contact Organization (Coordinator) of the Republic of Tajikistan for cooperation with IAEA. The Nuclear and Radiation Safety Agency is established at the framework of the Academy of Sciences. In future the Agency is planned to become the Regulatory Authority of the Republic of Tajikistan on Problems of Safety, Control, Storage, and Utilization of Radioactive Materials.

During this short period of time the Commission of the Republic of Tajikistan on Cooperation with IAEA had done a great job. In the beginning of 2002 we became INIS Member and already has received an INIS grant and assistance for establishing of our National INIS Information Center and for strengthening our communication means with IAEA. Since May of last year our Nuclear and Radiation Safety Agency joined the project RAW 09/008 of the IAEA Department on Technical Cooperation. After this event, the representatives of West Asian Sector of the IAEA Department on Technical Cooperation visited our Republic and acquainted themselves with state and progress of organization of safety, accounting, storage, and control of radioactive wastes in the Republic of Tajikistan. The IAEA representatives had fruitful meetings with the Government and Parliament officials. Particular attention was paid to the problem of organization of legislative base on radiation safety of population, use of radioactive sources, radiation protection, and, the most important matter, – establishing of Regulatory Authority of Tajikistan. Solid mutual understanding was achieved between parties during that visit.

Presently Majlisi Namoyandagon (the Parliament) of the Republic of Tajikistan considers two laws – Law on Radiation Safety and Law on Regulatory Authority. Practically, both laws were prepared with active participation and assistance of IAEA experts within the framework of the TC Project Raw 09/008. We hope that these laws will be adopted in the nearest future.

The second, not less important task of the Agency is training of well-educated, professional personnel.

Only during the second semester of last year and beginning of this year about 25 specialists from the Nuclear and Radiation Safety Agency, the Republican Cancer Center, the Center of Radiotherapy, the Republican Sanitary Epidemiological Station, the Ministry of Extreme Situations and Civil Defense, the Ministry of Nature Protection, etc. were trained during different training courses, special courses, fellowships, and scientific visits organized by IAEA within the framework of the Project Raw 09/008 of the IAEA Department on Technical Cooperation. Thanks to support of projects by the IAEA Department on Technical Cooperation, we received grant for upgrading of Nuclear Medicine Service at the Institute of Gastroenterology of the Academy of Sciences of Tajikistan and for providing individual dosimeters for personnel working with radioactive sources within the whole territory of Tajikistan.

In the report of Mr. Al-Baradey during Conference on Safeguards and Safety of Radioactive Sources (Vienna, 10-13 March, 2003) was mentioned that after disintegration of the USSR there are many "neglected" sources in the territories of former Soviet Republics. With the aim to have proper accounting of radioactive sources, by the proposal of the Agency, the Commission for Carrying Inventory of Radioactive Sources was established at the Government of the Republic of Tajikistan.

Inventory to be carried out in all ministries and bodies, which use radioactive sources. We plan to create the State United Database for Sources of Ionizing Radiation after the inventory will be finished. Thus, we shall be able to organize the control of radioactive sources "since cradle till tomb". We are organizing office-work on accounting of sources of ionizing radiation, starting from acquirement, use and delivery to repository sites, i.e. we shall create a register for all operations with sources of ionizing radiation.

According to the joint workplan in the framework of the project RAW09/008 for 2003-2004 we should carry out a large amount of work. First of all, we should finish the creation of legislative base on radiation safety programs, creation and ratification of regulatory documents, and, the most important thing, creation of plenipotentiary Regulatory Authority on Radiation Safety of the Republic of Tajikistan. In order to implement these projects we plan a visit of IAEA experts to assist us in training of the personnel for carrying out of inspections, inventories, accounting, control, storage, etc.

We plan trainings and seminars in a number of the Republican's cities and outside the Republic, individual monitoring of the whole personnel, training courses for personnel of the Republican Cancer Center on radiation protection of personnel and patients during radiation treatment, and etc.

But, unfortunately, we also have a number of problems with introduction of our plans. The main problem is a financial problem. Our friends know that our country recently came over the interstate conflict. Today we can see solid peace and understanding in the Republic of Tajikistan.

