RCA

Regional Cooperative Agreement
For Research, Development and Training Related to
Nuclear Science and Technology for Asia and the Pacific

Success Story in 2012

Preparing for the Nuclear Renaissance in the Asia Pacific Region-Establishing a Benchmark for Assessing the Future Radiological Impact of Nuclear Power Activities on the Marine Environment

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RCA Success Story: Preparing for the Nuclear Renaissance in the Asia Pacific Region-Establishing a Benchmark for Assessing the Future Radiological Impact of Nuclear Power Activities on the Marine Environment

1. Background to the Project

1.1. The Asia Pacific Region's Nuclear Future and Some of its Past

Over the past years there have been reports that more countries within the Asia Pacific region are building or planning to build nuclear power plants (NPPs). However presently many countries in this region are not well positioned to be able to assess the environmental and radiological consequences of the introduction of these NPPs, particularly on a regional scale.

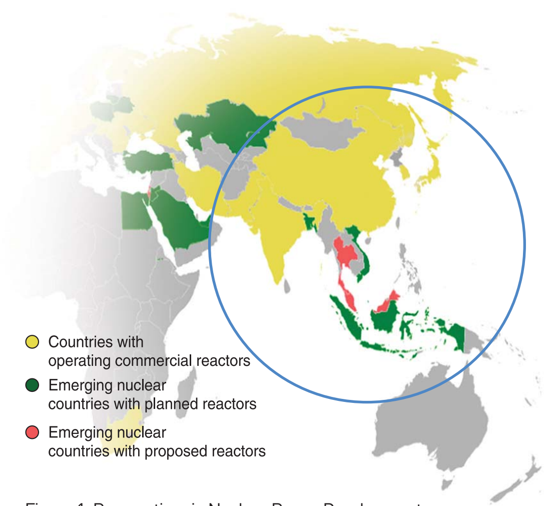


Figure 1. Perspectives in Nuclear Power Development in Asia-Pacific Region (Source: World Nuclear Association)

While nuclear power generation has tremendous potential to meet the growing electricity needs of the region's population and has the benefit of not contributing to the adverse environmental effects that are associated with the burning of fossil fuels in coal or oil powered plants, there are potential risks from planned and/or unplanned releases of radionuclides into the marine environment, especially from coastal located NPPs and associate plants.

As of November 2011, there were 433 nuclear power plants in operation world-wide and 65 nuclear power plants under construction. Twenty one (21) of the last 27 nuclear power plants that were connected to an energy grid were in Asia. Fourteen (14) of the 17 new nuclear power plants being built were reported as also being located in Asia. The world's most populous countries, China and India, have had seven new nuclear power plants completed in the last four years, with 26 more reportedly under construction - 2 for India and 24 for China (IAEA Press Release 2011).

While potential inputs from NPPs and related activities are a possible concern for the future, in the past the marine environment in the Asia-Pacific region has been contaminated with artificial radionuclides from a variety of sources, including: global fallout from above ground weapons testing programmes as well as close-in fallout from tests in the regions (e.g. Marshall Islands, Mururoa Atoll); dumped nuclear wastes, accidental losses (e.g. SNAP-9A satellite, nuclear-powered vessels, nuclear weapons) and low-level discharges into coastal regions.

1.2 Planning for Future Needs-the RCA Project in Brief

Twelve (12) Member States of the Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology (RCA), in the Asia and the Pacific region, joined together to focus efforts on improving national and regional capabilities to assess radiological impacts in the marine environment. Most RCA Member States share common marine areas, so for them trans-boundary movement of contaminants in the marine environment have the potential to become significant components in national planning and monitoring programmes. Technical skills, resources and quality management systems in several Member States have been recognised as requiring attention and upgrading.

This was achieved through the activities of the RCA project, "Establishment of a Benchmark for Assessing the Radiological Impact of Nuclear Power Activities on the Marine Environment in the Asia-Pacific Region (RAS/7/016)", which was successfully implemented between 2007 and 2011. Its overall objective was to improve the quality of radiological assessments of the marine environments in recipient RCA Member States through the following elements:

- enhancing regional coordination of the marine radioactivity monitoring programmes;
- enhancing national capacities in marine ecological risk analysis;
- utilising a regional database of existing and new results from marine monitoring; and,
- improving the quality assurance in marine monitoring programmes, through the production and use of standardised guidelines.

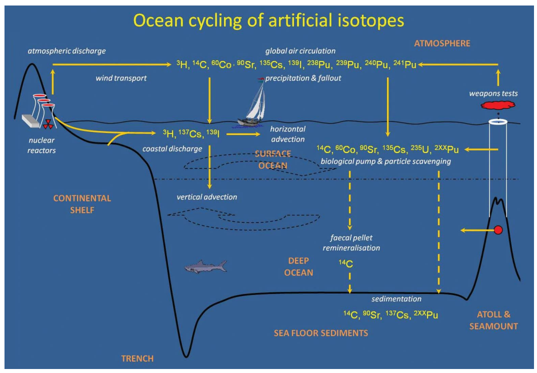


Figure 2. Cycling Pattern of Artificial Radionuclides in the Marine Environment

1.3 Setting the Project Strategy

A coordinated assessment strategy was considered to be necessary to establish a regionally-comparable database of existing nuclear contamination, against which future releases could be assessed. The harmonised approach to monitoring of radionuclides in the marine environment achieved through this regional project was assessed as being advantageous in many ways, including the efficient utilisation of existing regional resources and the establishment of a coordinated and quality assured approach to marine environmental monitoring of nuclear discharges.

Monitoring programmes to ensure that there would be no significant impacts to the marine environment from radionuclides will have to be developed or strengthened to meet issues that could emerge with the predicted increased in use of NPPs. For such radionuclide monitoring programmes to be useful, effective and reliable, nuclear research institutes will need to have analytical and management protocols which are :

(1) well-designed with built-in checks for quality assurance;

(2) appropriate and applicable to the country in particular, whilst retaining sufficient harmony to address

trans-boundary issues throughout the region in general;

(3) designed to include tools for timely risk assessments, with clear indicators of the presence or absence of radiological and related impacts to marine biota; and,

(4) sufficiently sensitive and conservative to protect the public from any potential or actual adverse outcomes associated with seafood consumption and/or recreational and commercial activities.

1.4 Bringing all the Key Players together

The primary competency for the analysis and measurement of radionuclides generally resides in the national nuclear research institutes (NNRIs). Governments have made significant investments in equipment and human resources to establish such capabilities. However, an effective marine monitoring programme requires cooperation between NNRIs, other stakeholder and end-user institutes. These included: Government Environmental Protection and Conservation Departments; National Fisheries and Oceanography Agencies; Emergency Response Groups; and universities. In recognition of this, a wide range of professionals from a variety of organisations participated in the National Project Teams and received training via this regional project.

1.5 Nuclear Techniques Advancing Ecological Studies

In comparison to classical approaches, nuclear techniques offer several unique advantages in ecological studies, such as highly sensitivity, cost effectiveness and elevated throughput of samples. Because of these unique advantages, radiotracer techniques are widely recognized as the cutting edge of experimental marine eco-toxicology, i.e. the study of pollutant uptake and retention by marine organisms. Radiotracer techniques are particularly useful when rapid results are required concerning environmental issues, guidelines and surveys associated with nuclear technologies such as nuclear power plants, or with regard to conventional pollutants such as metals and organics in seafood or the characterization and validation of bio-indicator species.

