Technical Cooperation Report for 2023

Report by the Director General

IAEA
International Atomic Energy Agency
Atoms for Peace and Development

Technical Cooperation Report for 2023

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Preface

The Board of Governors has requested the transmission to the General Conference of the attached Technical Cooperation Report for 2023, the draft of which was considered by the Board at its June 2024 session.

The Director General is also hereby reporting in fulfilment of the request contained in resolution GC(67)/RES/9 on "Strengthening of the Agency's technical cooperation activities".

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Summary

The Technical Cooperation Report for 2023 provides an overview of the Agency's Technical Cooperation (TC) activities during the year, covering actions to strengthen the technical cooperation programme, programme resources and delivery, and programme activities and achievements. Examples of project activities and achievements are listed in Annex 1 according to thematic area, and Annex 2 lists the TC programme Fields of Activity, grouped for reporting purposes. The report responds to General Conference resolution GC(67)/RES/9.

Part A covers the context for the technical cooperation programme in 2023, opening with an overview of the Agency's participation in global development dialogue. It covers the role of the major initiatives ZODIAC, NUTEC Plastics, Rays of Hope and Atoms4Food in supporting and facilitating the delivery of Agency development activities, particularly those technical cooperation activities that require major funding for high cost equipment, by mobilizing funds, conducting awareness-raising, and bringing together partners. Atoms4Food, the newest IAEA initiative, was launched together with FAO in October 2023 to ramp up Agency assistance to help countries boost food security and to tackle growing hunger. Part A also describes technical cooperation efforts to build human capacity, including through youth outreach, specialist schools, postgraduate support and legislative assistance. It describes how the programme is tailored to the needs of Member States, giving an overview of South-South and triangular cooperation, as well as responses to emergencies. It closes with a wrap up of efforts to make the programme more efficient and effective, addressing strategic partnerships, improvements to project design and quality monitoring, and female participation.

Part B presents a summary of financial and non-financial programme delivery indicators. It reviews the resources received for the TC programme through the Technical Cooperation Fund (TCF) and mobilized through extrabudgetary and in-kind contributions. Payments to the TCF in 2023 totalled €91.3 million[1], or 97.5% of the TCF target set for the year.[2] New extrabudgetary resources for 2023 came to €30.7 million and in-kind contributions were €0.2 million. Overall, implementation for the TCF reached 85.5% in 2023. Food and Agriculture, Health and Nutrition and Nuclear Safety and Security[3] were the top areas of disbursement for the programme.

Part C highlights programme activities and achievements, and covers assistance to Member States in the peaceful, safe, and secure application of nuclear science and technology. It highlights regional and interregional activities and achievements in technical cooperation in 2023, and presents an overview of the activities of the Programme of Action for Cancer Therapy (PACT).

A brief selection of project examples is presented in Annex 1 according to thematic area, covering health and nutrition, food and agriculture, water and the environment, industrial applications, energy planning and nuclear power, radiation protection and nuclear safety, and nuclear knowledge development and management. Annex 2 lists the technical cooperation programme Fields of Activity.

[1] This figure does not include National Participation Costs, assessed programme cost arrears and miscellaneous income.

[2] Total payments received in 2023 include €1.9 million either of deferred or of additional payments by 12 Member States. Excluding these payments, the 2023 rate of attainment on payments would have been 95.5%.

[3] Note that when and if nuclear security activities are implemented under TC projects, funding is provided from Nuclear Security Fund and not from the Technical Cooperation Fund.

The Agency's Technical Cooperation Programme in Figures

(as at 31 December 2023)

2023

150 (35)
Countries/territories receiving support (of which LDCs)

16 Country Programme Frameworks (CPFs) signed in 2023

144 Revised Supplementary Agreements (as at 31 December 2023)

3944
Participants in training courses

5253
Meeting participants and other project personnel assignments

196
Regional and interregional training courses

1873
Fellows and scientific visitors

2699
Expert and lecturer assignments

€93 686 000
2023 target for voluntary contributions to the Technical Cooperation Fund (TCF)

€127 276 266
TC 2023 year-end budget[b] (TCF, extrabudgetary resources and in-kind contributions)

97.5%(98.7%)
Rate of attainment on payments (pledges) at the end of 2023

85.5%
TCF implementation rate

New resources for the technical cooperation programme: **€127.3m**

Technical Cooperation Fund, NPC, APC, miscellaneous income: **€96.3m**

Extrabudgetary resources[a]: **€30.7m** In-kind contributions: **€0.25m**

Note: These figures include 773 virtual activities supported by the Agency in 2023.

[a] Includes donor contributions and government cost-sharing. Please refer to Table A.5 of the Supplement to this report for details.

[b] Year-end budget is the total value of all technical cooperation activities approved and funded for a given calendar year plus all approved assistance brought forward from previous years but not yet implemented.

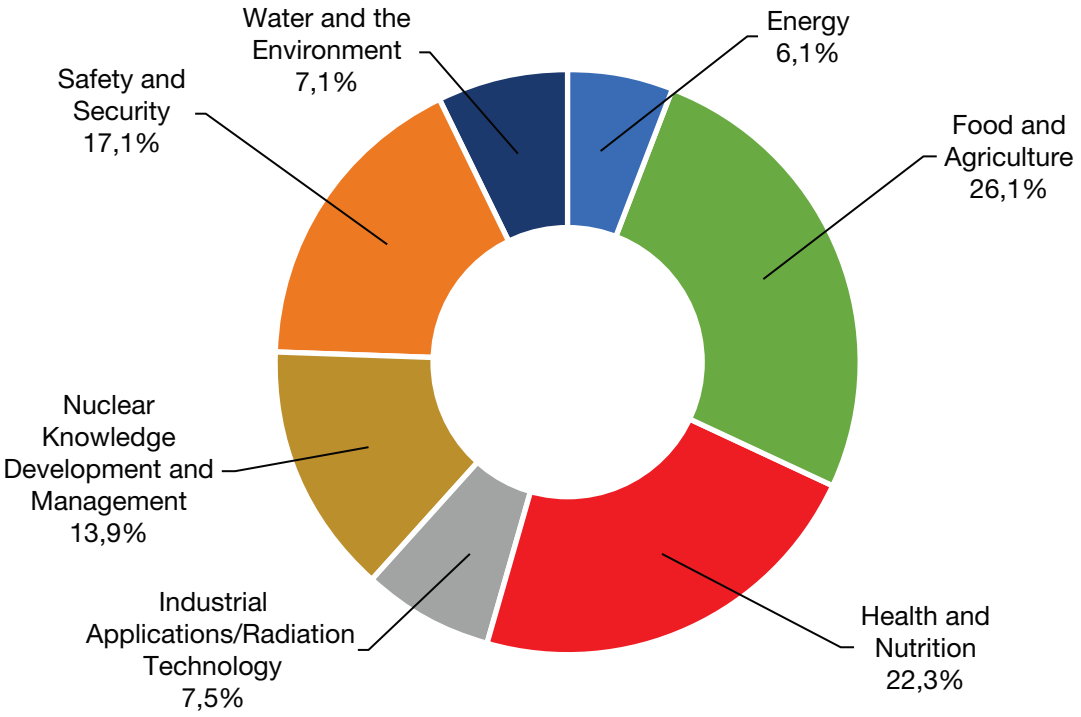


Figure 1: Actuals by technical field for 2023.[4]

[4] Throughout this report, percentages in charts may not add up to 100% exactly due to rounding. Unless otherwise stated, all figures are denominated in Euros. Note that when and if nuclear security activities are implemented under TC projects, funding is provided from Nuclear Security Fund and not from the Technical Cooperation Fund.

Technical Cooperation Report for 2023

Report by the Director General

This document responds to the request by the General Conference to the Director General to report on the implementation of resolution GC(67)/RES/9.

Part A of the report provides an overview of the progress achieved in delivering the technical cooperation programme in 2023.

Part B reports on the management of financial resources and programme delivery at an aggregate level in the calendar year 2023.

Part C reports on regional activities and programme achievements during 2023, and on the Programme of Action for Cancer Therapy.

Annex 1 provides examples of project activities and achievements in specific thematic areas. Annex 2 lists the technical cooperation programme Fields of Activity.

A.

Strengthening the Agency's Technical Cooperation Activities

A. Strengthening the Agency's Technical Cooperation Activities[5]

A.1. DELIVERING THE TECHNICAL COOPERATION PROGRAMME

In 2023, the IAEA technical cooperation programme delivered support to 150 countries and territories through more than 1100 projects, helping to address key national and regional priorities in health and nutrition, food and agriculture, water and the environment, industrial applications, and nuclear knowledge development and management. The programme also provided Member States with assistance in the fields of climate change monitoring and adaptation and clean energy, and in encouraging the next generation of nuclear scientists and researchers. The major initiatives, ZODIAC, NUTEC Plastics, Rays of Hope and Atoms4Food, support and facilitate the delivery of IAEA development activities, particularly those technical cooperation activities that require major funding for high cost equipment, by mobilizing funds, conducting awareness raising, and bringing together partners. The initiatives, particularly Rays of Hope, have also played a major role in supporting countries to address financial issues that are required for the physical infrastructure needed to house IAEA support. This assistance has been provided, for instance, through the development of bankable documents and by supporting countries in drafting funding proposals etc. Atoms4Food, the newest IAEA initiative, was launched together with FAO in October 2023 to ramp up Agency assistance to help countries boost food security and to tackle growing hunger.