Presently, we need support of international organizations and foundations in order to have successful development of Tajikistan, and, particularly, for organization of infrastructure on nuclear and radiation safety in our Republic, which is also promotes safety of our neighbors.

It should be mentioned that the Republic of Tajikistan, regardless of her small territory, has particular geopolitical location, as neighbors of Tajikistan are such countries as Afghanistan, other Central Asian Republics and she is located near such nuclear states as China, India, and Pakistan. Small Tajikistan has many kilometers of frontier with China and Afghanistan. Some areas of frontier are very hard to protect.

During many years of civil war in Afghanistan, particularly, during the recent years when the country was ruled by Talibans and Afghanistan was a location of international terrorism, the Government of Tajikistan faced not only the problem of safety of Tajikistan, but it also faced the problem of non-admission of narcotics' penetration into territories of other countries through the Republic of Tajikistan, the problem of prevention of using the territory of Tajikistan for illicit trafficking and illicit trade of nuclear materials and the problem of prevention of nuclear terrorists' penetration into the Republic of Tajikistan.

These problems are still actual today. Our specialists and experts face considerable difficulties and problems because of lack of modern equipment. Unfortunately, even customs and frontier services of most of frontier posts (airports, railway stations, highways) do not have necessary equipment for detection of radioactive materials.

4. Conclusions

The Government of the Republic renders its assistance as far as allow its financial possibilities to services and bodies, which has relation to use, storage, shipping, and control of radioactive and nuclear sources. However, this assistance is not enough for proper and effective work of all services and bodies.

That is why to solve these actual and urgent problems the Nuclear and Radiation Safety Agency of the Republic of Tajikistan needs new contemporary equipment (radiometers, dosimeters, spectrometers, etc.), training of well-educated staff, and creation of conditions for carrying out of monitoring of the whole territory of Tajikistan.

Cooperation with IAEA will allow solving of many problems in shortest period of time and to increase the level of radiation protection of the population of our Republic.

Training Programme on Radiation Emergency Response
The Brazilian experience

L. M. J. Belem Ferreira, W. M. Ferreira, R. dos Santos

Institute of Radiation Protection and Dosimetry (IRD)
Brazilian National Nuclear Energy Commission (CNEN)
Rio de Janeiro, RJ, Brazil

Abstract. One of the most important lessons learnt from the radiological accident in Goiania, Brazil, in 1987 was the need for adequate preparedness for the emergency responders. Since 1988, the Brazilian National Nuclear Energy Commission has been training several national, state and local agencies in Brazil to face radiation emergency situations. This training became more effective after September 11, 2001, within the world concern of nuclear terrorism This paper presents the traiming programme carried out in the past few years.

1. Introduction

The System for Response to Radiation Emergencies of the Brazilian National Nuclear Energy Commission (CNEN) had its origin in the year of 1980 with the objective to promptly respond to the potential or real emergency situations of nuclear or radiological origin in the Brazilian territory. Its first challenge occurred in the year of 1987 with the radiological accident in Goiânia, in which a Cesium-137 source found abandoned in a clinic was broken open, causing the death of four people and contamination in 249 others [1]. The lessons learned during the response to this accident and the international experience gained after the Chernobyl accident had taken the CNEN to implement updated concepts and techniques of planning, preparedness and response in case of accidents of nuclear or radiological origin. For that, two aspects had to be taken into consideration: the development of specific programmes for training the emergency teams and the introduction of courses for developing skills to the supporting government agencies also involved in the response to the emergency.

The training process started by considering the necessities for improving the internal response teams of the CNEN based on the acquired experience and adopting concepts and procedures developed by different International Organisations [2] which were updated to be consistent with the Basic Safety Standards published in 1996 [3]. The second step was to consider the implementation of courses, training and exercises to other government Agencies which are usually responding to conventional emergencies (Federal, State and Municipal Civil Defense, Armed Forces, Fire Brigade, Federal Police, and many others). This training process had to be intensified given the new scenarios presented by the possibility of the malevolent use of radioactive sources after the terrorist attacks of 11 September 2001. The action plan developed to train the organisations in order to establish an organised emergency response capability for timely, co-ordinated response in case of a radiation accident is described in the present paper.