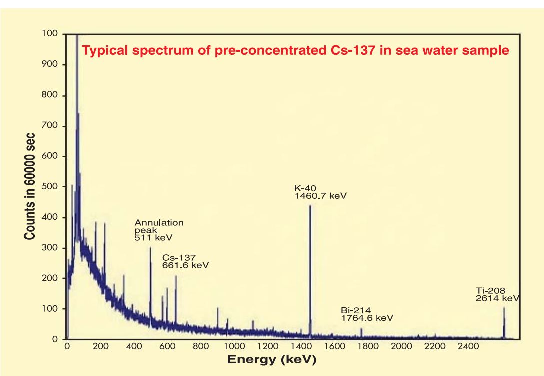


Figure 3. Typical Spectrum of Pre-concentrated Cs-137 in Seawater Sample

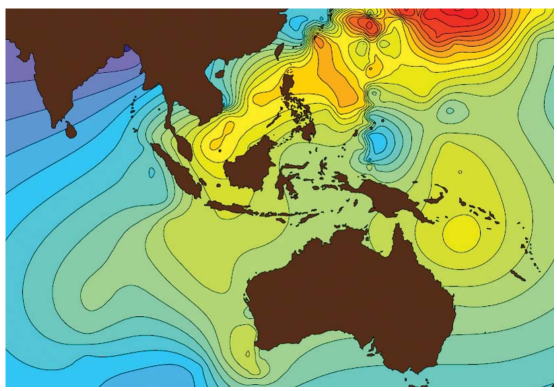


Figure 4. Artificial Radionuclide Distribution in the Marine Environment, Cs-137(mBq/L) in Surface Seawater (1975-1999), ASPAMARD(the Asia-Pacific Marine Radioactivity Database)

2. The RCA Project

A project proposal "Establishment of a Benchmark for Assessing the Radiological Impact of Nuclear Power Activities on the Marine Environment in the Asia-Pacific Region (RCA)" was prepared, endorsed by the RCA National Representatives and then in 2006 it was approved by the IAEA Board of Governors to be supported under the IAEA Technical Cooperation Programme. It was implemented under the project code RAS/7/016 over the 5-year period from 2007 to 2011. The total project expenditure was around US$530,000.

The project objectives were:

(1) To assist RCA Member States in developing and strengthening coordinated regional marine radioactivity monitoring programmes and in ensuring that the results were useful, verifiable and transferable (i.e. harmonised) to meet regional objectives.

(2) To refine risk assessments from the ingestion pathway of seafoods by establishing dose responses and transfer factors that were specific and more appropriate to the marine biota found in the region.

(3) To update and sustainably maintain the regional database to serve as an on-going repository for new data generated from monitoring programmes and enhance the utility of this regional resource for analysing trends and understanding the fate and behaviour of key radionuclides in the marine environment and

(4) To establish a documented quality management system for regional marine radioactivity monitoring programmes as well as data generated by Member States.

Mr. Ron Szymczak, then of the Australian Nuclear Science and Technology Organization (ANSTO) and more recently nuclear and oceanographic consultant at Tradewinds (Australia), served as the Project Lead Country Coordinator. Twelve (12) countries participated through their respective national institutions, as shown in Table 1.

Table 1. Counterpart/partner Institutions and Staff in the Participating Countries

Countries(Abbreviation)	Counterpart and Partner Institutions	Counterpart Staff
Australia (AUL)	Australian Nuclear Science and Technology Organization (ANSTO) and Tradewinds (Australia)	Ron Szymczak (Project Lead Country Coordinator)
Bangladesh (BGD)	Radioactivity Testing and Monitoring Laboratory, Bangladesh Atomic Energy Commission (BAEC)	Mantazul Islam Chowdhury Masud Kamal
China (CPR)	Third Institute of Oceanography National Bureau of Oceanography State Oceanic Administration (SOA)	Rongcheng Lin
India (IND)	Division of Environmental Assessment, Bhabha Atomic Research Centre (BARC), Department of Atomic Energy	Vijay Dev Puranik

Countries(Abbreviation)	Counterpart and Partner Institutions	Counterpart Staff
Indonesia (INS)	Centre for Application of Isotopes and Radiation Technology (PATIR) National Nuclear Energy Agency (BATAN)	Zainal Abidin
Malaysia (MAL)	Malaysian Nuclear Agency	Abdul Khalik Wood Zaharudin Ahmad Zal U'yun Wan Mahmood
Myanmar (MYA)	Department of Atomic Energy, Myanmar Scientific and Technological Research Department (MSTRD), Ministry of Science and Technology	Daw Moe Phyu Hlaing Myint Myint Khaing Kay Thwe Kywe Aye
Pakistan (PAK)	Pakistan Institute of Nuclear Science and Technology (PINSTECH), Pakistan Atomic Energy Commission (PAEC)	Riffat M. Qureshi
Philippines (PHI)	Philippine Nuclear Research Institute (PNRI)	Teofilo Garcia
Republic of Korea (ROK)	Korea Ocean Research & Development Institute (KORDI)	Young Il KIM
Singapore (SIN)	Centre for Radiation Protection and Nuclear Science, The National Environment Agency	Koh Kim Hock
Thailand (THA)	Bureau of Technical Support for Safety Regulation, Office of Atoms for Peace (OAP)	Suchin Udomsomporn
Vietnam (VIE)	Center for Analytical techniques and Environmental Research, Nuclear Research Institute, Vietnam Atomic Energy Commission (VAEC)	Ngo Nguyen Trong

3. Project Activities and Implementation

This project was implemented through series of several specific components;

a. Coordination Meetings

b. Technical Meetings

c. Regional Training Courses

d. National Project Activities

e. Expert Missions

f. Other Activities

3.1 Coordination Meetings

During the project implementation, there were three Project Coordination Meetings, which reviewed and assessed the project progress as well as adjusting the project work plan and activities (see Table 2). These meetings also provided opportunities for all participating Member States to present and discuss the activities and progress they were achieving at the national level within the scope of the regional project. This ensured that all participants were well-informed about the activities being undertaken in other countries and assisted in establishing coordination and synergy for effective cooperation.

Table 2. Project Coordination Meetings

Number	Host Country	Meeting Title	Dates
1	IAEA (Vienna)	Project Planning Meeting	July 2007
2	India	Mid-term Project Assessment and Review Meeting	April 2009
3	Thailand	Final Project Assessment Meeting	October 2011

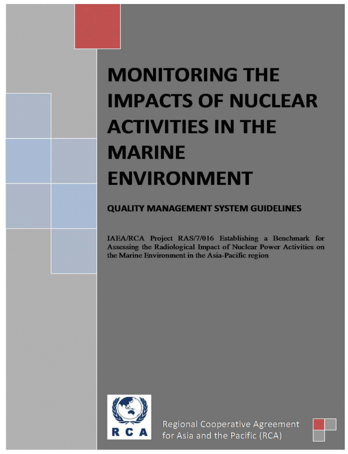
3.2 Enhancement of Technical Capability of Member States

Two technical meetings were held during the project (see details below). The first meeting was to gain consensus amongst the RCA Member States for the Implementation of Total Quality Management System Guidelines for Monitoring the Impacts of Nuclear Activities in the Marine Environment. The second meeting enabled participating RCA Member States to gain proficiency in utilising an integrated approach for site-specific application of all the tools and concepts for Marine Ecosystem Radiological Impact Analysis that had been introduced during the implementation of the project.

Figure 5. The Project Planning Meeting, Vienna, July 2007.

