THE IAEA REGIONAL COOPERATIVE AGREEMENT PROGRAMME (RCA) on Enhancement and Harmonization of Radiation Protection in the Asia Pacific Region (1998-2002)

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INTRODUCTION

The IAEA Regional Cooperative Agreement (RCA) was initiated in 1972, and currently consists of 17 Member States from East Asia and Oceania. These countries are Australia, Bangladesh, China, India, Indonesia, Japan, Korea, Malaysia, Myanmar, Mongolia, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Vietnam. The RCA is one of three cooperative agreements under the aegis of the IAEA, the other two being for Africa (AFRA) and Latin America (ARCAL). The RCA agreement has been extended five times, as it meets particular needs of the participating countries. The region covered by the RCA comprises nearly half of the world's population and is undergoing a rapid expansion in nuclear power development and in the uses of radiation sources (radioactive materials and irradiating equipment).

A number of activities in a wide range of areas of Agency interest are carried out under RCA. The Project to Strengthen Radiation Protection Infrastructures was initiated in 1988, as a five year programme, to offer a regional response to some of the radiation protection issues that were raised following the Chernobyl accident. It was extended into Phase 2 from 1993 to 1998 and has now reached a new phase.

The IAEA has a dual role to establish standards in radiation protection and safety and to provide for their application. Since the status of the implementation of radiation safety laws and regulations is variable within the RCA countries, the primary focus has been on providing assistance to member states in the drafting of laws and regulations to ensure that sources are authorized and are properly controlled. A number of accidents worldwide have resulted from inappropriate or a complete lack of regulations on the control of sources. However as countries develop, their needs change and it is important that the RCA project in radiation protection changes with them. Hence the new Phase 3 programme in radiation protection has a mixture of events to strengthen radiation protection infrastructures and also events to provide training and guidelines in the application of radiation sources. The Phase 3 project was thus entitled Enhancement and Harmonization of Radiation Protection.

Five of the 17 countries in the RCA have radiation protection infrastructures that are not commensurate with the requirements of the International Basic Safety Standards (BSS) [1]. For example, they may require assistance with introducing laws and regulations. These countries have become part of the Model Programme on Upgrading of Radiation Protection Infrastructure, also under the aegis of the IAEA.

The objectives of Phase 3 are:

- To assist Member States in understanding, introducting and implementating of the BSS within the region.
- To improve the regulation, control, transport, storage and safe handling of radioactive sources and wastes.
- The enhancement of regional cooperation and effective emergency response for potential radiological incidents within the region.
- To increase understanding of appropriate techniques and implementation of best practices in medical applications of radiation.
- To enhance national capabilities in Member States to ensure the safety in the use of radiation sources in industrial irradiation facilities and to ensure the safety in practices involving naturally occurring radioactive materials (NORM) from mineral sands, oil and gas industries.
- To establish regionally harmonized procedures for the dosimetry and assessment of occupational exposure to ionizing radiation.
- To strengthen regional co-operation in environmental radiation monitoring and to establish a regional system for environmental radiation monitoring.
- To compile the physical, anatomical, physiological and metabolic characteristics of the Asian populations in RCA Member States.

ORGANISATION OF THE PROGRAMME

The programme was developed through setting up a Task Group that consulted widely with all 17

Member States to understand their requirements and to structure the programme to cater for these needs.

The task group recommended grouping of activities into five thematic areas and these were subsequently adopted by the Project Formulation Meeting that was held in Korea in January 1997. These five areas are described below.

Standards and regulation

Implementation of standards and regulations to provide a defined level of infrastructure and practice is of high importance. This must be strongly linked to the principles in the BSS and corresponding standards and recommendations from the International Commission on Radiological Protection (ICRP) and International Commission on Radiation Units and Measurements (ICRU). Hence the key issues identified within this topic were :

a) Achieving consistency with the BSS
b) Registration, licensing and control of radiation sources
c) Waste safety
d) Training and accreditation of users of radiation sources
e) Transport of radioactive materials

The outputs from this area will be:

- Regionally harmonized guidelines for the control of sources at all stages.
- Common understanding and application of the principles, practices and measurement techniques recommended by ICRP, IAEA and ICRU.
- Consistency in practices and regulation for transport of radioactive materials.
- Regionally unified policies for the safe management of radioactive waste.
- Distance learning materials in radiation protection for use in training or accreditation of users of radiation sources.

Emergency planning

The effective management and collaboration in emergency response is a high priority issue for all countries in the region. The emphasis in the present programme is on enhancing the arrangements in each Member State and in use of regional resources to respond to regional needs. The activities in this area are strongly linked to the requirements under the IAEA Conventions on Early Notification and Mutual Assistance and emphasize the need for arrangements that are consistent with those conventions. Some of the key activities are training of response teams able to provide assistance if required, training for support personnel, such as medical and paramedical staff, and information sessions for senior national planners to ensure that radiation emergency response arrangements are integrated with other national emergency plans.