2. Description of the Action Plan

The first step of the Brazilian regulatory authority was to adjust the emergency planning, revising the diverse existing emergency plans and modifying the concept of operations, introducing adequate methods of training. The acquired experience took the Radiation Emergency Assistence Services – SAER – from the Institute of Radiation Protection and Dosimetry – IRD/CNEN – co-ordinator of the emergency response actions of the regulathory authority, to develop a structure to train the diverse teams of response to a radiological and/or nuclear emergency according to their expertises. This Service had the role to organize the system to respond to a radiation emergency in the Brazilian territory. The first provision was the constitution of technical and logistic support teams headed by a field coordinator on call twenty four hours a day on a weekly basis. The teams are composed by members from different areas of expertise:

- environmental monitoring;
- personal monitoring;
- internal and external dosimetry;
- triage, waste and decontamination;
- radiological assessment;
- aerial and ground survey;
- isotopic analysis laboratory;
- mobile whole body counter;
- support of operations;
- communication system;
- communication with the media;
- nuclear instrumentation;

These teams are submitted to programmed as well as unannounced training on a regular basis, besides participating, by legislation enforcement [4], of full scale and partial exercises, together with other government organizations to test the existing emergency plans for the Angra Nuclear Power Plant. The training applied to these teams is developed by means of the acquired experience and in compliance with the international legislation, adopting updated procedures [5,6,7].

The second step consisted of applying specific training for the other government organizations. The training applied to these units consists of regular courses and exercises. The courses are disseminated on a wide basis at the IRD Home Page, brochures and invitation letters. Basically, they consist of general topics of radiation protection, table top and field exercises, communication with the media, psychological behavior in adverse situations and first aid for radiocontaminated victims.

3. Results

The methodology applied to the optimization of the training process made possible to the System for Response to Radiation Emergencies of the CNEN to fulfill its role in terms of the demand for services related to the safety of nuclear technology offered to the society, providing a prompt response to a potential or real emergency situation in the Country. The quantification of the training process can be seen in Table 1, where it is shown the number of courses, seminaries and exercises that were offered to the organizations involved in the emergency response by law enforcement, as well as other institutions that were encouraged to have the knowledge of procedures for the safe use and manipulation of radioactive material. The data are listed starting in the year of 1995, during which the consolidation of the emergency plans was initiated in the Country, and through legal competence, the SAER started to train and to recycle the involved organizations and to reformulate the internal teams in accordance to the updated concepts of the international recommendations [8,9] and the experience acquired in the preparedness and response to a radiological and/or nuclear emergency.

TableI. Training activities during the period 1995-2002

	1995	1996	1997	1998	1999	2000	2001	2002
Courses	02	04	04	10	08	07	07	03
(participants)	(132)	(95)	(149)	(303)	(267)	(227)	(207)	(102)
Seminars	02	01	01	02	20	20	20	16
(participants)	(80)	(50)	(60)	(160)	(1259)	(1311)	(879)	(611)
Drills	-	-	01	04	07	06	05	04
Exercises	-	-	02	02	01	01	02	01

4. Conclusions

The actions developed with the participating organizations of the response to a radiological and/or nuclear emergency proved to be effective, resulting in a better trained emergency staff in close liaison with other organizations, besides fostering:

— a better understanding of the technical terms by other organizations involved;
— harmonization of concepts and procedures;
— the recognition by the regulatory authority of the importance of other organizations involved in a conventional emergency;
— the hability to work in a multidisciplinary team;
— constant update of concepts;
— interest by the society in searching information about courses, lectures on nuclear matters;
— use of adequate communication with the media.

A better trained emergency staff, together with the optimization in infrastructure, constitutes an important effort to prevent and to counter the threat of the malevolent use of radioactive material, such as terrorist attacks to nuclear reactors or attacks using radiological materials such as radiological dispersal devices – the so called "dirty bombs", which became a real concern after the large-scale terrorist attacks on 11 September 2001. The courses, exercises and seminars provided to different government organizations helped them to be prepared to respond to any related emergencies that might arise.