3.2.1 Technical Meetings

a. Technical Meeting on Implementation of Total Quality Management System Guidelines for Monitoring the Impacts of Nuclear Activities in the Marine Environment- Vietnam, 7-11 Sept 2009. Fifteen participants from 9 RCA Member States; Australia, India, Indonesia, Malaysia, Myanmar, Pakistan, Philippines, Thailand and Vietnam attended the meeting and reviewed, discussed and revised the scope and content of the, earlier prepared, project quality management guideline document, i.e. Total Quality Management System (QMS) Manual for Monitoring the Impacts of Nuclear Activities in the Marine Environment.



MONITORING THE IMPACTS OF NUCLEAR ACTIVITIES IN THE MARINE ENVIRONMENT

QUALITY MANAGEMENT SYSTEM GUIDELINES

IAEA/RCA Project RAS/7/016 Establishing a Benchmark for Assessing the Radiological Impact of Nuclear Power Activities on the Marine Environment in the Asia-Pacific region

RCA

Regional Cooperative Agreement for Asia and the Pacific (RCA)

Figure 6. Quality Management System (QMS) Guideline document

b. Technical Meeting on Integration of Tools & Concepts for Site-specific Marine Ecosystem Radiological Impact Analysis, Bangkok-Thailand, 22-26 February 2010. Twenty two participants from 12 RCA Member States; Australia Bangladesh, China, India, Indonesia, Malaysia, Myanmar, Pakistan, Philippines, Korea (Republic of), Thailand and Vietnam attended the meeting. Discussions and practical exercises undertaken during the meeting demonstrated how to coordinate radiochemical and radio-ecological studies for acquisition of monitoring data and transfer factors for a greater range of marine organisms and their life-stages for comprehensive site-specific radiological ecological risk analyses.

c. The Quality Management System (QMS) Guidelines for Monitoring the Impacts of Nuclear Activities in the Marine Environment document, prepared in this project, was again thoroughly reviewed and accepted by the participants and this will be used to achieve regionally consistent and comparable study outputs.

3.2.2 Regional Training Courses

Under this project four Regional Training Courses were undertaken (see Table 3). Eighty three (83) professionals, as well as over 20 local participants from National Nuclear Agencies, Marine Science Institutes, Universities and Environmental Regulatory Authorities gained an enhanced understanding of the behaviour of radionuclides in marine systems; collection and analysis of marine environmental samples; experimental procedures for radionuclide transfers to and from water, sediments and biota; nuclear and isotopic tracer applications; and radiological dose/risk analysis modelling.

Figure 7. Regional Training Course on Application of Nuclear & Stable Isotopes Tracers to Determine the Fate & Behavior of Nuclear Contaminants in Marine Systems, Indonesia, 2009

Table 3. Regional Training Courses Implemented in the Project

Number	Country	Topics of Regional Training Courses	Dates
1	Republic of Korea	Establishment of Transfer Factors and Dose Assessment for Marine Organisms from Contaminants released from Nuclear Activities	Feb 2008
2	India	Application of Agreed Nuclear Techniques to Measurement of Nuclear Contaminants in Marine Systems	May/Jun 2008
3	Indonesia	Application of Nuclear & Stable Isotope Tracers to Determine the Fate & Behaviour of Nuclear Contaminants in Marine Systems	May 2009
4	IAEA Monaco	Establishment of Dose Response and Risk Assessment for Marine Organisms from Contaminants released from Nuclear Activities	Nov 2009

3.3 National Project Activities

Activities by participating Member States included establishment of National Project Teams and National Work Plans for Marine Environment Monitoring Programmes, and undertaking National Workshops and Training Courses.

Figure 8. National Seminar on Radioactivity in Marine Environment and Radiological Risk Assessment, Thailand, 2010

3.4 Expert Missions

Five expert missions to provide technical support and consultations were undertaken to Malaysia (2), Indonesia, Philippines and Thailand. Experts were mostly recruited from donor and developed countries but in this project they were also from recipient/developing countries .

Table 4. Summary of Expert Missions Implemented in the Project

Number	Country	Mission Title	Dates
1	Malaysia	Assistance for stable isotope analysis (sample preparation) and data interpretation	June 2010
2	Indonesia	Nuclear and Isotope Applications in Marine Environment Fingerprint Studies	July 2010
3	Malaysia	Assistance for Radioecological Studies	July 2010
4	Philippines	Technical Expert on Gamma Spectrometry	October 2010
5	Thailand	Radiotracer Bioaccumulation Experiment for Heavy Metals and Radionuclides on Coral	March 2011

3.5 Other Activities

Several additional specific activities were undertaken during the project. These included:

a. a Contractual Services Agreement for Development of Total Quality Management System Guidelines (ISO9000 compatible) for Monitoring the Impacts of Nuclear Activities in the Marine Environment to establish a consistent framework for total quality management of marine radioactivity monitoring programmes and associated data generated by Member States;

b. expansion and improvement of Asia-Pacific Marine Radioactivity Database (ASPAMARD) (see inset below) to update analysis of regional distributions of nuclear contaminants; and,

c. purchase and distribution of materials for a laboratory inter-comparison exercise between participating Member States for improved data assurance.

> ASPAMARD, the Asia-Pacific Marine Radioactivity Database, represents one of the most comprehensive compilations of available data on Caesium-137 and Plutonium-239+240 in particular, and other anthropogenic and natural radionuclides in seawater, sediment and marine organisms from the Asia-Pacific regional seas.

4. Results and Impacts

4.1 Regional Project Achievements

Via the Regional Training Courses, participants from the Member States gained enhanced theoretical knowledge and practical understanding of the radiochemical analysis of marine samples, applications of nuclear and isotopic tracers, ecological risk analysis and dose assessment modelling of contaminants released to the marine environment from nuclear activities.

While previous RCA marine projects had held training courses, which encompassed both radioecology and radiochemistry disciplines, separating these into distinct courses, as done in this project, proved to be much more participant-oriented and was definitely more efficient in technology transfer and training of the participants. This was effectively demonstrated by a high standard of examination results, participants' feedback and improved ability of participants to relay their acquired information to other National Project Team members and stakeholders via subsequent local Training Courses and Workshops. The Project was not prescriptive with Marine Ecosystem Radiological Impact Analysis and provided training for several marine radiological risk analysis software packages (CoastalEcoSys V1.15, ERICA Tool and AquaRisk).

Through the Technical Meetings, the project successfully transferred strategies to RCA Member States for a regionally integrated and harmonious approach for consistency in design and implementation of marine nuclear monitoring programmes, as well as the subsequent analysis, interpretation and reporting of obtained results with agreed quality assurance protocols for all components of marine radioactivity monitoring programmes within the RCA region.

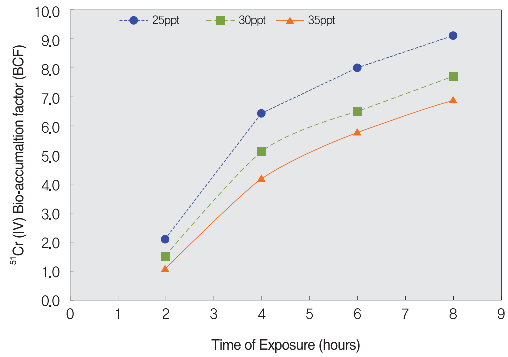


Figure 9. Bioaccumulation Factor (BAF) of ^{51}Cr (VI) in green mussels Perna viridis under the Influence of seawater salinity

The Standard Reference Material (SRM) IAEA 414 Fish Flesh was purchased and distributed to 11 Member States, which assisted in evaluating the precision of regional radionuclide monitoring analyses.