The outputs from this area will be:

- Trained emergency response personnel in the principles and practices of emergency response.
- Establishment of consistency and standard procedures for the response of radiological response teams to a regional incident.
- Enhanced organizational arrangements for emergency response.

Radiation protection in medicine

Many radiological accidents involving patients have occurred in the field of medicine. In addition, the dose received from a particular diagnostic examination can differ by more than one order of magnitude, depending on hospital and who carries out the examination. This implies that many people have received more dose than desirable during their diagnosis. The BSS issued by the IAEA introduced the concept of justification, optimization and guidance levels for radiation protection in medical exposure.

This phase of the RCA programme offers the opportunity to take some action for the improvement of radiation protection in medicine. The general objectives are :

- to increase understanding of appropriate techniques and implementation of best practices in medical applications of radiation.

Some of the problems highlighted in a previous workshop included:

a) Need for control of the use of X-ray machines.

b) Loss of brachytherapy sources.
c) Need to strengthen/amend related regulations
d) Need for training of medical and paramedical staff.
e) Unsatisfactory patient exposure in diagnostic and therapeutic radiology.
f) Management of waste from nuclear medicine.

The outputs from this area will be:

- Improvement of the present status of QA and QC programmes for radiography and radiotherapy in RCA member states.
- Transfer of modern technology and knowledge of dosimetry including measurement skills and calculation techniques to all countries.
- Establishment of appropriate regulatory systems in RCA member states for radiation protection of patients, medical staff and the public from medical exposure.

Radiation protection in industry

The agreed categories for this topic were :

a) Mineral sands
b) Mining and milling
c) Radon, thorn and daughter products
d) Other industrial areas - irradiators, industrial radiography.

The general objectives are :

- to support the establishment of national capability in RCA Member States to ensure safety in practices involving NORM from mineral sands, gas and oil industries
- to enhance national capability in RCA Member States to ensure safety in the use of radiation sources in industrial irradiation facilities.

The outputs from this area will be:

- An adequate and competent national capability for controlling the radiological hazard in industrial irradiation facilities.
- A national capability for controlling the hazard due to NORM from mineral sands and radiological hazards in the oil and gas industries
- Effective systems for the control of radon and thoron exposures.

Occupational and environmental exposure assessment and control.

The agreed categories in this topic were :

a) Individual Monitoring
    - External (photon, neutron, beta)
    - Internal
    - Reference Asian Man
    - Biological dosimetry

b) Area Monitoring
    - External radiation
    - Air monitoring

c) Environmental monitoring

The general objectives are :

- to establish regionally harmonized procedures for the measurement and dosimetry of ionizing radiation.
- to strengthen regional cooperation in the field of environmental radioactivity monitoring.
- for the Reference Asian Man project, to compile the physical, anatomical, physiological and metabolic characteristics of the Asian populations in RCA Member States.

The outputs from this area will be:

- Calibration of the radiation protection instruments in terms of operational quantities with radiation fields traceable to National/International Standards. Regional harmonization in the conversion factors used and procedures adopted for calibration.
- Evaluation of measurements in terms of dose following chronic exposure to radionuclides of long residence time in the body.
- Regionally harmonized measurement technology and capability for environmental radiation monitoring through inter-comparison.
- A regional system for environmental monitoring.

The activities consist of workshops, training courses, intercomparisons, for example of external and internal dosimetry services, and coordinated research programmes in specialist areas, such as that for developing the characteristics of Reference Asian Man. These activities are based on materials produced by the IAEA.

MANAGEMENT OF THE RCA PROGRAMME IN RADIATION PROTECTION

One of the major goals of the RCA programme is to devolve leadership to the participating countries and to utilize regional resources and expertise in carrying out the planned activities. To assist this process a five member task group was established to provide oversight of the programme and to ensure good liaison with the IAEA and avoid duplication with other programmes. This Coordination Group currently has members from Australia, India, Japan, Korea and Malaysia, who each oversee one of the five thematic areas.

Each country has a National Project Coordinator for radiation protection, who is the liaison officer for that country in ensuring implementation of the activities and representing their country at the Project Formulation Meeting and the Mid-term Review. Terms of reference for the Coordination Group and the National Project Coordinators were drawn up and each member has been nominated by their country as agreeing to carry out those terms of reference. Among the key duties of the National Project Coordinators are to ensure suitable people are selected from their country to attend the training courses, workshops and seminars, to follow up all participants from their country to ensure that there is ongoing dissemination of the information and expertise gathered from the course. National Project Coordinators are encouraged to organize national workshops to ensure that information is passed on. Other key duties are to provide reports on activities in their countries and to liaise with the IAEA on the development of lists of experts for missions and peer reviews.

