# Radioisotope Production and Radiation Technology

## *Objective*

*To strengthen national capabilities to produce radioisotope products and radiopharmaceuticals and to apply radiation technology, thus contributing to improved health care and sustainable industrial development in Member States.*

## Radioisotopes and Radiopharmaceuticals

The Agency continued to assist Member States in the production of technetium-99m (Tc-99m), the most widely used radioisotope in nuclear medicine. In March, it hosted a Technical Meeting on New Ways of Producing Tc-99m and Tc-99m Generators attended by 16 experts from 12 Member States. Participants discussed various options for producing molybdenum-99 (Mo-99), the radioactive parent of Tc-99m, including the relatively new photo-neutron reaction (i.e. the (γ, n) reaction on Mo-100). In this process, a beam of electrons (typically in the energy range of 20–50 MeV) from a high power electron linear accelerator is impinged on a dense target to produce high energy photons through bremsstrahlung radiation. These photons, in turn, strike the Mo-100 target to produce Mo-99 of low to medium specific activity (see Fig. 1). Another important topic of discussion at the meeting was the development of suitable generator systems using low to medium specific activity Mo-99. Participants reviewed ongoing efforts to develop high capacity sorbents for molybdenum. These would allow preparation of compact column generators, presenting new options for producing Tc-99m and Tc-99m generators at the national level.

In 2016, the Agency launched two new coordinated research projects (CRPs) on radiopharmaceuticals. The first, entitled 'Therapeutic Radiopharmaceuticals Labelled with New Emerging Radionuclides', involves 14 institutes from 13 Member States. The project aims at providing guidelines on producing new beta emitters of interest for therapeutic applications in nuclear medicine. The production routes considered will cover the use of cyclotrons, linear accelerators and, to a lesser extent, research reactors. The second CRP,

*FIG. 1. A linear accelerator used for producing molybdenum-99 using the (γ, n) reaction on molybdenum-100. (Photograph courtesy of R. Galea, National Research Council Canada; Canadian Crown Copyright.)*

entitled 'Copper-64 Radiopharmaceuticals for Theranostic Applications', focuses on copper-64 (Cu-64), one of the most promising radioisotopes for theranostic applications. Cu-64 emits both positrons, used in positron emission tomography, and beta particles and Auger electrons, used for therapeutic applications, making it suitable for both diagnosis and therapy. The CRP, which also involves 14 institutes from 13 Member States, aims at studying radiopharmaceuticals suitable for labelling with Cu-64. It follows on an earlier CRP on the topic, the results of which were published by the Agency in 2016 in *Cyclotron Produced Radionuclides: Emerging Positron Emitters for Medical Applications: $^{64}$Cu and $^{124}$I* (IAEA Radioisotopes and Radiopharmaceuticals Reports No. 1).

## Radiation Technology Applications

Radiation technologies have immense potential in a variety of areas, including reducing the impact of pollutants in the environment. In August, a Technical Meeting on Radiation Technologies for Degradation of Contaminants of Emerging Concern was held in Budapest, Hungary, to assess the present status of radiation technologies and to formulate a work plan for exploring their potential uses. The Agency completed the CRP entitled 'Radiation Treatment of Wastewater for Reuse with Particular Focus on Wastewaters Containing Organic Pollutants' in 2016. The CRP, which involved 16 participants from 14 Member States, demonstrated that radiation technology can be successfully integrated with current technologies to treat pollutants that are currently problematic for the industrial and municipal wastewater industry.

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The Agency undertook a number of activities in 2016 aimed at ensuring the safe use of radiation processing facilities, particularly with regard to facility safety and the secure transport of radioactive sources. In late May and early June, a Technical Meeting on Enhancing Safety and Control Features of Existing Radiation Processing Facilities was held at the Institute of Nuclear Chemistry and Technology, an IAEA Collaborating Centre located in Warsaw, Poland. The meeting's 20 participants from 16 Member States shared their experience of upgrading radiation facilities, and the resulting safety enhancements and economic benefits owing to faster processes and higher throughput. The Agency also hosted an experts meeting on the topic of Challenges Facing Gamma Radiation Sources: Emerging Scenarios, at its Headquarters in May. The meeting brought together five experts from five Member States, who evaluated recent issues related to the use of gamma irradiators. The participants concluded that current and foreseeable demand for cobalt can be met by anticipated supplies, and noted that industry was working with international and national organizations to enhance facility safety and the security of radioactive sources during transport.

The Agency completed its CRP entitled 'Application of Radiation Technology in the Development of Advanced Packaging Materials for Food Products' in 2016. Participants assessed the effects of ionizing radiation on commercial and emerging food packaging materials, and provided Member States with guidelines on developing new packaging materials based on natural and synthetic polymers using radiation techniques.

Radiometric techniques are essential tools in industrial processes and in the assessment of environmental changes. In 2016, the Agency concluded the CRP entitled 'Radiometric Methods for Measuring and Modelling Multiphase Systems towards Process Management', which involved 18 institutes from 18 Member States. The CRP focused on integrating two or more radiometric methods — each providing essential information complementary to that obtained from the other methods — with advanced modelling techniques to obtain the most valuable information on the multiphase system.

The first meeting of a new CRP entitled 'Development of Radiometric Methods and Modelling for Measurement of Sediment Transport and Dispersion of Particles and Pollutants from Outfalls' was held in 2016 in Quebec, Canada, with the participation of ten

institutes from ten Member States. This topic is particularly important in the light of the growing impact of climate change and human activities on coastal areas. The CRP is aimed at developing or improving technologies, methods and models to enhance the Member States' coastline protection capabilities.

In 2016, the Agency undertook emergency actions in response to the earthquake that affected Ecuador in April. As part of this response, it provided technical expertise in the use of non-destructive testing to evaluate the integrity of affected buildings and bridges.