In October, IAEA Director General Rafael Mariano Grossi and FAO Director General QU Dongyu launched the Atoms4Food initiative on the margins of the World Food Forum, with the aim of helping countries to boost food security and tackle hunger. Photo taken at FAO's organic rooftop garden in Rome. (Photo: D. Calma/IAEA)

In November, the IAEA Board of Governors approved the TC programme for 2024-2025. The programme addresses the needs of 148 recipient Member States and territories and comprises 458 new projects, including 10 interregional projects. The ongoing effort to focus on comprehensive, impactful projects is reflected in the more efficient number of projects designed for the new cycle.

To strengthen the smooth delivery of the TC programme at country level, a regular training opportunity for National Liaison Assistants (NLAs) has been established in the form of a group fellowship. In 2023, two batches of NLAs were trained at IAEA headquarters: in May–July 2023 for NLAs from Brazil, Bulgaria, Nigeria, Saudi Arabia, Senegal, Thailand, Tanzania and Uruguay; and in August–November 2023 for NLAs from Chile, Comoros, Cuba, Ethiopia, Iran, Tajikistan, Türkiye, Viet Nam and Zimbabwe.

[5] Section A responds to section 1. General, section 2. Strengthening technical cooperation activities, section 3. Effective execution of the technical cooperation programme, section 4. Technical cooperation programme resources and delivery, section 5. Partnership and cooperation, and section A.6. Implementation and reporting, of resolution GC(67)/RES/9, Strengthening of the Agency's technical cooperation activities.

A.2. TECHNICAL COOPERATION IN 2023: AN OVERVIEW

Global developments in 2023: The context for the TC programme

Global development dialogue

At the LDC5 conference in Doha in March 2023, IAEA Deputy Director General Hua Liu delivered a statement on behalf of the IAEA. (Photo: M. Edwerd/IAEA)

IAEA Director General Rafael Mariano Grossi met the Nuclear for Climate Youth Group at the United Nations Climate Change Conference UNCCC held at the Nuclear for Climate Pavilion, Expo City Dubai, United Arab

IAEA Director General Rafael Mariano Grossi delivers an opening statement at the Global Water Analysis laboratory (GloWAL) Network launch event at the UN 2023 Water Conference in New York. (Photo: IAEA)

In March 2023, the Agency participated in the Fifth United Nations Conference on the Least Developed Countries (LDC5), where it held bilateral meetings and co-organized an exhibition and side event with Cambodia, Nepal and Zambia on building the human and institutional capacities of LDCs through the peaceful use of nuclear science and technology. This supported closer collaboration between the Agency and the UN Office of the High Representative on Least Developed Countries, Landlocked Developing Countries and Small Islands Developing States, with the UN Technology Bank for Least Developed Countries, and with representatives of the private sector engaged in the LDC5 Private Sector Forum.

In July, the Agency took part in the UN High Level Political Forum, co-organising an exhibition and a side event with the United Nations Office for South-South Cooperation (UNOSSC), the United Nations Development Programme (UNDP), the Government of South Africa and the Government of Tajikistan, on the importance of South-South and triangular cooperation for the sustainability of water and energy. The Agency also participated in a side event organised by the United Nations Educational, Scientific and Cultural Organization (UNESCO) on Science-based Global Water Assessment.

At the 28th meeting of the Conference of the Parties (COP28) to the United Nations Framework Convention on Climate Change (UNFCCC) in December, the IAEA's Atoms4Climate Pavilion presented how nuclear science and technology is used to help mitigate, adapt to and monitor the effects of climate change. At the IAEA pavilion, government leaders, civil society, academia and the press discussed the application of nuclear technology to mitigate the impacts of climate change in energy, food and water.

In October, the Agency attended the World Bank and International Monetary Fund Annual Meetings in Marrakech as an observer, and participated in a panel discussion on universal health coverage and financing cancer care.

In January, the Agency held a side event to launch the Global Network of Isotope Enabled Water Analysis Laboratories (GLOWAL) at the 2023 UN Water Conference. The Agency also attended the 10th Roundtable on Water (Regional session for Africa) in November on the invitation of the Organisation for Economic Co-operation and Development (OECD) and the African Development Bank (AfDB). The Agency used the occasion to highlight the importance of quality data in informing decision-making in the water sector.

Agency collaboration continued with the United Nations Office of the Special Adviser on Africa (UN-OSAA), through participation in the Interdepartmental Task Force on African

Affairs (IDTFAA) Meetings at the Technical and Principal levels. These meetings focused on 'Digital Transformation to Accelerate the Implementation of the SDGs and Agenda 2063', looking at food systems transformation for building Africa's resilience and food safety and security.

The Agency spoke at the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Sixth Asia-Pacific Day for the Ocean, co-organised with the UN Environment Programme for Asia and the Pacific Office and UNDP's Bangkok Regional Hub, at the session 'Ocean-based Climate Action'. The Agency highlighted its expertise and the role of the IAEA NUTEC Plastics initiative in bolstering global marine health, raising awareness of how nuclear science and technology are applied to combat marine plastic pollution.

The Agency's participation in these and other global events in 2023 facilitated engagements with international financial institutions, the private sector and philanthropic foundations — all essential to resource mobilisation actions, including for the flagship initiatives – and helped to position the Agency as an experienced partner in the global advancement of South-South and triangular cooperation.

Contributing to specialized international and regional reports

The Agency contributes to specialised international and regional reports to raise awareness of the role of nuclear science and technology in specific development sectors. In 2023, it continued its practice of contributing to the United Nations Department of Economic and Social Affairs (UN DESA) report *Financing for Sustainable Development*, and continued discussions with the UN Committee on Science and Technology for Development, with the aim of raising awareness about the contribution of nuclear science and technology to development. The IAEA NUTEC Plastics initiative was included for the third time in the annual G20 *Report on Action Against Marine Plastic Litter*.

Comprehensive inputs in five key areas were provided for the 2023 edition of the Asian Development Bank's *Innovation Hub*: non-destructive testing, radiotherapy, mutation breeding, NUTEC Plastics recycling and planned growth enhancers.

Advancing cancer control

Through Rays of Hope, the Agency continued to advocate for improved access to quality cancer diagnostics and treatment services in low- and middle- income countries, including through participation in international fora and events such as the 11th Annual Symposium on Global Cancer Research, the World Cancer Leaders Summit, the African Organisation for Research and Training in Cancer conference (AORTIC) and the London Global Cancer Week. At these events, Agency experts emphasized the need to integrate radiation medicine into national cancer control planning. The Agency facilitated the participation of emerging cancer leaders from across Africa to attend AORTIC, all of whom presented posters or oral presentations on radiation medicine projects in their local contexts, and was invited by Varian to co-sponsor an AORTIC side event.

The Agency continued to raise awareness on the role of radiation medicine in the global health community by participating in World Health Organization (WHO) Regional Committee meetings, including those of the African, Eastern Mediterranean, Europe, Pan-American and Western Pacific regions. Jointly with WHO and the International Agency for Research on Cancer (IARC), the Agency convened a series of National Cancer Control Plan workshops for Ministry of Health focal points. The workshops successfully strengthened capacities in cancer control planning and governance by creating a forum for interactive dialogue to share lessons learned on NCCP development, implementation, monitoring and evaluation.

The IAEA attended World Health Organization Regional Committee meetings in 2023, including the meeting of the 73rd session of the WHO Regional Committee for Europe (Photo: WHO)

A.3. A.3. CONTRIBUTING TO THE MAJOR INITIATIVES

The major initiatives support the work of the Agency and the technical cooperation programme by raising awareness, building partnerships and mobilizing resources.

NUTEC Plastics

The NUTEC Plastics Initiative brings together countries and partners from around the world to enhance marine plastic monitoring and to develop innovative recycling technologies using irradiation, with the aim of accelerating the transition to a circular plastic economy. The initiative is currently supporting 82 Member States. The Agency is an official partner of the UN Decade of Ocean Science for Development and collaborates with a broad range of stakeholders such as the Intergovernmental Oceanographic Commission of UNESCO, the Food and Agriculture Organization, the United Nations Development Programme, United Nations Environment Programme and United Nations Industrial Development Organization, the Global Plastic Action Partnership regional working group for Africa, the World Economic Forum, the Economic and Social Commission for Asia and the Pacific, Group of 20 and the private sector to tackle the global problem of plastic pollution. The Agency participated in the Second Meeting of the Intergovernmental Negotiating Committee on Plastics Pollution in Paris, France in May 2023, to support negotiations of a Plastics Pollution treaty, coordinated by UNEP, and to raise awareness of the NUTEC Plastics initiative.