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Radioactive Sources Security and Emergency Preparedness Regulation in Ukraine

O. Makarovska, V. Holubiev

State Nuclear Regulatory Committee of Ukraine
Kiev, Ukraine

Abstract. Radiation sources are widely used in industry, medicine, researches and education in Ukraine. To constrain the associated with radioactive sources risks state regulatory system (infrastructure) is created in Ukraine. Beginning from the 1990s Ukrainian regulatory body began to pay especial attention to combating illicit trafficking, safe management of sources that have high risk to become orphan and to restoration control over orphan sources. After terrorist attacks of September 2001 particular concern appeared about potential malevolent use of radioactive sources. The answer for these new regulatory challenges was given by implementation of different measures aimed at strengthening of safety and security of radioactive sources and prevention of unauthorized access or damage to radioactive sources. These measures included: creating of special law for physical protection and regulations for management of orphan sources and security of highly active sources; assessment of applicant security measures and emergency preparedness before authorization granting and enforcement of user compliance with security and emergency requirements; implementation of basic elements of national system for gaining and regaining control over orphan RS (including creating of radiation monitoring systems at borders and scrap yards and creating of emergency preparedness system for the cases of loss of control or discovery of radiation source); creating of national tracing Register. These measures are implemented or are at different stages of implementation. On the other hand, Ukrainian regulatory body has problems with implementation of some legislative requirements. Essential international and national efforts make us sure that Ukraine is moving towards sustainable and effective radiation sources safety and security regulation.

1. Introduction

Radiation sources (RS) are widely used in industry, medicine, researches and education in Ukraine. There are 978 non-medical users and more than 2500 medical users. According to 1995 data more than 80000 sealed radioactive sources were used. In teletherapy, irradiation and power generation more than 1000 high radioactive sealed sources of first category are used.

To constrain the associated with radioactive sources risks state regulatory system (infrastructure) is created in Ukraine. This system includes all main regulatory instruments, such as:

- Establishment of laws, regulatory standards, requirements and guides;
- Notification, registration, certification and licensing;
- Inspections and enforcement.

Beginning from the 1990s International Atomic Energy Agency and national regulatory bodies began to apply more and more efforts regarding safety and security of radioactive sources. In the framework of these international initiatives Ukrainian regulatory body (State Nuclear Regulatory Committee of Ukraine) began to pay especial attention to combating illicit trafficking, safe management of sources that have high risk to become orphan and to restoration control over orphan sources. After terrorist attacks of September 2001 particular concern appeared about potential malevolent use of radioactive sources.

2. Strengthening of Radiation Sources Security

The answer to these new regulatory challenges was given by implementation of different measures aimed at strengthening of safety and security of radioactive sources and prevention of unauthorized access or damage to, and loss, theft or unauthorized transfer of, radioactive sources, and to prevent the malicious use of radioactive sources to cause harm. These measures included:

— Creating of legislative base and regulations for security (physical protection) of RS;

— Assessment of applicant security measures and emergency preparedness before authorization granting and enforcement of user compliance with security and emergency requirements;

— Creating of national tracing Register of radiation sources as national system for registration and control of sources;

— Implementation of basic elements of national system for gaining and regaining control over orphan RS.

These measures are implemented or are at different stages of implementation.

2.1. Creating of legislative base and regulations for security of radiation sources

In 2000 the Law of Ukraine was published - "For the physical protection of nuclear materials, nuclear facilities, radioactive waste, *other radiation sources*". This Law extended conception of physical protection for radioactive sources. To implement this Law regulations were elaborated:

— "Rules for security of nuclear materials, nuclear facilities, radioactive waste, other radiation sources";

— "Procedure for definition of level of physical protection of nuclear materials, nuclear facilities, radioactive waste, other radiation sources according to their category".

From the point of view of security sources now are divided into 2 categories. First category RS (activity more than $3{,}7 \cdot 10^{13}$ Bq and half-life time more than 5 years) practically coincides with those in IAEA-TECDOC-1344 "Categorization of radioactive sources" and requires management in the protected area, which is surrounded by physical barrier (protected area shall be in controlled area, which is surrounded by perimeter, which is guarded). Of course this levels will be developed and we are waiting for the appearance of IAEA guide "Security of Radioactive Sources".

