



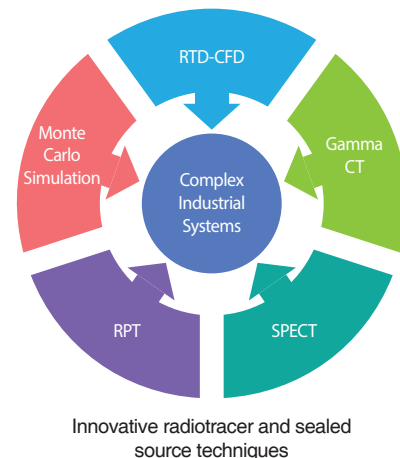
## Enhancing the Regional Capability in using Innovative Radiotracer and Sealed Source Techniques for Investigation of Complex Industrial Systems

Radiotracer and Sealed Source Techniques are special tools for investigating complex industrial systems. These techniques are widely used for troubleshooting in industries with minimum plant shutdown; thereby loss can be reduced or prevented. The success of radioisotope applications is due primarily to the cost effectiveness and suitability to apply the unique properties of radioactive material to collect information that cannot be obtained by other investigative techniques.

Furthermore, these techniques are used to optimize various process industries to improve the product quality, performance of the industry, reduce pollution and save energy.

The Regional Cooperative Agreement (RCA) has made considerable progress previously in promoting the industrial applications of radiotracers and sealed sources in the region through implementation of various projects in this area since 1997. As a result, many conventional radioisotope techniques have been established and are in routine use in most of the countries in the region. Specifically, these techniques include:

- Gamma Computer Tomography (CT)
- Single Photon Emission Computer Tomography (SPECT)
- Radioactive Particle Tracking (CARPT)
- Residence Time Distribution (RTD) analysis integrated with Computational Fluid Dynamics (CFD) simulation
- Monte Carlo simulation for the design of radioisotope experiments



Two phase flow visualization by gamma CT system (GORBIT)

These techniques allow detection, diagnosis and remedy of industrial system malfunctions. Applications include flow rate/mixing time/level/interface measurements, leakage detection in heat exchangers & underground pipelines, wastewater treatment plant studies, sediment transport studies and inter-well communication studies in oilfields.

The capacity built through previous RCA projects provided a suitable foundation to take a step forward to initiate a new RCA project entitled "Characterizing and Optimizing Process Dynamics in Complex Industrial Systems using Radiotracer and Sealed Source Techniques". The project objective is to investigate complex industrial systems, particularly multiphase flow systems, which are encountered in many industrial and environmental installations. Since the fluid dynamics of these industrial systems is very complicated and it is often difficult to predict important process parameters, it is preferred to visualize the process for the diagnosis in real time. Innovative radiotracer and sealed source technology-based applications provide state of the art techniques that possess the ability to see through opaque industrial systems and can be applied on-line in harsh industrial conditions.

Participating countries of the project have enhanced their capability in effective use of these advanced nuclear techniques for diagnosing complex industrial processes. Some countries including China, Indonesia, Malaysia, Korea and Vietnam have established very good facilities of gamma CT and SPECT. In Vietnam, the Center for Application of Nuclear Techniques in Industry (CANTI) has developed a first generation gamma CT system (GORBIT), which has been supplied to various countries in the region. The Industrial

Applications Group at the Pakistan Institute of Nuclear Science and Technology (PINSTECH) has successfully tested this system for visualization of two-phase air-water flow developed across 90° horizontal and vertical bends. The group has also developed a CFD-based model of this two phase flow system and compared the results with gamma CT. India, Malaysia and Korea have developed facilities for the Radioactive Particle Tracking (RPT) technique. Korea has also developed expertise in Monte Carlo simulation for CT, SPECT, RPT and the design of radiotracer experiments. Pakistan has developed its expertise in RTD analysis integrated with CFD simulation.



Radioactive gaseous tracer preparation system in Vietnam



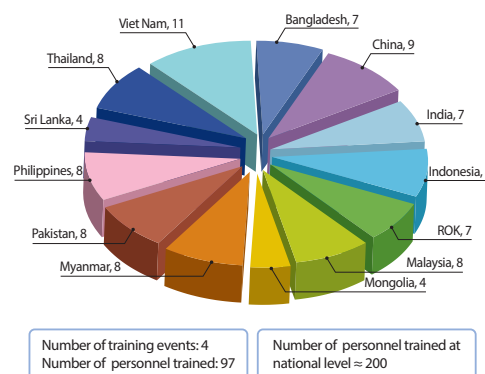
CFD simulation of an extraction column in Pakistan



RPT facility in Malaysia

Participant countries have also made significant progress in the development of new radiotracers for use in multiphase flow systems. These include improvement in the radionuclide generator based radiotracers in China, fabrication of radioactive particles for RPT in India and Malaysia, development of nano-tracers in India and Vietnam, and synthesis of gaseous radiotracers in Vietnam. Development of various facilities and expertise regarding innovative radiotracer and sealed source techniques has also resulted in an excellent Technical Cooperation among Developing Countries (TCDC) component.

In addition to technical development in the region, the project has contributed to human resource development as well. Four training events were organized, in which 97 participants from the region were trained. At national level, around 200 participants were trained in the relevant subject through organizing seminars and demonstrating the techniques, which also resulted in increased user awareness of the technology. Various training course materials and protocols in the field of radiotracer and sealed source applications were developed during the period of project implementation. In addition, an E-learning module entitled "Radioisotope Sealed Source Technology as Applied to Industry" was developed in the framework of this project at IAEA. This E-learning module is accessible through IAEA Learning Management System CLP4NET having URL: <nkm.iaea.org/clp4net/plms>.



Overall impact of human resource developed during the implementation of RAS/1012



With successful operation of the RCA network, the project has achieved technical as well as educational development in the region in the field of innovative radiotracer and sealed source techniques. The current major stakeholders of radiotracers and sealed source technology are waste water treatment plants and chemical, petrochemical and petroleum industries.

Mineral processing is another potential target beneficiary of this technology. Based on the achievements of the project and continuous efforts from each participating country, it is expected that the application of the technology will be further extended and strengthened in the Asia-Pacific region.



### Regional Co-operative Agreement

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

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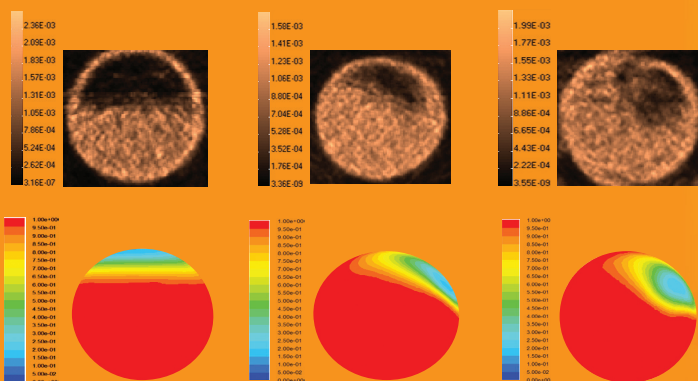


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