Technical cooperation activities supported by the NUTEC Plastics initiative are being implemented through national and regional projects in Africa, Asia and the Pacific, Europe and Latin America and the Caribbean.

NUTEC Plastics: Progress in ASEAN countries

The Philippines made progress in developing treated plastic for construction materials, and the country is collaborating with industry partners and research entities. Malaysia has made progress in recycling polytetrafluoroethylene (PTFE) waste, and is also working on an assisted-radiation pyrolysis project to convert mixed plastics into fuel and additives, in collaboration with industrial partners. Indonesia has focused successfully on wood-plastic composites made of recycled polyethylene, reaching TRL3, and is collaborating with academic partners on assisted-radiation pyrolysis. Thailand is making progress in enhancing the mechanical properties of recycled high density polyethylene (HDPE) pellets from discarded fishing nets and developing wood-plastic composites.

In 2023, the upstream component of the NUTEC Plastics initiative in Asia and the Pacific, under project RAS1024, 'Reutilizing and Recycling Polymeric Waste through Radiation Modification for the Production of Industrial Goods', focused on the innovative reuse and recycling of polymeric waste through radiation modification. Significant advances were made in the experimental proof of concept for the technologies, and successfully completed in the pilot countries: Indonesia, Malaysia, the Philippines and Thailand. The research phase has now been completed and the project has moved on to the development phase, progressing from Technology Readiness Level (TRL) 3 to TRL4.

In 2023, 63 laboratories around the world participated in the marine monitoring component of NUTEC Plastics. Of these, 17 laboratories in the Asia and the Pacific region were equipped with sampling and analysis kits, and training on sampling and analysis and preparation was provided through a regional training course in December 2023 in Kuwait. Guidelines and harmonized operation protocols for sampling, separation, identification, classification and monitoring microplastics in sand beaches and surface waters in marine ecosystems were established and adopted in 2023 under a regional training course in Asia and the Pacific, supporting reporting on SDG indicator 14.1.1B.

A joint webinar, held in 2023 by the Agency and the Asia Development Bank on NUTEC Plastics, resulted in the publication of a document, *Four Southeast Asian Countries Pilot the Use of Nuclear Technology in Plastic Recycling*, on the Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA) portal.

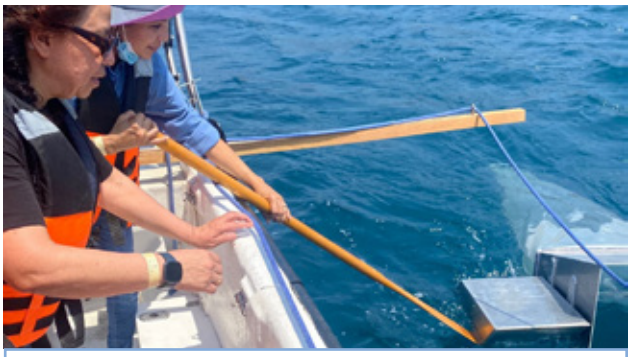
IAEA NUTEC PLASTICS

82 Member States are participating in NUTEC Plastics: 31 in the area of plastic recycling using nuclear technology, and 77 in marine monitoring.

Marine monitoring activities

Plastic recycling

With the help of NUTEC Plastics, research into using radiation to improve plastic recycling is being carried out in countries across Africa, Asia and Latin America. The photo shows a plastic recycling plant in Davao City, Philippines. (Photo: M. Gaspar/IAEA)



Participants at a training course hosted by INVEMAR practice taking water samples. (Photo: INVEMAR)

In Latin America and the Caribbean, regional activities to promote the use of radiation in developing polymers for new products are being supported under RLA1020, 'Promoting Radiation Technology in Natural and Synthetic Polymers for the Development of New Products, with Emphasis on Waste Recovery (ARCAL CLXXIX)'. Three pilot countries have been identified to assess the technology in connection with industry demand and supply availability. Two regional courses were conducted in 2023: on the economic feasibility of polymer irradiation; and on technical feasibility and the development of business plans for the application of radiation technology for plastics recycling.

In January 2023, a regional meeting in Latin America and the Caribbean facilitated the inclusion of IAEA-CARICOM Member States in the Research Network of Marine-Coastal Stressors in Latin America and the Caribbean (REMARCO). The meeting was attended by representatives from UNEP, REMARCO and Caribbean counterparts.

Also in the framework of NUTEC Plastics, the Agency is conducting a preliminary assessment in Honduras of national capacities to perform microplastics analysis in beach sand, water, sediments and aquatic organisms, to support the monitoring of microplastics in water systems. The assessment began with an expert mission in November to Rio Motagua, which reportedly accounts for about two percent of all plastic emissions to the ocean.

ZODIAC

Launched in 2020, the Zoonotic Disease Integrated Action (ZODIAC) initiative aims to enhance the preparedness and response capabilities of Member States with regards to zoonotic diseases. Member States are being supported to sustain and advance the capacity building embedded in the ZODIAC project's critical goal. ZODIAC is delivered in close collaboration with WHO and FAO.

So far, 150 Member States have appointed a ZODIAC National Coordinator (ZNC), and 128 Member States have designated a ZODIAC National Laboratory (ZNL). Thirty-nine ZNLs have been furnished with equipment for serology and molecular diagnostics through TC project INT5157, 'Supporting National and Regional Capacity in Integrated Action for Control of Zoonotic Diseases'. In 2023, procurement was initiated for nine ZNLs: Chile, DR Congo, Mexico, Nepal, Panama, Paraguay, Peru, Ukraine and Viet Nam.

Through ZODIAC, the Agency is providing training on the verification and adoption of Standard Operating Procedures (SOPs) for new serological and molecular techniques. This has significantly bolstered national and regional capacities in the detection, surveillance, and control of emerging and re-emerging zoonotic diseases. Individual fellowships at the Agency's Seibersdorf laboratories focusing on whole-genome sequencing are being provided to enhance the capacities of ZNLs in characterizing zoonotic pathogens.

In Africa, fellowships on whole genome sequencing were provided for fellows from Senegal and Tunisia. With the support of TC project RAF5082, 'Enhancing Veterinary Diagnostic Laboratory Biosafety and Biosecurity Capacities to Address Threats from

150 Member States have appointed a ZODIAC National Coordinator, and 128 Member States have designated a ZODIAC National Laboratory.

AFRICA

ZODIAC National Laboratories

ZODIAC National Coordinators

EUROPE AND CENTRAL ASIA

ZODIAC National Laboratories

ZODIAC National Coordinators

ASIA AND THE PACIFIC

ZODIAC National Laboratories

ZODIAC National Coordinators

NORTH, CENTRAL AND SOUTH AMERICAS AND CARIBBEAN

ZODIAC National Laboratories

ZODIAC National Coordinators

Zoonotic and Transboundary Animal Diseases (AFRA)', a training programme on calibration and verification of biosafety cabinets was prepared and a face-to-face training course for African Member States, including 10 ZNLs, was held in February at the IAEA Laboratories in Seibersdorf. Such training strengthens the sustainability of the support provided to the ZNLs as it allows them to maintain and to calibrate their biosafety cabinets and thereby to increase bio-safety and bio-security in the working environment.

25 participants from 17 Zodiac National Laboratories in the Asia and the Pacific region attended a course hosted by KAERI on Verification of SOPs for New Serological and Molecular Techniques, enhancing national and regional capacity for the surveillance, detection and control of zoonotic diseases. (Photo: KAERI)

In Asia and the Pacific, ZODIAC-related training hosted by the Republic of Korea in February has built capacity in the region for the detection of and rapid response to identified priority and emerging animal diseases such as Brucella. Two training activities were delivered in 2023 under regional project RAS5085, 'Using Nuclear Derived Techniques in the Early and Rapid Detection of Priority Animal and Zoonotic Diseases with Focus on Avian Influenza', on techniques of serological and molecular detection of Brucella and on detection and characterization of Capripox Viruses such as lumpy skin disease virus, sheep pox and goat pox viruses. Two further trainings course focused on genome sequencing and the use of iVetNet to support the implementation and maintenance of the ISO17025 standard in veterinary laboratories.

In Europe, a regional training course on the verification of SOPs for new serological and molecular techniques was held in Sofia, Bulgaria. Twenty-three participants from 19 countries in the region attended.

Professional and technical staff from 14 Latin American and Caribbean countries received training on the verification of SOPs, and the biosafety and biosecurity status of the designated 23 laboratories was evaluated.

An IAEA training course trained experts from Asia on early detection and characterization of lumpy skin disease, sheep pox, goat pox in Kuwait in May 2023. (Photo: KISR/Kuwait)

Rays of Hope

The IAEA's Rays of Hope initiative addresses global inequalities in access to quality radiation medicine for cancer care. Over 70 Member States across Africa, Asia and the Pacific, Europe and Latin America are either seeking or already benefiting from assistance under Rays of Hope.