2.2. Applicant (licensee) security measures and emergency preparedness

From the point of view of sources security conditions to license issuance are that applicant shall have available:

— Security assessment in safety analysis report and implemented security measures for RS;
— Accounting system with yearly inventories, registration in State Register (from 2004);
— Emergency Plan and suitable material resources and trained response personnel;
— Financial capabilities to reimburse cost for management of disused sources and damages in case of radiation accident.

One of the obligatory parts of emergency plans is prompt reporting to regulatory body and other relevant authorities about decontrolled, lost, stolen or missing RS. Yearly reports to regulatory body shall include information about RS transfers to other places or other licensees. Applicant emergency preparedness and security of radiation sources are examined during the course of licensing process and planned inspections.

As for the security of disused RS - only those ways of management are allowed:

— Temporary secured storage at the facility (not more than 6 months);
— Return of RS to country of production according to the agreement with supplier;
— Prolongation of service life of RS by conducting certification test at accredited test centres;
— Transfer of RS to special enterprises of radioactive waste disposal.

2.3. State register of radiation sources

In 1997 the Government of Ukraine made decision to establish unified computerized system of registration, accounting and control of radiation sources – State Register of radiation sources. In 1998 on the basis of Ukrainian State Production Enterprise “Isotope” a separate subdivision “State Register of Radiation Sources” was established. This subdivision discharges functions of Main Registration Centre. This centre is equipped with the assistance of the IAEA Launching into operation of the Register and state registration is important for upgrading of the level of safety and security of radiation sources, reduction of orphan sources and illicit trafficking, investigation and enforcement. Main principles of state registration of RS in the Register are:

— All radiation sources that are not exempted from regulatory control are subject to registration;
— Registration bears obligatory nature and is chargeable.

The Register shall file data of all radiation sources in electronic form and trace RS starting from the moment of their appearance at the territory of Ukraine and till their removal from Ukraine or transfer to special enterprise on radioactive waste management (disposal). Interaction is kept running between the Register and State Custom Service of Ukraine, State Export Control Service of Ukraine, Radioactive Waste Register according to procedure that is approved by the Cabinet of Ministers of Ukraine. Information about registered sources shall be updated not less than once per year and also in cases: changing of owner of radiation source, place of location; import or export of radiation source through the border of Ukraine. The following information shall be entered in the Register: type of source, isotope, activity, accelerating potential, manufacture number, device to which source is included, location of source, owner of source, its postal address, license number.

One of the main stages of the Register creation is State accounting campaign. Such pilot campaign is carried out at Kiev city.

On the whole Register is created for 50%. All procedures and software are ready, but regional registration centres are not created, equipped and staffed. Lack of funds is the main problem impeding the commissioning of the Register.

Upon request of regulatory authorities and state authorities involved in handling of radiation sources the Register will provide information of orphan sources or being in elicit trafficking. Register will provide annual report to regulatory bodies.

2.4. Basic elements of national system for gaining and regaining control over orphan RS

In spite of measures of safety (accounting) and security some sources become orphan. According to our expert estimation each country has number of orphan sources detection cases (detection and disappearance both) that make about 0,1 - 0,5 % from overall number of users. In Ukraine we have dynamics of “orphan sources cases” that is shown in the Table 1.

Table I. Dynamics of "orphan sources cases" in Ukraine

Case character	Number in 2000		Number in 2001		Number in 2002	
Appearance:	10		10		2	
Metal scrap monitoring	5		4		2	
Radiological monitoring	3		5		0	
Criminal investigation	2		1		0	
Losses:	3	(3RS)	4	(4RS)	2	(4RS)
With discovery	2	(2RS)	3	(3RS)	1	(2RS)
Without	1	(1RS)	1	(1RS)	1	(2RS)
Thefts:	3	(4RS)	5	(10RS)	3	(5RS)
With discovery	2	(3RS)	3	(3RS)	2	(2RS)
Without	1	(1RS)	2	(7RS)	1	(3RS)
Unauthorized management:	4		3		0	
Transportation	3		2		0	
Use	1		1		0	
Radioactive metal scrap	4		4		3	
Total	**24**		**26**		**10**	

In order to combat illicit trafficking and to gain control over orphan sources monitoring at borders and metal scrap monitoring is obligatory in Ukraine. Radiation monitoring of exported metal scrap is followed by issuance of the relevant Certificate.