4.2 Enhanced National Capabilities

All participating Member States undertook marine radioactivity monitoring programmes for seawater, sediments and biota in their national waters with improved precision and for an extended range of radionuclide analyses. In total, 6,676 new data for 24 radionuclides were generated. Radioecology experiments for determination of seawater-biota transfer factors and seawater-sediment partitioning (distribution coefficients) were completed in seven Member States, and Malaysia and Pakistan established new radioecology laboratories during the execution of this project. Risk analyses of the impact of observed levels of radionuclides, derived from radiological dose calculations were conducted by seven Member States. Table 5 below gives a metadata summary of accomplishments.

Table 5. Regional Metadata Summary Table

Country	Number of new data	Type	Nuclides	Transfer factor	Kd	Dose/Risk analysis	Comments
AUL	Nil	N/A	N/A	N/A	N/A	yes	Fukushima ecological risk analysis
BGD	36	seawater freshwater sediment	^{238}U, ^{232}Th, ^{137}Cs, ^{40}K	no	no	no	
CPR	327	seawater sediment biota	Gross α/β, ^{3}H, ^{40}K, ^{58}Co, ^{60}Co, ^{65}Zn, ^{90}Sr, ^{110m}Ag, ^{134}Cs, ^{137}Cs, ^{208}Tl, ^{228}Ac, ^{226}Ra, ^{238}U, ^{232}Th	no	yes	yes	

Country	Number of new data	Type	Nuclides	Transfer factor	Kd	Dose/Risk analysis	Comments
IND	1742	seawater sediment biota	^{226}Ra, ^{137}Cs, ^{232}Th, ^{40}K, ^{210}Pb, ^{210}Po, $^{239+240}Pu$	yes	yes	yes	
INS	56	Sediment	^{40}K, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th	no	no	no	
MAL	2500	seawater sediment biota	^{134}Cs, ^{137}Cs, $^{239+240}Pu$, ^{241}Am, $^{243+244}Cm$, ^{226}Ra, ^{228}Ra, ^{210}Po, ^{210}Pb, ^{109}Cd	yes	yes	no	Fukushima ecological risk analysis Transfer factors for ^{134}Cs & ^{109}Cd
MYA	21	seawater sediment biota	^{40}K, ^{134}Cs, ^{137}Cs, U-series, Th-series	no	yes	yes	sediment = sand
PAK	280	seawater sediment biota	^{40}K, ^{51}Cr, ^{65}Zn, ^{90}Sr, ^{137}Cs, ^{226}Ra, ^{228}Ra	yes	yes	yes	
PHI	643	seawater sediment biota	^{40}K, ^{137}Cs, ^{210}Po, ^{226}Ra, ^{232}Th	yes	no	no	
THA	500	seawater sediment biota	Gross α/β, U-series, Th-series	yes	yes	yes	
VIE	800	seawater sediment biota	^{238}U, ^{232}Th, ^{226}Ra, ^{90}Sr, ^{137}Cs, $^{239+240}Pu$, ^{210}Po, ^{40}K	yes	yes	yes	
TOTAL	6676		24	6	7	7	

4.3 Improved Quality Assurance Marine Radioactivity Monitoring Programmes

An agreed Quality Management System (ISO 9000 compatible) was established for marine radioactivity monitoring programmes and data management by participating RCA Member States. The Total Quality Management System (QMS) Manual for Monitoring the Impacts of Nuclear Activities in the Marine Environment Guideline document was considered to be a valuable asset to the Member States, which will contribute to uniformity in the monitoring activities for nuclear discharges in the region. Seven Member States have acquired Quality Management System accreditation (China, Indonesia, India, Malaysia, Myanmar, Pakistan and Philippines) and two Member States have new or additional accreditation in progress (Philippines and Vietnam).

5. Project Outcomes and Future Prospects

5.1. Project Outcomes

A coordinated and transparent regional approach to the development and execution of marine radioactivity monitoring programmes was achieved through; the documented protocols for design and execution of marine contamination monitoring programmes; and commonality in radiological risk analysis strategies.

Strengthened capabilities in the region for measuring radionuclides in marine environmental samples and making risk assessments using dose assessment and transfer factors for marine biota were demonstrated by Member States through radioactive contaminant analyses (6,646 new data for 24 radionuclides), radioecological experimentation and radiological risk assessments.

Figure 10. On-site Training at Radioecology Laboratory

This project has contributed 1,443 inputs of new data into the ASPAMARD database for seawater, sediments and marine biota endemic to the region. This has provided an enhanced regional resource for analysing trends and understanding the fate and behaviour of key radionuclides in the marine environment of the Asia-Pacific region.

A consistent framework for total quality management of marine radioactivity monitoring programmes and associated data generated by Member States was accomplished though the development, agreement and distribution of a Total Quality Management System (QMS) Manual for Monitoring the Impacts of Nuclear Activities in the Marine Environment guideline document.

As well as the overall project outcomes detailed above, there has been a wide array of achievements in individual Member States, as described below:

Bangladesh

During the Project, Bangladesh procured and installed a new Broad Energy Gamma-ray Spectrometer facility at the Radioactivity Testing and Monitoring Laboratory, Chittagong and conducted four studies on: Assessment of Radionuclides in Coastal Sediments; Radioisotopes Concentration in Offshore Sediment and Water of the Bay of Bengal; Analysis of Water and Sediment Samples from Passur River, Sundarban Mangrove Forest, Bangladesh; and Analysis of Refinery Samples near the Coast of the Bay of Bengal. One national and one international seminar were organized and several students from different universities completed their M. Phil. and M.Sc. thesis research under this project.

China

China undertook offshore investigations and assessment of marine radioactivity and collected coastal water, sediment and marine organisms for analysis of key anthropogenic and naturally occurring radionuclides. They developed and utilised a rapid enrichment device for ^{137}Cs in seawater which is about five times quicker than traditional analytical methods. China also developed a ship-based marine radioactivity monitoring and warning device, which could play an important role in the national marine radioactivity monitoring systems. In 2011 China undertook coastal and offshore studies for potential contamination of marine resources from the Fukushima Daiichi nuclear accident. The project has improved the ability of their project team to assess the radiological impact of nuclear power activities on the marine environment in the seas around China and the Pacific Ocean. China participated in this project actively and obtained a range of results. Further research results will be forthcoming because of the inspiration generated by this project.


Figure 11. Sampling cruises are conducted for collecting samples of sea water, marine sediments and biota for monitoring of the marine environments

India

The concentrations of naturally occurring and man-made radionuclides like ^{137}Cs, ^{40}K, ^{226}Ra, ^{232}Th, ^{210}Pb and ^{210}Po in seawater, marine sediments and biota were measured in this project from 35 sampling locations selected for the monitoring programme in India generating 1742 new data. Seawater-sediment distribution coefficients and biological transfer factors of naturally occurring and man-made radionuclides were calculated and the dose and associated risk were estimated.

Indonesia

Indonesia established collaboration amongst BATAN and national stakeholders based on the understanding of the use of nuclear techniques for marine and environment studies. Moreover, stakeholders obtained more information on the nuclear technologies which could be applied to study marine and environment because of their participation in the training and the communication with researchers in BATAN. They conducted a study in the sedimentation of coastal of Muria Peninsula (a proposed NPP site) and participated in the World Ocean Conference (WOC) 2009 with a presentation of nuclear applications in coastal sedimentation using environmental isotope ^{210}Pb.