IAEA Director General Rafael Mariano Grossi, at the Rays of Hope Side event at the IAEA 67th General Conference held at the Agency headquarters in Vienna, Austria. 26 September 2023. (Photo: D. Calma/IAEA)

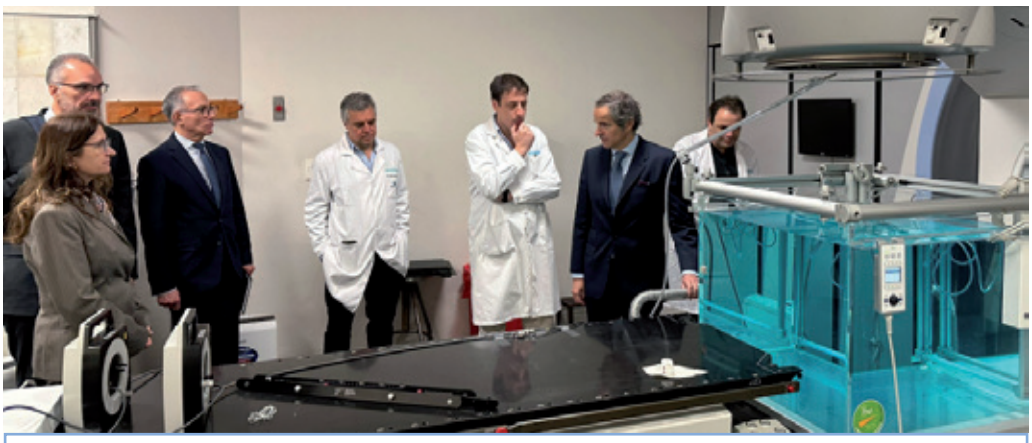
At a side event on the margins of the 2023 General Conference, IAEA Member States presented their progress under Rays of Hope and their future plans. Five Anchor Centre agreements were signed during the event with Algeria, Jordan, Morocco, Pakistan and Türkiye. Anchor Centres will contribute to building up expertise in their regions in medical imaging and radiotherapy, thus increasing access to cancer diagnosis and treatment.

Other outreach activities on Rays of Hope took place at the ASEAN Regional Forum meeting, the 76th World Health Assembly and the meeting of the Preparatory Committee for the 2026 Nuclear Non-Proliferation Treaty Review Conference. The Rays of Hope initiative was presented at the World Oncology Forum and at the World Institute for Nuclear Security.

The Agency and St Jude Children's Research Hospital extended cooperation in childhood cancer under a new Practical Arrangement and signed a Letter of Intent to enhance access to radiation medicine for children under Rays of Hope.

Seven first-wave countries in Africa (Benin, Chad, Democratic Republic of Congo, Kenya, Malawi, Niger and Senegal) have received support for training, procurement of equipment and expert missions. In 2023 the first public radiotherapy centre in Botswana opened. The Democratic Republic of the Congo completed designs for the First Public Radiotherapy Centre in Kinshasa and held a foundation stone ceremony in November 2023, attended by Director General Rafael Mariano Grossi, Minister of Scientific Research Gilbert Kabanda Kurhenga, and Minister of Higher and University Education Muhindo Nzangi Butondo. Procurement of equipment, including linear accelerators (linacs), and staff training is ongoing in Kenya, Niger and Senegal. Benin, Chad and Malawi are currently engaged in construction for radiotherapy and nuclear medicine facilities, and the Agency is providing relevant training for national staff.

Nine Member States in the Asia and the Pacific region have requested participation in Rays of Hope. Indonesia is seeking to roughly double its radiation medicine facilities by the end of 2025, aiming to establish 43 new radiotherapy centres. The Agency is providing relevant technical support through INS6001, 'Preparatory Support for the Expansion of Radiation Medicine Facilities in Indonesia', and in 2023 it carried out a multidisciplinary mission in coordination with the Ministry of Health under the framework of Rays of Hope.



IAEA Director General Rafael Mariano Grossi announced that Hospital de Clínicas Dr. Manuel Quintela in Montevideo, Uruguay, will receive a linear accelerator through the IAEA's Rays of Hope initiative, on 19 December 2023. (Photo: IAEA)

The mission resulted in the development of a roadmap and an action plan on how to support the expansion of the health services in the country.

Fiji and Papua New Guinea have formally requested to participate in the Rays of Hope initiative, and both countries received an imPACT Review mission in 2023 to assess their cancer control capacities and needs and to identify priority interventions. The mission in Papua New Guinea was coordinated with the 57th Annual Medical Symposium of the Medical Society of Papua New Guinea, and the imPACT team presented the preliminary finding to the relevant national authorities.

Support is being provided to Ukraine under Rays of Hope for medical equipment and training in radiation medicine for medical staff. A workplan has been developed and agreed upon under project UKR6014, 'Strengthening Radiation Therapy and Medical Imaging in Ukraine'.

A total of 17 Member States from the Latin America and the Caribbean region are receiving support under the Rays of Hope initiative. Efforts are on-going to mobilize resources in order to scale up much-needed nuclear medicine and radiotherapy services for cancer patients in the region.

A linear accelerator for the treatment of cancer patients, was received in May 2023 at the oncological department of the National Cancer Institute (INCAN) in Paraguay and inaugurated in October 2023. INCAN is the only government entity with radiotherapy and brachytherapy facilities, and the new linac enables the institute to treat a broad range of cancers, including common women's cancers such as cervical and breast cancer.

A new linear accelerator was inaugurated at INCAN, Paraguay in October 2023. (Photo: Nuclear and Radiological Regulatory Authority of Paraguay)

IAEA RAYS OF HOPE
CANCER CARE FOR ALL

Rays of Hope supported seven 'first wave' Member States in 2023, and 65 additional Member States requested support. Five Anchor Centre agreements were signed.

'First wave' Member States

Member States who requested support

Anchor Centre Member States

Atoms4NetZero

INT2023, 'Supporting Member States' Capacity Building on Small Modular Reactors and Micro-reactors and their Technology and Applications as a Contribution of Nuclear Power to the Mitigation of Climate Change', and INT2021, 'Supporting Member States Considering or Planning to Introduce or Expand Nuclear Power Programmes in Developing the Sustainable National Infrastructure Required for a Safe, Secure and Peaceful Nuclear Power Programme', contribute to Atoms4NetZero.

Atoms4Food

The newest IAEA initiative, Atoms4Food, was launched together with FAO in October 2023. It will ramp up Agency assistance to help countries boost food security and to tackle growing hunger. Working with the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, the IAEA's technical cooperation programme will continue to deliver support to build Member State capacities in crop improvement, soil and water management, animal production and health, insect pest control, food safety and nutrition as part of a comprehensive package of targeted assistance. Member States were briefed on the new initiative at an informal briefing on 16 November 2023.

IAEA Director General Rafael Mariano Grossi and FAO Director General QU Dongyu launched the Atoms4Food initiative at the 2023 World Food Forum in Rome. (Photo: D. Calma/IAEA)

Atoms4Food services

Assessment Mission

to map the food security needs and to develop a tailored plan to address food security challenges.

Crop Variety Improvement Service

to build crop improvement programmes using the nuclear method of plant mutation breeding to create more robust and nutritious crops.

Animal Production and Health Service

to provide a scientific assessment of the epidemiological situation of animal diseases; interventions for prevention, diagnosis and control; and laboratory and other veterinary service capacities.

Soil and Water Management and Crop Nutrition Service

to use the precision of nuclear and isotopic science to gather information on soil fertility, major crops and their average yield, availability of fertilizer and water irrigation systems.

Insect Pest Control Service

to address insect pests that affect agricultural production by using the nuclear-based sterile insect technique.

Food Safety and Control Service

to assess laboratory capabilities and the ability to conduct surveillance of food hazards.

Public Health Nutrition Service

to inform impactful nutrition programming using evidence on the nutritional value of foods and diet quality derived from the use of stable isotope techniques.

A.3.1. Building human capacity

In 2023, the IAEA-supported Asian Network for Nuclear Education and Training in Nuclear Technology (ANENT) celebrated its 20th anniversary at a side event on the margins of the 67th IAEA General Conference, discussing the way forward with the Korea Atomic Energy Research Institute, and the Regional Network for Education and Training in Nuclear Technology.

The International Nuclear Science and Technology Academy (INSTA), a recently established regional educational initiative supported by the Agency, contributes to the development of the global nuclear workforce through regional and inter-regional collaboration, empowering educators and advancing NST education programmes at the tertiary level. INSTA membership is drawn from 41 institutions in 20 countries. In 2023, the INSTA Executive Education Programme for Educators was launched, together with a pilot online training course Learning Strategies in the 20th Century. Agency and INSTA experts attended an event in Muscat, Oman, in November to facilitate a sustained approach to NST capacity building strategies for educators.

In Europe and Central Asia, the TC programme supports education and training in nuclear knowledge management. As part of RER0049, 'Enhancing the Capacities of Educational Institutions for the Sustainable use of Nuclear Technologies', the Agency trained 100 participants through three regional workshops on nuclear and radiation education.