To regain control over orphan RS "Procedure for interaction of executive authorities and involved legal entities in case of revealing of radiation sources in no legal use" was approved by Resolution #207 of 04.03.97 of the Cabinet of Ministers of Ukraine This Procedure provides measures to regain control over source that are shown in Table 2.

Table II. Procedure to regain control over orphan radioactive source

Action	Responsible authority or person
Detection and address to local executive authorities or internal affairs bodies	Legal or physical person who has detected a suspicious material
Material security measures arrangement at the site and information of local radiological offices of state sanitary epidemiological supervision service	Local executive authorities or internal affairs bodies (Ministry of Internal Affairs)
Preliminary examination of a suspicious material, information of local executive authorities as well as territory authorities of Ministry of Emergencies of Ukraine, internal affairs bodies about necessary individual protection measures	State sanitary epidemiological supervision service (Ministry of Health)
Criminal proceedings and conduction of investigation	Law enforcement authorities (Ministry of Internal Affairs)
A source shall be: taken away by emergency team, placed at special enterprise on radioactive waste management, stored until an owner will be found or criminal case will be closed.	State Enterprise for radioactive waste management "Radon" emergency teams (Ministry for Emergencies)
Search for owner: search of an owner of radiation source through the State Register of radiation sources, informing the IAEA, competent authorities of interested countries and mass media.	State Nuclear Regulatory Committee of Ukraine, Main Registration Centre

2.5. Implementation problems

Ukrainian legislation and regulations include strict requirements for the disused sources and accidents with RS. These requirements for the user (owner) are:

— Prohibition of disused sources long-term storage at the facility (after two months storage or six months in authorized cases disused sources are to be handed to special enterprise or supplier);
— Availability of financial resources for the case of radiation accident (including loss or theft of the source).

Very often user has not enough financial resources to meet these requirements, from the other hand - appropriate implementation mechanisms are not elaborated. Now in Ukraine more than 120 enterprises store at the facilities about 11500 disused sources (mainly smoke detectors). Provisions requiring users to carry appropriate insurance to cover the costs of management of disused source and costs of compensation in the event of an accident are still discussed. There are uncertainties as to whether such insurance would be available or available at affordable price. So further national and international studies of financial implications are needed.

3. Role of International Undertakings

Of great importance for strengthening radiation sources safety and security for Ukraine are international undertakings, especially those that strengthen national radiation safety infrastructure and establish guidance for States, such as Code of Conduct on the Safety and Security of Radioactive Sources and categorization of radioactive sources. Finalisation of IAEA guide “Security of Radioactive Sources” will assist importantly in creation of security strategy. Also it is important to have access to IAEA repository of information on characteristics of RS and devices containing RS and to elaborate common criteria for RS national Registers to facilitate information exchange between States.

4. Conclusion

Ukraine makes steady efforts towards achieving and maintaining high level of security and safety of radioactive sources, preventing unauthorised access to, loss, theft and unauthorised transfer of radioactive sources through such measures as:

— Management of sources within legal regulatory framework,
— Prevention of acquisition of radioactive sources with malevolent intent,
— Detection of actual loss of control over radioactive sources,
— Emergency preparedness, including recovery of theft or loss of sources, efforts to recover stolen or loss sources and minimization of consequences of accidental or malevolent use of radioactive sources.

Further essential international and national efforts are needed to achieve sustainable and effective radiation sources safety and security regulation.

Lessons Learned from the Regulatory Control of the Accidental Exposure of Radiotherapy Patients occurred in Panama

E. Gibbs, A. Douglas

Department of Radiological Health
Caja de Seguro Social
Panama, Republic of Panama

Abstract. The lessons learned from the accidental exposure of radiotherapy patients generated a series of corrective actions, among which it was observed that, in addition to the existence of a national regulatory structure with approved norms and regulations, audits, radiological inspections, and performance verifications of the Cobalt Teleterapy Unit, it is relevant to apply the necessary enforcement measures that generates immediate execution of corrective actions, the implementation of a Quality Assurance and Control Program and an adequate training of professionals of the Radiotherapy Department.