Malaysia

Two research projects were successfully implemented in Malaysia. The first project, "Establishment of anthropogenic radioactivity concentration in Peninsular Malaysia marine environment" established the distribution of radioactive contaminants in the marine environment of Peninsular Malaysia Economic Exclusive Zone to strengthen Malaysian Marine Radioactivity Database, which will be used for reference levels in future nuclear activities. The second project entitled "Application of nuclear techniques to study bioaccumulations and transfer factors for marine biota" evaluated the biological transfer factors of toxic elements by marine biota using radiotracers and established dose responses specific and appropriate to marine biota found in Malaysian marine environment. A new Radioecology laboratory for uptake experiments was established in November 2008.

Figure 12. Ocean Sampling Cruise Tracks and Dissecting Fish Samples Collected in Malaysia

Myanmar

In Myanmar, measurements were done for sea water and sea sediment, seaweed and sea foods by using low level alpha/beta counting and high resolution gamma ray spectroscopy. Up to now, the measurement samples contain no contamination radioactivity in excess of the lower detection limit set by the ICRP. Fukushima-related activities in Myanmar include monitoring of radioactivity in rain water and air samples and measurement of radioactivity in seawater. According to these measurements, no obvious changes have been found in the levels of radioactive materials in the environment in Myanmar and no contamination was found in the coastal water of Rakhine and Ayeyarwaddy.

Pakistan

As part of this RCA project, Pakistan established a new marine radioecology facility at the PINSTECH laboratories in Islamabad with the assistance of IAEA Technical Cooperation experts. They then undertook a series of experiments to determine the bioaccumulation factors (BAFs) and the rate of uptake and release of three radionuclides, i.e. ^{137}Caesium, ^{65}Zinc and, ^{51}Chromium in local green mussels (Pernaviridis) under different conditions of seawater salinity and temperature. The


Figure 13. Radioecology Experiments on Green Mussels at the new Pakistan Institute of Nuclear Science and Technology (PINSTECH) Radioecology Laboratory

results of this work are directly transferrable to other RCA Member States. These kinds of studies are vital for effective and predictive risk analyses of the impact of radiological discharges on marine organisms in the Asia-Pacific region under local oceanic conditions, which vary considerably from those of Europe and North America. Pakistan also undertook surveys and analyses of radionuclides in seawater, sediments and marine organisms to obtain essential baseline data as a prelude to establishing new nuclear power plants, which will be located nearby the Arabian Sea coast.

Philippines

The main achievements of the Philippines included field sampling in the fishing grounds of Ilocos Norte, Palawan and Davao and collecting marine biota samples in the provinces of Zambales, Batangas, Manila, Batanes, Leyte, and Bataan with laboratory processing and analysis of the key anthropogenic radionuclide ^{137}Cs and naturally occurring radionuclides ^{40}K, ^{232}Th, ^{226}Ra and ^{210}Po. Training provided in the project allowed for subsequent statistical data evaluation and determination of specific activities and hence the calculation of transfer factors. More than 300 new data were generated for inclusion in the ASPAMARD database.

Thailand

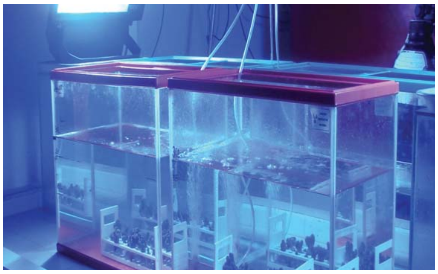


Figure 14. Radioecology Experiment of Coral in Thailand

With an effective National Project Team, including 26 members from nine institutes, agencies and universities, Thailand established a national marine monitoring programme and a national data centre. The existing marine monitoring network was strengthened by the collaboration of the Office of Atoms for Peace with the Aquatic Resources Research Institute (Chulalongkorn University) and the Andaman Coastal Research and Development Institute (Kasetsart University). During the RCA Project they completed four nationally-funded projects on marine monitoring (500 new data - see Table 5) and radiological dose assessments and held two National Training Seminars for local professionals. A mission-supported study of radionuclide uptake by corals was undertaken and related projects are on-going. After the Fukushima accident, seawater and seafood were collected from the Gulf of Thailand to measure ^{131}I, ^{134}Cs, and ^{137}Cs. The results showed that there was no radioactive contamination found in the Gulf of Thailand at that time. Furthermore an emergency fund has been granted to install two underwater gamma radiation monitoring stations at Phuket and Rayong.

Vietnam

Vietnam undertook a marine monitoring programme for seawater, marine sediments and biota which contributed 800 new data to the ASPAMARD database, as well as determining bioaccumulation factors for several radionuclides used to analyse risks to consumers. They concluded that the project played an important role in assessing the radiological impact of nuclear activities in their nuclear power development programme and very necessary for all countries in the region, especially for Vietnam, because of its more than 3,000 km long of coastline and about 1.5 million sq. km of exclusive economic zone, which is rich in biodiversity. Furthermore, two nuclear power plants will be commenced to be built around the years of 2014 in Ninhthuan Province.

5.2. Future Prospects

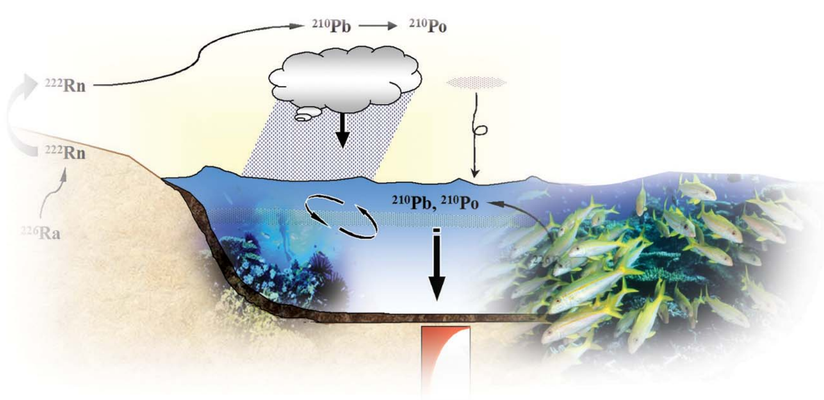
This RCA initiative has also generated considerable interest amongst marine research institutes, universities and the environmental management agencies that have formed sustainable and strategic links with national nuclear agencies.

As well as disseminating a range of skills and strategies that will serve project participants well into the future, the project has proved to be extremely timely in providing several countries with the capabilities to rapidly respond to concerns related to the regional dispersal of radioactive discharges from the recent Fukushima Daiichi nuclear power plant accident in Japan.