Reaching the next generations

Director General Rafael Mariano Grossi and the winners of the African Students' Competition on the Benefits of Nuclear, a side event organized by the Department of Technical Cooperation at the 67th IAEA General Conference in September 2023. (Photo: D. Calma/IAEA)

The Agency launched a competition for African students in March 2023 to enhance awareness of the role of nuclear technology in contributing to socioeconomic development in their countries. Entries from seventy teams, comprising 200 students in total, from secondary schools and universities were received. Nine teams were selected as competition winners and acknowledged for their outstanding submissions at a GC side event, 'Winners of the African Students' Competition on the Benefits of Nuclear Sciences', opened by IAEA Director General Rafael Mariano Grossi. The event was attended by 19 students from Benin, Egypt, Ghana, Kenya, Morocco, Nigeria and South Africa, with teams from Madagascar and Malawi joining the event remotely.

In 2023, the Agency launched the Nuclear Science and Technology (NST) Education Exhibition and the NST Education Competition for Students and Secondary Teachers on the International Day of Education, receiving over 5,000 registrations. The online exhibition showcased education programmes, resources for educators, virtual nuclear facility tours and videos on the benefits of NST submitted by students and teachers from the Asia and the Pacific region. The competition received over 200 videos from secondary and tertiary students, and secondary-level teachers, and the winners were invited to participate in a study tour in October at Agency headquarters.

Science teachers from Asia and the Pacific conducted hands-on experiments in Argonne National Laboratory in preparation for the International Nuclear Science Olympiad. (Photo: Argonne National Laboratory/USA)

The International Nuclear Science Olympiad (INSO) was also launched in 2023. A Steering Committee and Jury was established, drawn from eight Member States in the Asia Pacific region (Malaysia, Oman, Pakistan, Philippines, Saudi Arabia, Sri Lanka, Thailand, United Arab Emirates), as well as from Argonne National Laboratory. The inaugural INSO will be held in the Philippines in 2024, aiming to increase awareness of the peaceful applications of NST among secondary school students.

Specialist schools

In 2023, a national School on Nuclear and Radiological Leadership for Safety was held in Argentina, the first to be delivered at national level in the region and specially tailored to the country's needs. The School supports governments in their work to foster leadership for safety and safety culture by helping early to mid-career professionals to develop their safety leadership potential.

The School of Radiation Emergency Management for the Caribbean Community (CARICOM) was held in May, attended by 31 professionals representing ten countries, drawn from national organizations with a role to play in response to a nuclear or radiological emergency. The participants received training in the development and management of sustainable emergency preparedness and response (EPR) programmes, based on the IAEA Safety Standards, technical guidelines, EPR tools and training materials.

In June, the School of Drafting Regulations brought together 30 participants from 10 Member States in the Caribbean region. The participants received support to review or develop draft regulations relating to aspects of radiation safety and the security of radioactive material. Participants also presented a peer-reviewed Action Plan which considered the initial draft developed by each Member State and incorporated comments from peers, experts and lessons-learned in the School. The National Action Plan will assist each Member State to issue and implement the regulations necessary for the safe and secure use of radioactive sources.

In July, the Agency delivered a presentation on the effects of climate change on food security in Latin America during the 9th edition of the Summer Course on Nuclear Disarmament and Non-Proliferation. The summer course is the result of close collaboration between the Agency, the Organization for the Prohibition of Nuclear Weapons in Latin America and the Caribbean, the Mexican Secretariat of Foreign Affairs, the Matías Romero Institute, and the James Martin Centre for Nonproliferation Studies at the Middlebury Institute of International Studies at Monterey.

PhD and postgraduate support

The Agency focuses strongly on long-term and academic training of fellows in Africa. In addition to Master's programmes for radiopharmacy, isotope hydrology and medical physics, the first Master of Science in Nutrition and Nuclear Techniques was approved in South Africa (North-West University) and Morocco (International University of Rabat). Ten candidates from Africa embarked on their MSc studies in October 2023 in Rabat, Morocco.

At the PhD level, the TC programme in Africa continues to use a 'sandwich' modality to support studies related to nuclear science and technology. For water resources management, including isotope hydrology, 58 students are receiving support at MSc, PhD and postdoctoral levels. A steady stream of high-quality papers, related to the characterisation of shared water resources, is appearing in the international literature.

The Phoenix Leader Education Program for Renaissance from Radiation Disaster, launched in 2021 and supported by Hiroshima University, aims to nurture leaders ready to spearhead reconstruction and recovery initiatives following radiation disasters. In 2023, three PhD fellows from the Philippines, Mongolia and Iran successfully concluded the two year programme. Additionally, two fellows from Indonesia and Saudi Arabia have enrolled in the four-year doctoral 'Radiation Disaster Medicine Course'. The international Master's programme in Nuclear Engineering and Management, supported by Tsinghua University China (TUNEM) under the Chinese Government Scholarship, accepted six Masters students in 2023. The participation of the fellows was supported though regional technical cooperation projects.

The fourth edition of the 12 month Master's programme in Advanced Radiotherapy started in October 2023, with eight new students from Argentina, Bolivia, Costa Rica, Ecuador, Nicaragua, and Paraguay. So far, 30 radiation oncologists from 15 countries in Latin America and the Caribbean have successfully graduated from this course. Participation in the course is funded through the regional ARCAL project RLA6090, 'Strengthening Radiotherapy Management for the Treatment of Cervical Cancer in Latin America and the Caribbean (ARCAL CLXXXII'. The course is delivered by the Arturo López Pérez Foundation in Chile, in close collaboration with the University of the Andes and the Chilean Nuclear Energy Commission.

Twenty-three students from 18 Member States graduated from a two-year Master's programme offered by the Abdus Salam International Centre for Theoretical Physics (ICTP) and the University of Trieste. The programme was held from 1 January 2022 until 31 December 2023, and graduates achieved an Advanced Studies Master's Degree in Medical Physic.

Postgraduate Educational Courses (PGEC) in Radiation Protection and Safety

The Postgraduate Educational Course (PGEC) in Radiation Protection and the Safety of Radiation Sources provides a comprehensive training programme for young professionals, usually from national regulatory bodies. The course, delivered through a combination of lectures, technical demonstrations, field visits and hands-on activities, is designed to provide students with a sound basis in radiation protection and the safety of radiation sources.

In Africa, two courses in French and English were organized in 2023 in Algeria and Kenya respectively. In Asia and the Pacific, a PGEC was launched in Indonesia in English for the first time, while a PGEC in Arabic was organized in Jordan. In Latin America, the course was hosted in Spanish in Argentina. PGECs launched in 2022 that closed in 2023 were hosted by Morocco, Greece and Kenya.

The first IAEA Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources to be held in Indonesia was supported by the Government of Indonesia through the Indonesia National Research and Innovation Agency. (Photo: P. Salame/IAEA)

Legislative and drafting assistance

In 2023, the Agency provided Member States with assistance on nuclear law through four regional projects. The Legislative Assistance Programme covers all branches of nuclear law and includes interregional, regional, sub-regional and national activities that help countries to raise awareness of decision-makers, policy-makers and legislators, to assess, review and draft nuclear legislation and to benefit from the training of officials in nuclear law. These activities also support the promotion of, adherence to and effective implementation of the relevant international legal instruments. In 2023, 23 Member States received assistance through comments and advice on draft and enacted national nuclear legislation. Bilateral meetings were held with decision-makers, policy-makers and other senior officials, as well as legislators in 19 Member States. In addition, national workshops on nuclear law were held with 15 Member States.

In Asia and the Pacific, regional project RAS0090, 'Establishing and Enhancing National Legal Frameworks' enabled such legislative assistance to be provided to Brunei, Mongolia, Myanmar, Nepal, Philippines Sri Lanka, Qatar and Saudi Arabia. The legislative assistance mission to Sri Lanka conducted in November 2023 provided an opportunity to hold a

national workshop on nuclear law which was attended by over 30 officials and to conduct a series of awareness raising with decision-makers, policy-makers and senior officials. A bilateral legislative drafting discussion on the review of the 2014 Atomic Energy Act was held to support the development of a comprehensive law to support a potential future nuclear power programme.

The Agency continued to support Member States in Europe and Central Asia within the framework of regional project RER0048, 'Enhancing National Legal Frameworks'. In particular, Armenia, Serbia and Turkmenistan received comments and advice on drafts and enacted national nuclear legislation. North Macedonia benefitted from discussions on the review of its Law on Ionising Radiation Protection and Radiation Safety. Further, Montenegro and Tajikistan hosted regional workshops on nuclear law in English and Russian, respectively.

Through the regional project for Africa, RAF0061, 'Establishing and Enhancing National Legal Frameworks', Benin, Central African Republic, Eswatini, Gambia, Madagascar, Rwanda, Uganda and Zambia all received support on legislative assistance and on nuclear law.