1. Introduction

Executive Decree Nº 1194 of December 3, 1992 establishes the Radiation Protection Regulations in the Republic of Panama, and creates the regulatory structure by which the Ministry of Health is the Competent Authority for the administrative and technical implementation of norms pertaining to Radiation Protection [1]. The Competent Authority for the exercise of its regulatory functions is based on the technical criteria of the Radiological Health Department of the Caja de Seguro Social Institution, which is the National Technical Unit in matters of Radiation Protection.

In order to strengthen the Regulations, concrete actions were required; such as the execution of a radiological survey to identify ionizing radiation sources, as well as, the number of occupationally exposed personnel at national level. This task was completed in 1996 with the participation of the country in the Radiation Protection Model Project of the International Atomic Energy Agency (IAEA), whose objective was to improve the national infrastructure of Radiation Protection. During the execution of this project, the Competent Authority authorized complementary regulations for the activities relative to the regulatory control; the personnel were trained in radiological inspection tasks, the personal dosimetry program was strengthened, and a National Authorization System was implemented [2].

In the execution of activities of regulatory control, radiological inspections were applied to relevant installations in process of authorization. Thus, the Authorization proceedings for the use of ionizing radiation sources were initiated late 1996 at the National Oncology Institute (ION), an action which, at the time of the accidental exposure, had not yet been approved. In the process, the Technical Unit identified administrative and technical irregularities which finally lead to the accidental overexposure of the radiotherapy patients [3]. This accident, reported in January, 2001, caused a change of attitude of the authorities and authorized legal persons (licensees) of radiation sources, and fomented the incorporation of a series of administrative and technical actions. It is in the context of the implementation of these new measures, that this document presents the facts, evaluates the corrective measures applied, and values the lessons received.

2. Administrative Aspects

During the ION authorization process, the Competent Authority established a written communication with the Administration and demanded in several instance the fulfillment of the most relevant aspects, such as the preparation of procedure manuals, physical and clinical protocols; the calibration of the dosimetry instruments, and the hiring of personnel with adequate technical and academic training.

The alteration of the methodology used in one of the treatment planning procedures lead to the accidental overexposure at the ION. Nevertheless, the following aspects of administrative nature must be considered as factors contributing to the event.

— The absence of a safety culture which was undoubtedly an element that contributed to the non-activation of the mechanisms necessary to attain the conclusion of the protocols and procedures required for the completion of the authorization efforts.
— The hiring of human resources which was made without considering the academic and technical training requirements for the development of their tasks.
— Approximately 100 new patients were referred monthly to the radiotherapy Department, representing an excessive work load for the 16 daily hours serving the demand with limited personnel.
— There was not a clear definition of functions for the professionals of the Radiotherapy Department.

3. Technical Aspects

The technical evaluation of the accident leads to the conclusion that the overdose accidentally applied to the patients undergoing pelvic cancer treatment (colon, prostate, and uterine neck) in the ION Radiotherapy Department was due to the modification of the routine procedure of the treatment planning, which produced an error in the calculation of the dose rate applied to the patients.

The procedure modification consisted basically of two aspects: The addition of a protection block to the patient's field, and the direction in which the blocks were digitized taking them as one block only. The routine procedure consisted of the use of four protection blocks; the modification consisted of an additional protection block. Moreover, the routine procedure digitized the block in an individual manner, while the modification consisted of digitizing all the blocks as one only, and in the clockwise direction. [4] The modification applied lead to a longer treatment time to the patients which in turn resulted to an overdose in the range of 1,7 Gy to a 42, 49 Gy [5].

The symptoms revealed by patients, such as prolonged diarrheas were not timely detected by the treatment personnel because they did not have an adequate follow-up plan.

The non availability of documented protocols as well as mechanisms for the evaluation and pproval of methodology being used, were actions that did not allow the timely detection of the error. For example, the modification of the procedure did not have a dosimetric verification either manual or by measuring. Furthermore, there was not a single mechanism implemented to apply the principle of defense in depth.