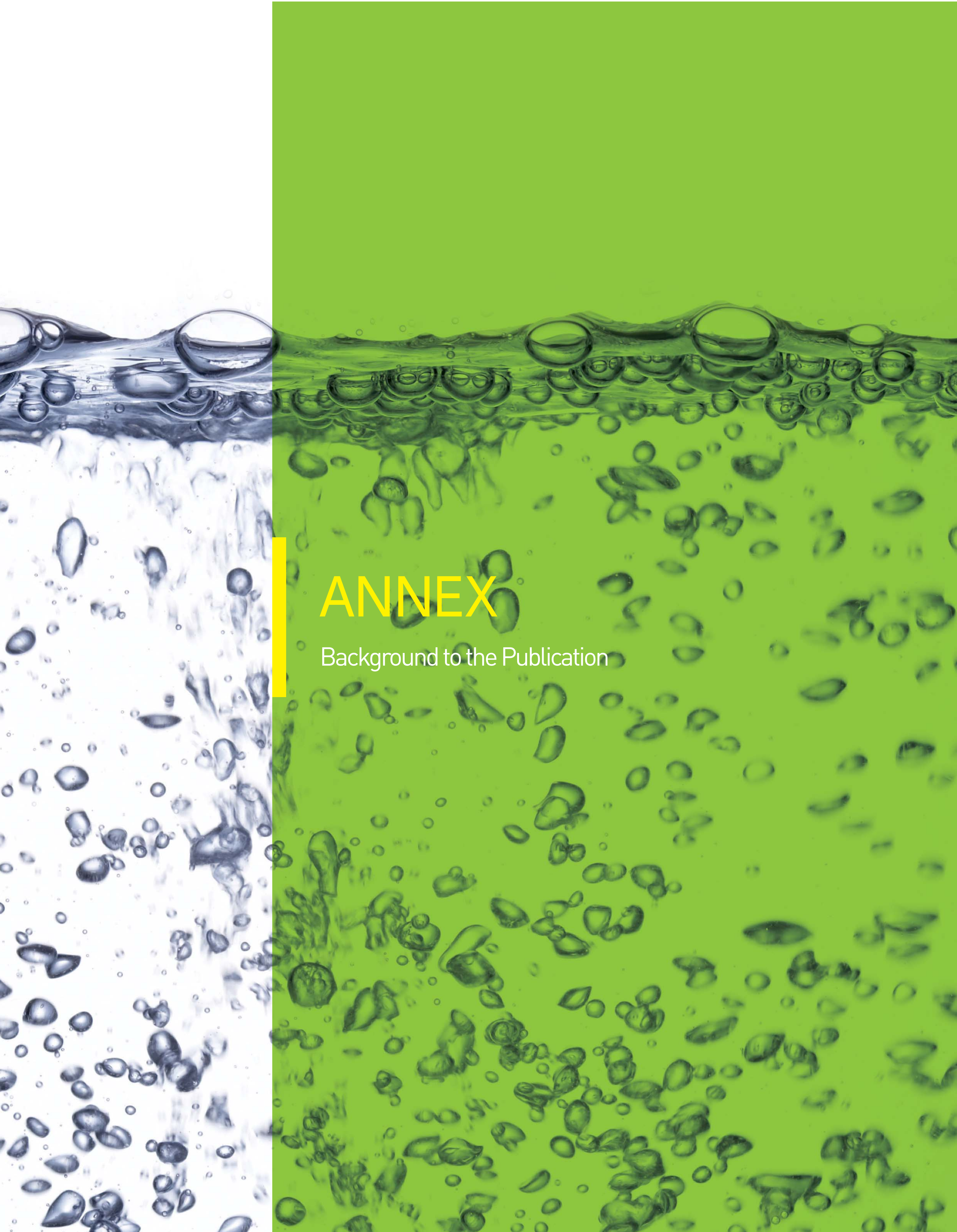
The Total Quality System (QMS) Manual for Monitoring the Impacts of Nuclear Activities in the Marine Environment guideline document has subsequently been further revised and adopted for application in the new project "Marine benchmark study on the possible impact of the Fukushima radioactive releases in the Asia-Pacific Region (RCA)"-RAS/7/021.

The need for regional standardisation of radiological environmental protection as identified in the original project plan has been reaffirmed and addressed through the project activities. However, data/knowledge gaps still exist in the biological transfer factors for radionuclides appropriate for the RCA region and deep-water radionuclide activities. Future RCA projects in the marine area should be considered addressing these gaps.

The Standard Reference Material (SRM) IAEA 414 Fish Flesh distributed in this project will be utilized in the future for a laboratory inter-comparison of the proficiency of Member States to undertake environmental radiochemical analyses. Although success in technology transfer from regional training courses has been evident, further training opportunities are required through regional training courses, support of national training courses and/or training fellowships.



RCA Success Story in 2012



ANNEX

Background to the Publication

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1. Objectives of Publication of RCA Success Stories

One of the major roles of the RCA Regional Office (RCARO) is to promote and publicize the achievements of the RCA programme. A key element in this task is the preparation and maintenance of a portfolio of achievements set out in the form of success stories. These success stories also contribute to the achievement of the RCA Vision of earning recognition in the region as a resource capable of contributing to the provision of high impact solutions to significant technological problems in the region using nuclear science and technology.

Past success stories have been in a short one page leaflet format. The publication in this booklet format is responding to requests to provide more detailed information that highlights the successful achievements together with the socio-economic impacts in the region as well as some basic information on the project.

What is the RCA?

The RCA is an intergovernmental agreement among the International Atomic Energy Agency (IAEA) Member States of South Asia, South East Asia and the Pacific, and the Far East that entered into force in 1972 under the aegis of IAEA. It is an abbreviation for "Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology for Asia and the Pacific".

The following 17 IAEA Member States in the Asia and the Pacific region are the current signatories to the RCA: Australia (AUL), Bangladesh (BGD), The Peoples' Republic of China (CPR), India (IND), Indonesia (INS), Japan (JPN), The Republic of Korea (ROK), Malaysia (MAL), Mongolia (MON), Myanmar (MYA), New Zealand (NZE), Pakistan (PAK), The Philippines (PHI), Singapore (SIN), Sri Lanka (SRL), Thailand (THA), and Vietnam (VIE).

2. History of Publication of RCA Success Stories

The development of good RCA success stories has been a regular discussion point at past RCA meetings and, following the establishment of the RCARO, this task has been assigned to the RCARO. A brief review of the milestones in chronological order is set out below.

Initial Formulation

Opening of the RCA Regional Office, March 2002, Daejeon, Republic of Korea

This was a landmark event in the history of the RCA. The publication task was assigned to the RCARO as a part of its mission. In 2002 the RCARO printed the "RCA 2001 Annual Report" which included RCA success stories from the RCA Member States. The report was presented at the 31st National RCA Representatives General Conference Meeting (GCM) in September 2002 and the Meeting requested the RCARO to send it to all RCA Member States and also to international development organizations.

> The Success Stories in the "RCA 2001 Annual Report' gave summary on the Thematic Sectors at the time: Agriculture, Health, Environment, Industry, Radiation Protection and Energy / Research Reactor / Radioactive Waste Management.

The Meeting made recommendations concerning the highlighting of those RCA projects that: contributed to the socio-economic development of the region; demonstrated the distinctive advantages of nuclear science and technology to solve or to contribute to the solution of significant regional problems; showed potential sustainable benefits; and, displayed the potential for collaboration with others.

25th National RCA Representatives Regional Meeting (NRM), May 2003, Colombo, Sri Lanka

It was agreed that the RCARO should prepare the RCA Success Stories in the form of a brochure.

Development of Success Story Guidelines

5th RCARO Advisory Committee (AC) Meeting, April 2004, Islamabad, Pakistan

The Meeting recognized that there was a need to provide guidelines to help the Lead Country Coordinators to produce the Success Stories. Representatives from Australia (John Easey), the Philippines (Alumanda dela Rosa), Malaysia (Nahrul Alang Md Rashid) and Japan (Hideo Tatsuzaki) drafted guidelines and recommendations.

Publication of the 1st and 2nd Batch of Success Stories

The drafts for the 1st batch of five RCA Success Stories in leaflet form were submitted to the 2nd Standing Advisory Committee Meeting (SAC), which was held in conjunction with the 28th RCA NRM in March 2006. These drafts were further refined and edited by the stakeholders including the relevant Project Lead Country Coordinators, IAEA/RCA Focal Person, a professional editor and the RCARO.

The 1st batch of five RCA Success Stories in leaflet form was published in May 2007. A similar process was used for the 2nd batch of four Success Stories published in 2008. Each batch of leaflets was distributed to Member States and other target readers. The leaflets were also handed out at appropriate meetings and conferences held in the region.