Legislative support to Member States in Latin America and the Caribbean was provided in 2023 through TC project RLA0072, 'Establishing and Enhancing National Legal Frameworks in Member States' to Bahamas, Barbados, Colombia, Dominica, El Salvador, Grenada, Honduras, Nicaragua, Paraguay, Trinidad and Tobago and Venezuela. In particular legislative assistance missions to Colombia, El Salvador, Nicaragua, Paraguay and Venezuela enabled discussions on in Spanish their national legislation and relevant international legal instruments in nuclear safety, security, safeguards, and civil liability for nuclear damage. Meetings were held with government officials to raise awareness of the importance of becoming party to the relevant international legal instruments and in developing comprehensive nuclear legislation to support the safe and secure use of nuclear techniques and ionizing radiation. In addition to these missions, the draft laws from Member States in the Caribbean (Bahamas, Barbados, Grenada and Trinidad and Tobago) were reviewed and feedback was provided.

The four regional TC projects on legislative assistance also provide a mechanism to develop capacities and increase the level of expertise in nuclear law in Africa, Asia and the Pacific, Europe and Latin America and the Caribbean. The 2023 IAEA Nuclear Law Institute which brought 63 participants from 52 Member States to Vienna to acquire both a solid understanding of nuclear law, and hands-on practical experience in in drafting comprehensive nuclear legislation at the national level. Support was also provided to 15 participants at the OECD/NEA International School of Nuclear Law in Montpellier (ISNL).

The 2023 Nuclear Law Institute, held in October in Vienna, Austria, brought together 60 participants from around the world to acquire a solid understanding of nuclear law. (Photo: D. Calma/IAEA)

A.3.2. Tailoring support to Member State needs

South-South and Triangular Cooperation

Using South-South cooperation mechanisms, the IAEA's technical cooperation programme brings countries together in regional and interregional projects to exchange experiences and share knowledge on how to address development challenges using nuclear science and technology. The Agency works closely with the UN Office of South-South Cooperation to identify joint activities in areas of mutual interest.

An international team of experts from Egypt, Kenya, Mozambique, Uganda and Zimbabwe participated in the imPACT Review to Ethiopia. (Photo: Ethiopian Pharmaceutical Supply Service)

Joint IAEA-IARC-WHO support to Member States continued to leverage South-South Cooperation through collaboration with international experts in cancer control coming from the region where support was requested. The imPACT Review to Djibouti benefited from cancer control experts from Algeria, Egypt, Morocco, Senegal and Sudan. Likewise, specialists from Egypt, Kenya, Mozambique, Uganda and Zimbabwe provided expertise in the imPACT Review to Ethiopia. This ensured that technical support was delivered taking account of regional economic, political, social and cultural contexts. In an effort to build capacities in low- and middle-income countries, and to establish collaborative networks across Member States, qualified counterparts were subsequently trained and deployed as experts in other imPACT Reviews. In addition, nine imPACT Review experts offered recipient Member States the possibility to train fellows within their institutions, fostering the linkages with ongoing national projects in the IAEA technical cooperation programme.

The regional AFRA project RAF0056, 'Enhancing Nuclear Science and Technology Capacity Building through Technical Cooperation Among Developing Countries (AFRA)' focuses on the development of triangular partnerships. A triangular project between Stellenbosch University in South Africa and the University of Nairobi in Kenya has, with Agency support, successfully supported capacity building to trace sediments using natural radionuclides. Two systems were developed for terrestrial and aquatic measurements, and methods and techniques were developed to analyse and visualise the results. The technology was tested in radiometric mapping of two harbours.

Various collaborative activities were carried out in 2023 based on the 2022–2023 Action Plans guiding triangular cooperation between the Agency, Cambodia, Lao PDR and Viet Nam. Progress has been made in radiation safety, animal health, and industrial applications of irradiation technology. An expert mission and scientific visit to the Viet Nam Agency for Radiation and Nuclear Safety (VARAN) supported Cambodia's Department of Nuclear Science and Technology in establishing the national radioactive waste management inventory system. A series of fellowships on non-destructive testing (NDT) techniques and scientific visits at the Centre for Non-Destructive Evaluation in Viet Nam helped Lao PDR's NDT Centre at the Ministry of Industry and Commerce to build basic NDT capacities and to understand its application in civil engineering. Furthermore, a scientific visit in August to the food irradiation facility of the Viet Nam Research and Development Centre for Radiation Technology provided an excellent opportunity for the National Agriculture and Forestry Research Institute in Lao PDR and the Ministry of Industry, Science, Technology and Innovation in Cambodia to learn about food irradiation techniques. In November, staff from the National Animal Health Laboratory in Lao PDR and the National Animal Health

and Production Research Institute in Cambodia visited the National Centre for Veterinary Diagnosis in Viet Nam to discuss training courses for regional laboratories and SOPs for the detection of transboundary animal diseases that could be implemented under the national TC programme in Viet Nam. The three parties to the agreement met in September on the margins of the 67th IAEA General Conference to reflect on the achievements, challenges, and lessons learned from their triangular cooperation. Cambodia and Lao PDR are currently developing action plans in various key thematic areas to continue building on this innovative collaboration.

The Regional Network of Research Reactors and Related Institutions in Latin America and the Caribbean (RIALC) was launched in Vienna in February in the presence of representatives from Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, Jamaica, Mexico and Peru. The new IAEA-facilitated network of research reactors and related institutions will help meet growing demand in the Latin American and the Caribbean region for the analytical and technological services of research reactors, as well as for the radioisotopes and radiopharmaceuticals they produce. RIALC has been working on five thematic areas: education and training; operation and ageing; reactor applications such as geochronology; neutron imaging and neutron activation analysis; and radioisotope production.

Following the launch of RIALC, the Chilean Nuclear Energy Commission has hosted technical experts from Peru to discuss neutron activation analysis — a non-destructive testing application for determining trace elements that is often conducted at research reactors due to their neutron flux capabilities.

The Regional Network of Research Reactors and Related Institutions in Latin America and the Caribbean (RIALC) was launched in Vienna in February 2023. (Photo: J. O'Brien/IAEA)

A new Spanish language e-learning course, *Strategic Planning for National Nuclear Institutions,* was launched at the IAEA's 67th General Conference in September 2023, complementing the English language course on the same subject. The course has been tailored to the Latin American and the Caribbean region, and includes two in-depth case studies provided by the RIALC representatives from Argentina and Chile. It is based on the 2017 IAEA publication entitled Strategic Planning for Research Reactors (IAEA Nuclear Energy Series No. NG-T-3.16) and concentrates on the operational management of research reactors. Participants in the course learn how to prioritize demands for different types of services to ensure the effectiveness and sustainability of research reactors.

Addressing the needs of Least Developed Countries

The imPACT Review to Cambodia focused on supporting country plans to develop a National Cancer Control Programme, prioritize strategies for cervical cancer elimination and enhance efforts to establish a national comprehensive cancer centre.

The Agency provided Cambodia and Lao PDR with intensive support in 2023 to develop a fundable proposal for the establishment of e-beam technology for food irradiation. The

bankable documents were finalized and preparations for their presentation to donors for funding is ongoing.

Yemen has requested support to enhance cancer treatment capacity in Aden. The Agency set up a technical expert team to provide inputs, which reviewed documents and met remotely with the cancer management team in Aden. Support to the country in this area has been on-going. Procurement in support of diagnostic imaging services was initiated.

Supporting Small Island Developing States

Comoros received an imPACT Review to inform the development of first-time cancer services in the country, including the first radiotherapy facility. The country has also requested to be part of Rays of Hope. The imPACT Review to Fiji focused on assessing needs and feasibility of the country to establish the first radiotherapy service.

The Agency continues to support SIDS in the Caribbean region through regional and national technical cooperation projects designed to address the social, economic, and environmental vulnerabilities of these countries. In Haiti, for example, capacity building activities were conducted and equipment procured in 2023 under HAI0007, 'Building National Capacity in Nuclear Technology Applications', to strengthen radiology services and to improve agricultural practices in the country.

Taking a sub-regional approach to the Pacific Islands (SAPI)

Radiographers from the Pacific Islands participated in a training course in Monash University in Australia. (Photo: J. Sim/Monash University, Australia)

Under RAS6099, 'Developing Sustainable, High Quality, and Safe Medical Diagnostic Imaging and Radiotherapy Services (SAPI)', two editions of a regional training course on Quality Assurance (QA), Quality Control (QC), Radiation Protection and Positioning in Diagnostic Radiology were conducted in Monash University in Melbourne, Australia. The course provided radiographers from the Pacific Islands with the means to respond quickly, efficiently, and safely to daily radiological professional challenges. The courses combined theoretical teaching with practical work in the radiography room and covered positioning, QC tests, QA and management, radiation protection, and the basics of radiological interpretation.

A regional workshop on the Establishment of a National Regulatory Framework in Small Islands Developing States (SIDS) in the Pacific Region was conducted in Port Louis, Mauritius, under the framework of RAS9095, 'Strengthening Radiation Safety Infrastructure – Phase I (SAPI)'. The event allowed policymakers and regulatory staff in SIDS to discuss and share experiences related to the practical understanding of a national regulatory framework. Participants heard about Mauritius' successful experience in established a functional regulatory body – an example to consider following for the Pacific Islands, and an example of south-south and interregional cooperation between the Indian Ocean and the Pacific Ocean. The event supported the launch of a tailored approach for Pacific Islands, in response to requests from some Pacific Islands Member States for a stronger, more focused approach to legislative assistance.