To ensure adequate communication and review of activities, the Coordination Group meets once each year and provides a report on the effectiveness of the activities, as well as plans for the future years.

Activities planned for the future include peer review missions to each country to understand more clearly the needs of each Member State for assistance and to review the effectiveness of the activities in each Member State. These missions will start in 2000 and will be a vital input to the planning of activities.

The reports of the annual review meetings are presented to the RCA meeting of National Representatives, which is reviews all RCA activities, and meets shortly after the radiation protection programme meeting. Endorsement by this group is important in obtaining support from the IAEA.

By these means, the RCA programme in radiation protection seeks to ensure the most effective use of the funding provided for the programme and the best means to ensure a high ongoing application of the programme in member states.

ACHIEVEMENTS OF THE PROGRAMME

This section will describe some of the major activities and achievements within these five thematic areas, highlighting in particular the areas where the RCA has been instrumental in producing new initiatives and new research in radiation protection. Three areas have been chosen to illustrate the achievements.

Emergency Planning

Emergency planning and effective response to incidents is a vital part of ensuring safety in the use of radioactive materials. The rapid growth in applications of radioactive materials in the region, including the growth of nuclear power and the expansion in medical and industrial uses, means that enhancement of emergency planning arrangements, exercising of those plans and coordination within countries is essential. Some of the key

initiatives in this area are described below.

IDENTIFICATION OF REGIONAL RESOURCES AND REQUIREMENTS FOR EMERGENCY RESPONSE

A meeting was held to identify the requirements to respond to radiological emergencies in the region and to identify regional resources. This meeting recommended new procedures for requesting assistance and the recommendations from that meeting were taken up by the Agency and a consultant group was convened to look at the improvement of the process of requesting assistance. As a result, a new set of procedures were produced and have been incorporated into revisions of the guidelines supporting the nuclear accident assistance Convention [2]. In addition identified were;

- The facilities able to cope with exposed people
- The countries with teams able to provide assistance
- The equipment and support needs for those teams.
- The procedures to be used by the teams.

EMERGENCY EXERCISE

As a follow up to the previous meeting, an emergency team training exercise was held in China at which response teams from Australia, China, India, Korea and Japan were exercised on a range of possible accident scenarios. The teams were advised beforehand that they were to bring dose rate meters, contamination monitors, an air sampler and a portable gamma spectrometer and were provided with briefing notes on three exercise scenarios designed to test their equipment and exercise the personnel.

The scenarios were:

- External radiation hazard exercise (Industrial Irradiator Loss of Shielding due to an Earthquake)
- Surface contamination and external radiation hazard exercise (Fire Damaged University Building Containing Sealed and Unsealed Radioactive Sources)
- Field Monitoring Exercise (Field Search for Radioactive Debris from an Aeroplane that has Exploded in Mid Air).

A number of practical conclusions were drawn including the need to reconsider the type of equipment to be used, the ability of such equipment to work in very cold conditions, the need to consider how better to handle communications difficulties which arose between teams from different countries and the value of having clear procedures.

Other courses have provided training on developing emergency plans, participating in research reactor emergency exercise and table top exercises with simulated scenarios. A workshop for senior emergency response personnel in each country is planned.

Intercomparisons

Member states in the RCA have stressed the need for dosimetry intercomparisons, both for internal and external dosimetry. These have been a valuable and regular feature of the activities. A major intercomparison on external dosimetry finished last year and involved 40 regional dosimetry services representing all 17 RCA member states. A marked improvement in the performance of dosimetry services was noted during the process. The intercomparisons provide the participating services access to calibration fields and resources not available to most of them, with radiation energies covering the full range encountered in the work place. Particular issues that arose during the intercomparison included the fading of TLD chips between issue and collection, the algorithms used by the readers and the calibration of equipment.

Accurate measurement of environmental contamination levels was a major concern following the Chernobyl accident. As a step in upgrading regional capabilities and harmonization of the techniques used for environmental radioactivity measurements, an intercomparison using reference samples has been conducted involving 15 participating regional analytical laboratories. The intercomparison was completed in 1998 with a workshop in Melbourne, and the results published as an Agency technical report [3)].

Reference Asian Man

Again after Chernobyl, there was considerable regional concern about the fact that dosimetric parameters recommended by the ICRP and used by the Agency are based on the physical, anatomical, metabolic and dietary characteristics of Western populations, primarily Europe and North America, and may not be fully

representative of Asian populations. Under Japanese funding, a five year coordinated research programme (CRP) was initiated and conducted, under the RCA Project to Strengthen Radiation Protection Infrastructures, to address this concern by compiling analogous data for Asian populations. Participants from ten countries representing half of the world's population were involved in an extensive process of data collection resulting in the most comprehensive single set of such data yet compiled.