Monitoring of Impact

30th NRM, April 2008, Hochiminh City, Vietnam

At this Meeting it was recommended that the RCARO conduct a survey on the impact of the two batches of the RCA Success Stories that had been published and distributed, before continuing with publication of the 3rd batch. A survey questionnaire was designed by the RCARO and circulated to Member States for comment.

31st NRM, April 2009, Tokyo, Japan

The survey results were reviewed. Based on the positive survey results, the Meeting decided to proceed with the publication of the 3rd batch of Success Stories.

Test Publication in Booklet Form

38th RCA GCM, September 2009, Vienna, Austria

In addition to the four stories that made up the 3rd batch of the RCA Success Stories, the Meeting decided that there should be a trial publication of a Success Story in booklet form and the topic selected was, "Combating Soil Erosion-Caused Land Degradation in the Asia and the Pacific Region".

Publication of the 3rd Batch of Success Stories

32nd RCA NRM, April 2010, Manila, the Philippines

The drafts for the 3rd of RCA Success Stories; four stories in leaflet form and one story out of the four in booklet form, were submitted to the 10th Standing Advisory Committee (SAC) held in conjunction with the 32nd RCA NRM in April 2010. As decided at the Meeting, the 3rd batch was successfully published and distributed after editorial refinements and inputs from Member States.

Publication of the 4th Batch of Success Stories

39th RCA GCM, September 2010, Vienna, Austria / 33rd RCA NRM, April 2011, Bali, Indonesia

As decided in the 32nd RCA NRM, RCARO proceeded with the 4th batch of RCA Success Stories; one story in leaflet form on the RCA/UNDP Tsunami Project and the other one in booklet form on the area of radiotherapy. While the draft for leaflet form was submitted to the 39th GCM, the one for booklet form was submitted to the 33rd NRM for approval. The stories were published and distributed to Member States and other target audiences.

3. Summary of RCA Projects

The RCA projects have assisted Member States to gain additional knowledge and experience in the field of nuclear science and technology. This has enabled them to increase their contribution to their national programmes with these enhanced technical capabilities and capacities. Table 1 provides a detailed breakdown of the current and past projects with regards to the numbers in each of the nine thematic areas/sectors and 23 technical areas. Member States have responded about the significant benefits they have received from these projects and have provided many examples of the strong outputs and outcomes that have been generated as a consequence of their participation.

Since its establishment in 1972, the RCA Programme has delivered significant benefits to the participating Member States through 125 projects. As of January 2011, the following inputs of training and assistance have been delivered to the Member States:

- 514 Regional Training Courses for 8,463 participants;
- 245 Regional Workshops or Regional Technical Meetings for 2,534 participants;
- 173 Project Management Meetings for 2,773 participants;
- 124 Fellowships;
- 64 Scientific Visits; and
- 1,051 Expert missions.

The total expenditure on the programme has been almost US$61.6 million.

Table 1. Number of RCA Projects versus Areas

Sector	Technical Area		No. of Projects	
			Completed	Active in 2011
Agriculture	Animal health and production		3	0
	Food irradiation		4	2
	Plant breeding		3	1
	Soils and land use		2	0
	Sub-total		12	3
Human Health	Cancer		8	1
	Joint and bone disorders		3	0
	Medical physics		0	1
	Nuclear medicine imaging		5	1
	Radioimmunoassay		4	0
	Tissue grafts		2	0
	Sub-total		22	3
Industry	Industrial applications		13	1
	Nuclear analytical systems (NAS) and nucleonic control system(NCS)		2	0
	Non-destructive testing (NDT) and tomography		4	1
	Radiation processing		6	1
	Tracers and sealed sources		6	0
	Sub-total		31	3
Environment	Air pollution		2	1
	Fresh water resources		7	1
	Marine and coastal environment		5	3
	Sub-total		14	5
Others	Energy	Sub-total	9	0
	Radioactive waste management	Sub-total	1	0
	Radiation Protection	Sub-total	7	1
	Research reactor utilization	Sub-total	8	0
	Technical Cooperation between Developing Countries	Sub-total	6	0
TOTAL			110	15

4. Criteria for the Selection of the RCA Success Stories

A success story should be able to clearly describe how regional cooperation and the applications of nuclear technology have contributed to the solution of significant problems which would have then resulted in socio-economic benefits at the national level.

Examples could be:

- The introduction of new agronomic practices through RCA projects has resulted in an increase in agricultural productivity and this in turn has led to local farmers increasing their productivity and income;
- Improvements in the quality of health-care from the RCA projects results in better quality of life as well as less lost time for workers, which is resulting in greater productivity, higher incomes and providing a boost to local economies;
- Improving productivity and safety of industrial processes through the RCA projects is boosting the output of local industries, increasing employment, decreasing accidents and benefiting the local economy; and,
- Monitoring environmental pollution using technologies transferred through the RCA projects has resulted in the local agencies introducing better control of plant emissions, which has lowered locally the incidence of health-related problems, decreased associated medical costs, and increased local school attendance and level of achievement at school.

Mere completion of project activities such as training of personnel should not be considered as a success story. A success story is not a progress report. However the establishment of a new capability and capacity that has the potential to benefit the local community might be something that should be publicized.

A success story may either highlight the impact from "human interest" or "technical interest" point of view and preferably both aspects can be represented. "Human interest" stories would probably come most readily from projects covering Agriculture, Environment and Human Health Sectors, while "technical interest" stories would be mostly from Energy, Industry, Research Reactor and Radiation Protection Thematic Sectors.

Since most success stories would be the result of a combination of contributions from other inputs as well as those from the RCA projects, it would be necessary to highlight the contribution of the RCA Programme. For example, the reduction in cancer deaths in a country could be due to many other factors in addition to improvement of radiotherapy facilities. Claiming credit for the total reduction could affect credibility.

5. Published RCA Success Stories

The following 16 RCA Success Stories have been published: in 14 leaflet form and 2 in booklet form, which are available on the RCARO website at www.rcaro.org.

Table 2. List of Published Success Stories

BATCH	AREA	TITLE
First Batch	Air Pollution	Nuclear analysis of airborne particles provides a key to alleviating air pollution
	Drinking Water	Isotope hydrology helps find water fit to drink
	Polymer Processing	New materials from natural polymers: using nuclear technology to improve nature's gifts.
	Tissue Grafting	Restoring health and saving lives: global benefits from RCA's trail blazing
	DAT on Nuclear Medicine	'Distance assisted training' strengthens regional skills in nuclear medicine.
Second Batch	Plant Breeding	Cultivating better crops for sustainable agriculture
	Marine Environment	Turning the tide against marine pollution
	NDT Applications	Strengthening skills in NDT for regional industry
	Geothermal Investigation	Harnessing energy from the heart of the earth
Third Batch	Livestock Productivity	Improving livestock productivity while conserving the environment
	Soil Erosion	Combating soil erosion-caused land degradation in the Asia and the Pacific Region(1 leaflet + I booklet)
	Energy Planning	Enhanced energy analysis and planning capabilities
	Radiotracers Technology	RCA innovation supporting regional chemical, petrochemical and petroleum industries
Fourth Batch	Post-tsunami environmental assessment	Mitigating Coastal Impacts of a Tsunami: the Role of Nuclear Technology
	Radiotherapy	Improving the Quality of Radiotherapy in the Asia and Pacific Region (1 booklet)

Published Stories in Brief

Improving Air Quality
Through the application of the nuclear techniques transferred through the RCA projects, local agencies now are able to better monitor and understand air pollution. These new technologies provide them with the means of obtaining important information to assist in national efforts on the introduction of better control of emissions from industries and other sources. The projects have contributed to the development of a significant regional database to provide information about air pollution in the region, including source, distance, and trans-boundary aspects.