At the national level, the first fact-finding missions to new IAEA Member States Samoa and Tonga took place in July. Key priority areas for collaboration under SAPI were identified, as well as new national projects for the 2024–2025 TC cycle. Relevant national institutions and regional partners were identified.

The Agency made a presentation on the SAPI programme at a symposium in April organised by IAEA Safeguards and US Department of Energy, National Nuclear Security

Administration, and the International Nuclear Safeguards Engagement Programme. The presentation was attended by participants from current IAEA Member States but also allowed outreach to potential new Member States such as the Federated States of Micronesia, Kiribati, Maldives, Nauru, Solomon Islands and Tuvalu. Bilateral meetings were conducted with Maldives and the Solomon Islands.

Responding to emergencies

The Agency provided emergency assistance to Syria and Türkiye in the aftermath of the earthquakes that struck in February 2023. Medical equipment, including portable and mobile medical X-ray machines, was dispatched, and the Agency offered technical support to strengthen the medical response systems. The Agency also organized a workshop for Syrian engineers and scientists to equip them with knowledge and tools to assess accurately earthquake damage, thereby facilitating recovery efforts. Support was delivered under the umbrella of INT0098, 'Strengthening Capabilities of Member States in Building, Strengthening and Restoring Capacities and Services in Case of Outbreaks, Emergencies and Disasters'.

In March 2023, Vanuatu declared a national state of emergency following two consecutive cyclones that damaged infrastructure and disrupted essential health, education and communication services throughout the country. The Agency provided emergency assistance in the form of a portable X-ray machine and a portable ultrasound machine, supporting medical assistance to patients in remote locations.

Following an earthquake in March 2023 that affected the southwest part of Ecuador, the Agency provided emergency assistance in the form of equipment to the Armed Forces University and the National Polytechnic School, both institutions which had been involved in previous TC projects. Two international expert missions were fielded to initiate the first assessment of the situation and prepare the national technical team, which included engineers and specialists from different institutions. Training and practical sessions in the application of non-destructive testing in the affected civil structures will contribute to improving local skills in infrastructure assessment, which will enable a more effective response to future disasters.

Libya received Agency assistance following the widespread flooding caused by Storm Daniel in September, which caused widespread flooding. The Agency provided a mobile X-ray machine and portable X-rays and ultrasound machines, helping to restore medical capacities in the affected area.

A.3.3. Building awareness of the technical cooperation programme

New outreach material on the TC programme issued in 2023 included a new video and a brochure: *The IAEA Technical Cooperation Programme: Selected Highlights 2022*. A series of web presentations focusing on IAEA-supported climate projects was produced for COP28, together with a booklet to promote a new interregional TC project designed to build resilience in food and water systems.

Exhibitions were mounted at three international events: the UN High-Level Political Forum, the UN Climate Change Conference and the UN Conference on the Least Developed Countries.

Technical Cooperation Outreach in 2023

83 Agency web articles on technical cooperation

8866 @IAEATC Twitter followers (growth of 12.1% from 2022)

2641 @iaeapact Twitter followers (growth of 5% from 2022)

5131 LinkedIn followers and **50** posts

Social media continued to offer a cost-effective channel for outreach on the programme, and both the @IAEATC and @IAEAPACT Twitter accounts grew significantly: @IAEATC Twitter followers grew by 12.1%; @IAEAPACT followers grew by 5%. Fifty posts were made

on the IAEATC LinkedIn channel. These activities enhanced programme visibility among key, targeted audiences and increased awareness of the TC programme's contribution to socioeconomic development at the national and regional levels.

A side event at the 67th IAEA General Conference, titled 'NUTEC Plastics: Progress and Prospects' showcased progress under the initiative to date, and examined its future direction. (Photo: O. Yusuf/IAEA)

Several side events were organized during the 67th regular session of the General Conference. 'Improving Quality and Patient Safety in Diagnostic Radiology in Central Asia,' gathered more than 30 national experts from the region to present, discuss and explore ways to improve the quality of diagnostic interventions and patient safety. At the 'Presentation by the Regional Network of Research Reactors and Related Institutions' side event, a new e-learning course, *Strategic Planning for National Nuclear Institutions*, was launched by IAEA Director General Rafael Mariano Grossi. The side event 'Remediation of the Semipalatinsk Test Site: 30 Years of IAEA Assistance' showcased the results of the Agency's sustained and ongoing support provided to Kazakhstan in its efforts to remediate the Semipalatinsk nuclear test site. At the side event 'Winners of the African Students' Competition on the Benefits of Nuclear Science,' students shared winning video entries on how nuclear technology can address development challenges in the fields of human health, climate change and food production. The side event 'Supporting the Development of the Africa Continental Power System Masterplan' described the support that the Agency and the International Renewable Energy Agency have been providing, as modelling partners, to the development of the Africa Continental Power System Masterplan since March 2021. Finally, 'Applying Advanced and Climate-Smart Technologies for a Food-Secure Africa' showcased the successful applications of advanced and climate-smart technologies, as well as the results being achieved at the national level towards food security in Africa.

A Seminar on Technical Cooperation for Permanent Missions was held in October, attended by more than 30 participants from 25 Members States.

A.4. BUILDING A MORE EFFICIENT, MORE EFFECTIVE TECHNICAL COOPERATION PROGRAMME

A.4.1. Revised Supplementary Agreements and Country Programme Frameworks

Sixteen countries signed Country Programme Frameworks (CPFs) in 2023, with the total number of valid CPFs by the end of the year reaching 110. All newly signed CPFs contain a concise and focused medium-term programme plan and are linked with relevant objectives of national and/or sectoral development plans and strategies, and the Sustainable Development Goals (SDGs). The CPF preparation process applies a results-based approach to programme planning, implementation, monitoring, reporting, and self-evaluation, guided by the TC central criterion and the consideration of gender perspectives.

The total number of Revised Supplementary Agreements Concerning the Provision of Technical Assistance by the International Atomic Energy Agency (RSAs) is now 144.

16 CPFs were signed in 2023		
Algeria	Greece	Paraguay
Bahrain	Kazakhstan	Thailand
Benin	Kenya	Türkiye
Burkina Faso	Lesotho	Tanzania United Republic of
Cameroon	Malta	
Congo Democratic Republic of	Nigeria	

A.4.2. Maximising programme impact through strategic partnerships

Partnering with traditional and non-traditional donors and partners, including with the private sector, brings resources as well as new approaches. Practical Arrangements signed with the Ministry of Public Health of Qatar in 2023 aim to promote the safe use of nuclear technology for diagnosing and treating cancer and other non-communicable diseases, as well as addressing food safety risks related to trade. The Arrangements aim to contribute to the enhancement of the quality of healthcare in other countries, in particular Least Developed Countries (LDCs), and are an important step forward in supporting the outcomes of the discussions of the LDC5 Conference in Doha.

Practical Arrangements were established for South-South and triangular cooperation between the Agency, the Ministry of Health of Mongolia and the Korea Institute of Radiological and Medical Science to strengthen the national capacity of Mongolia in nuclear medicine and radiation oncology. The cooperation targets the First and Second State Hospitals and Mongolia's National Cancer Centre. The Agency's collaboration with the Ministry of Science and ICT of the Republic of Korea was solidified through a Memorandum of Understanding to enhance technical cooperation for the Sustainable Development Goals, including through the IAEA flagship initiatives. Existing Practical Arrangements were amended with the Ministry of Science and Technology of Viet Nam, the Ministry of Mines and Energy of the Kingdom of Cambodia, and the RCA regional office.

Furthermore, the Agency expanded its collaboration in education and training by signing Practical Arrangements with the University of West Indies, the 11-member Consortium of Universities and Institutions in Japan, and the Chinese National Nuclear Corporation. These collaborations not only encompass nuclear medicine and medical radiation physics under Rays of Hope, but also marine monitoring, nutrition, radiation protection and safety of radiation sources.

The IAEA, the Korea Institute of Radiological and Medical Sciences, and the Ministry of Health of Mongolia signed Practical Arrangements to strengthen triangular cooperation in cancer care and radiation medicine. (Photo: O. Yusuf/IAEA)

On 28 August 2023, Practical Arrangements between the Japanese Society for Non-Destructive Inspection and the IAEA were signed, paving the way for the provision of technical support to Member States in the event of emergencies (Photo: R. Yan /IAEA)

Practical Arrangements were signed with the Japanese Society for Non-destructive Inspection for cooperation in non-destructive testing, paving the way to provide technical support to Member States in the event of emergencies, and also to conduct training and capacity building activities.

The Agency signed Practical Arrangements with the China Atomic Energy Authority for collaboration in the development of nuclear power infrastructure and the deployment of Small Modular Reactors. It also signed Practical Arrangements with the Chinese National Nuclear Agency to support the establishment of Rays of Hope Anchor Centres.