The lack of standardization of procedures, as well as, the non existence of mechanism reflecting the compliance of radiotherapist and physicist in the application of patient treatment adds to the series of technical irregularities detected in the evaluation of the event.

A Quality Assurance and Control Program did not exist to allow the detection of deficiencies related to the technical provisions, as maintenance and repair procedures of equipment, instruments calibration, quality control tests, and control procedures of documents and data collection.

The ION was subject to two external audits by IAEA Experts Missions whose specific objective was the evaluation of the Cobalt Teleterapy Unit with respect to its calibration. Their reports indicated that most of the tests performed were within acceptance limits. Nevertheless, the report also reflects observations which coincide with those presented by the Technical Unit in regard to the lack of procedures and irregularities in the safety systems; however, no corrective measures were applied to the observations.

4. Corrective Measures

The accident generated a series of corrective measures in connection with the aforementioned administrative and technical irregularities. After the event, the ION administration showed greater interest on the fulfillment of the regulations, regarding the practice of radiotherapy and established mechanisms to comply with the requirements necessary for the authorization procedures. Likewise, concern was observed with regards to the personnel assigned to the Radiotherapy Department, the implementation of a radiation protection committee, and the hiring of a full time employee in charge of radiation protection.

The preparation of protocols and procedures adds to the tasks attained by the ION administrative efforts, as a result of the application of restrictive actions of the Competent Authority.

Aware of the limitations of the technical personnel formation as well as the reduced number of personnel in proportion with the existing work load, the authorities supported the tasks for the development and implementation of two courses. The first, at the postgraduate level for the formation of Dosimetrists and whose graduates satisfy the potential profile for the Master's Degree in Medical Physics; and the second course, for the formation of Radiotherapy Technicians, both a one year program.

As far as equipment is concerned, the ION administration negotiated the acquisition of the most advanced technology in equipments and instruments for oncology treatment, with investments exceeding six million dollars.

The post accident actions suggest an evident interest in the application of measures aimed to an improvement of the conditions in matters of radiation protection and safety, Nevertheless, a commitment of the administrative and technical staff is necessary to attain a safety culture promoting the Radiotherapy Department quality of work and efficiency.

5. Lessons Learned

— It is imperative that the personnel responsible for the treatment planning tasks (radiotherapists, physicists and dosimetrists) be familiar with the operating procedures and limitation of the treatment planning system, as well as, with the Cobalt Teleterapy Unit and instruments operation.

— Mechanisms must be established for the revision, verification, approval and communication of any modification and implementation of new protocols and procedures which must be standardize and approved by Head of the Radiotherapy Department.

— Standardization of the documented protocols is important for the treatments as a joint activity of radiotherapists and physicists, which must be preceded and approved by the Director of the Radiotherapy Department.

— Implementation of mechanism is necessary to guarantee adequate follow-up of patients which allow actions to be taking before irregularities and anomalies are detected.

— Periodical implementation and evaluation of the Defense in Depth principle is vital.

— The hiring of human resources not fulfilling the requirements established in the national normative is inadmissible.

— It is the administration's commitment to maintain an adequate work load consistent, for example, with the recommendations of the Health World Health Organization.

— The authorities must be strict in the application of the sanctions set forth by law, in order to achieve in a peremptory term, the compliance of the corrections recommended by the Technical Unit.

6. Conclusion

The existence of standards regulations in the country for the practice of radiotherapy prior to the accident, allowed the authorities and administrators to have reference documents which permitted the prompt application of corrections.

The actions following the accidental exposure of radiotherapy patients taken by the authorities are indicative of the interest that exists to improve the previous conditions. Nevertheless, there is still a need at the administrative level of a commitment with respect to radiation protection and quality assurance and control programs.

Professionals working in the Radiotherapy Department must be adequately trained and qualified. Likewise, their responsibility must be individually identified and specified.

The efforts made at the technical level in the execution of regulatory control activities must be strictly evaluated by the authorities responsible for the application of restrictive measures. In light of the remarkable advances in the ION authorization proceedings, there still remain regulatory aspects to be fulfilled in order that the Competent Authority can issue the license to this institution.

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