Contributing to the Search for Fresh Water
Applications of isotope hydrology techniques in RCA Member States have resulted in more accurate assessment of groundwater behavior, providing better information on the search for and management of clean drinking water resources. Use of these techniques has also contributed to informed decision-making on water policy and control in the region.

Enhancing Materials Properties
The transfer of radiation processing technology to the RCA Member States has helped them develop the capabilities to produce new and innovative products and deliver them to markets. An example is a radiation processed polymer (Chitin), which is being developed for medical uses.

Enhancing the Use of Tissue Graft Materials
This project has greatly assisted national agencies build up their capabilities as well as their training and physical infrastructure in the production, use and promotion of tissue graft materials prepared using radiation sterilization. This has resulted in tissue grafts become much more affordable, more widely available and more widely used in RCA Member States. This success has served as a role model for other regions.

Assisting Nuclear Medicine with Training at a Distance
The demand for qualified nuclear medical technologists is high in the region as the number of nuclear medicine departments grows at a rapid rate. There are competing demands for technologists to be trained while at the same time these technologists are urgently required to be working in the departments. The RCA projects have established a distance assisted training programme, which has been able to address both demands. Hundreds of students from many Member States have taken part in the programme and other regions are now taking up the use of these training materials.

Improving Crops
The RCA Member States are acquiring nuclear technology to assist them to breed new varieties of crops which will have higher yield rates, greater resistance to drought, salinity, disease and pests as well as improved quality for consumers. Several high performance varieties of soybean, groundnut, mungbean, wheat, and sesame have already been released to the market, and a number of other new crop varieties are being field-tested prior to commercial release.

Tackling Marine Pollution

RCA Member States have improved their regional capacity to deal with aquatic pollution in coastal areas. Hydrologists have been trained in the use of nuclear and conventional techniques and tools to sample and analyze the composition water-borne pollutants and then use this information, together with relevant hydrodynamic models, to carry out risk assessments using advanced computer simulation tools.

Strengthening Skills in Non-Destructive Testing (NDT)

NDT techniques use penetrating radiation (i.e., gamma- or x-rays) to examine the internal state of materials (such as identification of defects) and are widely applied in industry. A total of 300 personnel from 14 RCA Member States were trained initially through the RCA projects. In turn, these individuals have then provided training, disseminating the NDT knowledge and technology at the national level. The current aim is the harmonization of the region's NDT qualification and certification process by 2012.

Helping the Search for Geothermal Power

In the search for sustainable energy sources, some RCA Member States have been developing geothermal power, which has now reached a collective capacity of about 3,500MWe. The RCA project has been providing assistance in the search for suitable new geothermal sources through the provision of regional training in the utilization of isotopic techniques, including natural isotopes and artificial radiotracers. These techniques have provided valuable information on reservoir characteristics especially when the reservoirs are subject to changes in pressure, temperature, and fluid flow. Member States have carried out investigations on 33 new geothermal prospects (about 130 geothermal springs) and have contributed to the development of several geothermal power plants in Member States such as the India, Indonesia, and the Philippines.

Improving Livestock Productivity while Conserving Environment

The improved productivity of the livestock has enabled RCA Member States to: increase the weight gain and milk production of farm animals; achieve genetic improvement in the livestock; reduce methane emissions through improved nutrition by developing new feeds and Urea Molasses Multi-nutrient Blocks (UMMB); and develop reproduction strategies using nuclear and nuclear related techniques. Artificial Insemination (AI) with diagnostic support, in the form of radioimmunoassay (RIA) technology, has also been used to improve reproductive efficiency through a better understanding of the reproductive status of livestock. China, India, Malaysia, Mongolia, Myanmar, Pakistan, Sri Lanka, Thailand and Vietnam consolidated their ability to sustain the use of RIA by making the standards and quality control samples in their national laboratories.

Preventing Soil Erosion caused Land Degradation

The use of a nuclear based technique known as "Fallout Radionuclides" (FRNs) in the RCA's regional projects has significantly contributed to prevent soil erosion and at the same time protect land and water resources and environmental sustainability in the region. It has been widely accepted as a technique and is even being used by the Ministry of Soil and Water Resources, China to establish water quality maps. Effective implementation of this FRN technology has involved RCA Member States forming teams with multidisciplinary skills and expertise. They have also had to invest in essential infrastructure and equipment so that they could perform the required field and laboratory work.

Enhancing Energy Analysis and Planning Capabilities

RCA Member States have responded to the drastic increase in energy demands causing by the fast economic and population growth in the region. National teams have been assisted by an RCA project to conducted national studies on the design of long term energy strategies and evaluate the impact of environmental regulations on energy system development using the advanced computer modeling package, "Model for Energy Supply Strategy Alternatives and their General Environmental Impacts" (MESSAGE). Their studies have directly supported or influenced the decision-making process for national or local long-term electricity planning and have provided policymakers with technically sound information. This project also has fostered regional cooperation and facilitated integrated analysis of regional energy and environmental issues. Most RCA Member States have seriously considering adopting the model for energy planning and policy.

Radiotracers for Innovation Supporting Chemical, Petrochemical and Petroleum Industries

Radiotracers and sealed source technologies are well known as effective tools for online control and measurement as well as being indispensable agents for troubleshooting in the operation of chemical, petrochemical and petroleum plants. However, opportunities for RCA Member States to gain the benefits from the use of these technologies are limited due to the highly commercial nature of the production advantages that can be achieved. In spite of these difficulties RCA projects have been responding to the needs of regional industries by transferring knowledge and enhancing capabilities and capacities. Two examples of technologies that have been transferred for use in areas of significant importance to the industries of the Member States are: Interwell Tracer Technology (IWTT), which is used in oil fields; and, Gamma Scanning, which is used to investigate operational problems in distillation columns in chemical and petrochemical and petroleum plants.

Mitigating Coastal Impacts of a Tsunami

A large-scale ocean tsunami is one of the chronic natural disasters that can periodically afflict the RCA region and threaten Member States' socio-economic integrity, as well as individuals' livelihoods and their health and welfare. Through a science-based risk assessment process introduced to the region by this project, Member States can now assist in combating and decreasing the vulnerability of affected populations to the environmental contamination problems they face as a consequence of tsunami and other natural disasters. The project has also provided increased awareness of advantages of nuclear analytical techniques through well-structured interactions with national and regional organizations. Scientists and technicians in the RCA Member States who were engaged in the activities surrounding the post-tsunami environmental assessment activities now have an enhanced capacity the application of Nuclear Analytical Techniques (NATs).

Improving the Quality of Radiotherapy

In both the developed and developing Member States in the region the number of cancer patients is increasing and has become a burden to national development. Radiotherapy has been recognized as an essential treatment for cancers frequently experienced in the Asia Pacific region. This project contributed to the training of radiotherapy technologists in recipient RCA Member States in improved patient care and improved the quality of the radiotherapy through enhancing national capacities in brachytherapy. Since Member States may not have adequate quality assurance programmes, the project has included Quality Assurance Team on Radiation Oncology (QUATRO) missions so as to obtain comprehensive information on the individual status of radiotherapy treatment in those participating Member States. This measure has greatly contributed to improving the quality assurance in radiotherapy.

RCA Success Story in 2012

Preparing for the Nuclear Renaissance in the Asia Pacific Region-Establishing a Benchmark for Assessing the Future Radiological Impact of Nuclear Power Activities on the Marine Environment


MON
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