Three major aspects were the compilation of (a) anthropomorphic and anatomical parameters, (b) metabolism and (c) physiology. The specific values obtained were:

- Height, weight, chest, head and neck measurements
- Organ measurements (masses and fraction of body mass)
- Daily dietary intake, its elementary composition and nutritional value.
- Physiological parameters such as pulmonary function and water balance.

The database developed represents a valuable resource for radiation protection studies and as a basis for further national research.
The Agency has published the findings of the CRP as TECDOC [4]. Also throughout the Project, results of the activities have been published in the open literature. Some participants in the Reference Asian Man CRP have already published the results of their work as institution reports or papers in the open literature. The results have also been provided to the ICRP for use in their efforts to revise the 23 year old, Report of the Reference Man Task Group.

The data compiled under the CRP do not appear to be sufficiently different from the values which served as the basis for the recommendations presented in the BSS to warrant deviation from those recommendations for normal or routine internal dosimetry purposes. However, specific situations could occur in which use of the population specific data presented in the CRP report may be appropriate for decision making and dosimetry purposes.

Distance Learning Materials

Early on in the RCA programme, there was a perceived need for training materials in radiation protection to be produced in a distance learning format because of the geographical spread of users of radiation sources. The radiation protection distance learning course material, developed by Australia, was a response to this need.

The course material is divided into five parts and each part is divided into modules, averaging 6 modules in each part. The structure is shown in the table below. A module represents a single topic and will take several hours to complete. At the conclusion of the module the student completes an assessment task. Some modules contain practical tasks.

TABLE 1 - STRUCTURE OF DISTANCE LEARNING MATERIAL

PART 1	GUIDANCE NOTES AND REFERENCE MATERIAL
1.1	Introductory Notes for Students
1.2	Introductory Notes for Regulatory Authorities and Supervisors
1.3	Reference Material
	Glossary of Terms
	Acronyms
	Quantities and Units
	Reading List

PART 2 BASIC KNOWLEDGE
2.1 Basic Mathematics
2.2 Structure of Matter
2.3 Ionizing Radiation and Radioactive Decay
2.4 Interaction of Radiation with Matter
2.5 Radiation Detectors
2.6 Biological Effects of Exposure to Ionizing Radiation

PART 3 RADIATION PROTECTION
3.1 Principles of Radiation Protection
3.2 Protection from External Hazards
3.3 Protection from Internal Hazards
3.4 Use of Radiation Monitoring Instrumentation
3.5 Personal Dosimetry
3.6 Environmental Radiation

PART 4 RADIATION PROTECTION INFRASTRUCTURE
4.1 Radiation Protection Legislation and Regulations
4.2 Transport and Storage of Radioactive Substances
4.3 Safety Assessment
4.4 Safe Handling of Radioactive Waste
4.5 Emergency Response

PART 5 RADIATION PROTECTION FOR SPECIFIC INDUSTRIES
5.1 Safe Use of Nuclear Gauges
5.2 Safe Use of Industrial Radiography Techniques
5.3 Safety in Radioisotope Laboratories
5.4 Safe Use of Radioactive Tracers
5.5 Radiation Protection in Diagnostic Radiology
5.6 Radiation Protection in Nuclear Medicine
5.7 Radiation Protection in Radiotherapy

The material was trialed by a number of countries in two phases. In Phase 1 trials, there were 22 students from four participating countries (Korea, Thailand, the Philippines and New Zealand). All modules from Parts 1, 2, 3 and 4 were trialed in this phase. In phase 2 trials, covering all parts of the course, there were 63 students from 7 countries (the original countries plus Australia, Indonesia and Mongolia). These trials provided excellent feedback for improvements to the material. Supervisors were appointed in all participating countries to oversee the trial and to provide a point of contact for the students. These supervisors participated in review meetings in Australia.

The material is due for completion in the year 2000-2001 and will be distributed by the IAEA. Versions will be available on the internet for access by participating countries.

CONCLUSION

The RCA programme in radiation protection has been a valuable resource to Member States in enhancing and strengthening radiation protection infrastructures. However the emphasis of this third phase is on promoting consistency with BSS, both in regulation and in practices. The focus on improving practices is important since the exposure in many countries, particularly in industry and medicine, remains a key issue.

Regional management has also been a feature of the new programme and this has provided the Member States with a greater ownership of the programme and commitment to effectiveness of the activities. The follow up process is a new aspect that seeks to achieve this increased effectiveness.

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