In 2022, partnership agreements were signed with six universities from Africa, Asia and the Pacific and Latin America and the Caribbean to increase education and professional development opportunities for students and aspiring professionals in the field of nuclear law. In 2023, the IAEA delivered introductory courses on nuclear law at three academic institutions, attended by over 200 participants, as part of the university partnership pilot initiative on nuclear law launched by the Director General in April 2022. The courses were held in Brazil in May/June at the Nuclear Engineering Institute of the National Nuclear Energy Commission; in Egypt in November at Alexandria University; and in Jamaica in January at the University of the West Indies. This followed the two courses in 2022 in in Argentina at the University of Buenos Aires and in the United Arab Emirates at Khalifa University of Science and Technology. Further, eleven professors and faculty staff were also trained at the NLI and the ISNL. In addition, a training course on nuclear law, held at IAEA Headquarters in November 2023, was attended by 12 professors and faculty from the six partner universities. The Agency is supporting each university to develop a postgraduate course on nuclear law covering the four traditional branches of nuclear law – safety, security, safeguards, and liability. These courses are expected to be launched in 2024.

Actions under ongoing partnerships

Practical Arrangements were signed with the OPEC Fund for International Development to raise awareness of the contributions of nuclear science and technology to climate adaptation and food security. Collaborative efforts between the Agency and the Fund are continuing, with intentions to broaden the spectrum of cooperation to encompass various sectors outlined within the IAEA flagship initiatives.

The Agency and the Asian Development Bank (ADB) have continued to nurture a robust partnership to address development challenges across Asia and the Pacific. This collaboration, underpinned by the Cooperation Framework Agreement (CFA) signed in September 2018, addresses a range of sectors, including agriculture, food safety, climate change, disaster risk management, environmental conservation, health, and water resources management. In mid-2023, a high-level delegation from ADB, visited IAEA headquarters and Seibersdorf laboratories. A joint webinar in March, on nuclear technology's potential in managing plastic pollution, raised awareness of the Agency's efforts to pilot nuclear technology for plastic recycling in Southeast Asia. A regional training workshop on Sustainable Energy Supply Assessment in March, using the IAEA's MESSAGE tool, enhanced the skills of participants from the region in sustainable energy planning.

Rafael Mariano Grossi, IAEA Director-General, together with OPEC Fund Director-General Abdulhamid Alkhalifa, signs the Practical Arrangement between the International Atomic Energy Agency and the OPEC Fund on Cooperation in the Area of Climate Adaptation at the 28th United Nations Climate Change Conference UNCCC held at the Expo City Dubai, United Arab Emirates. FAO Pavilion, 1 December 2023. (Photo: D. Calma/IAEA)

The Agency continued its partnership with the Islamic Development Bank (IsDB) in cancer projects under Rays of Hope, to leverage technical expertise and resources. It continued to support Member States in seeking financing from IsDB with the preparation of bankable documents, worked with Member States to implement IsDB financed activities through TC mechanisms, and coordinated with IsDB under the existing Memorandum of Understanding.

Following a partnership agreement between the Agency and GE Medical Systems SCS, 11 fellows were trained at the Department of Nuclear Medicine, University Hospital Zurich in 2023. The purpose of the training was to assess and reinforce the principles and application of PET/CT imaging in oncology.

Under the Practical Arrangement with ASEAN, the Agency participated in the 10th Annual Meeting of the ASEAN Network of Regulatory Body on Atomic Energy (ASEANTOM) in 2023 to provide an overview of progress in capacity building and activities to operationalize the regional emergency communication protocol adopted under project RAS9094, 'Enhancing Nuclear Emergency Preparedness and Response in the Member States of ASEAN (2022-2025)'.

A.4.3. Continual improvement in project design quality and monitoring

In 2023, the Agency conducted a full quality review of TC projects designed and proposed for TCP 2024-2025, to support the results-oriented approach and implementation strategies of all projects, applying the TC programme quality criteria of relevance, coherence, effectiveness, efficiency, sustainability, and ownership. The quality review emphasized the links between TC project design and Country Programme Frameworks, to align planning and design and reinforce monitoring of outcomes.

The submission rate of Project Progress Assessment Reports (PPARs) for the 2022 reporting period was 83%. The annual PPAR provides a unique opportunity to record project progress towards outputs and outcome, and to analyse the extent to which project teams interact efficiently and adapt to changes in a timely manner.

83%
submission rate for Project Progress Assessment Reports

The Agency continued to support impact assessment studies by Regional Cooperative Agreements in selected thematic areas.

Knowledge management and training in 2023 focused on improving implementation for results, sharing lessons learned and building technical or thematic awareness or expertise. Training on the Logical Framework Approach methodology in project designs was conducted, alongside training sessions to reinforce processes for staff induction, orientation, hand-over, and peer knowledge-sharing. A set of e-learning courses aimed at both internal and external audiences was launched to support management of the TC programme.

The Office of Internal Oversight Services (OIOS) carried out several evaluations and audits of the work of TC in 2023. One hundred and seventy-two OIOS recommendations have been addressed since 2019, including 21 recommendations which were closed or implemented in 2023. All recommendations owned by TC issued prior to 2023 have been closed.

A.4.4. Female participation in the TC programme

The Agency strongly encourages the expansion of female participation in the TC programme, and gender must be carefully considered during the development of technical cooperation project designs. Member States are encouraged to nominate female NLOs, meeting and training course participants, fellows and scientific visitors, and counterparts.

Eighteen women from 16 countries in Africa, Asia and the Pacific, Europe and Central Asia, and Latin America and the Caribbean graduated from the week-long Women for Nuclear Science Education and Communications (W4NSEC) training course held in February at a ceremony coordinated by ANSTO and the Agency at IAEA headquarters in Vienna. These 18 women have received support and guidance to develop programmes for their own countries that will help to support education and outreach around nuclear science and technology, as well as encouraging young people and women to embark on careers in STEM.

In 2023, the Agency supported the establishment of four national chapters for Women in Nuclear (WiN) in Africa (Ethiopia, Malawi, Togo and Zimbabwe), and sponsored the participation of 53 women and younger generation professionals at the WiN Global Conference. The Agency also organized the first annual meeting of WiN Africa which laid a solid foundation for advancing the objectives of the organization through commitment to fostering collaboration, communication, and knowledge-sharing. The first elections of the executive committee of the Latin American chapter of Women in Nuclear – WiN ARCAL – took place at the end of 2022. The regional chapter is a platform for the organization of joint events to promote women in nuclear, and for supporting the establishment of new national WiN chapters in Latin America and the Caribbean.

ARCAL launched a series of workshops for young professional women in 2019, with the aim of ensuring equal participation and engagement in the nuclear field by both men and women in Latin America and the Caribbean. The most recent workshop in this series took place in March in Argentina, attended by more than 20 participants from 15 countries in the region. The workshop comprised a combination of leadership sessions, technical lectures, group work and site visits to nuclear installations.

Young professional women at a workshop for New Leaders in Nuclear Fields in Latin America and the Caribbean, March 2023 (Photo: CNEA)

The cadre of international experts available to conduct imPACT Reviews, has been expanded through the engagement and training of 26 new experts from LMICs who can now participate in imPACT Reviews and support the development of National Cancer Control Plans. A strong emphasis was placed on increasing the participation of women experts.

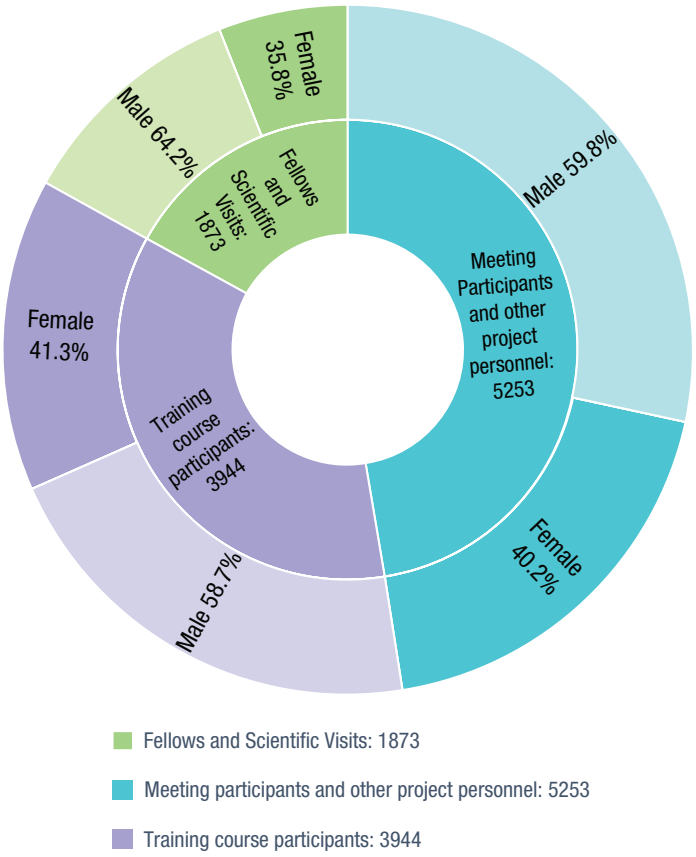


Figure 2: Male/female participation in the TC programme.

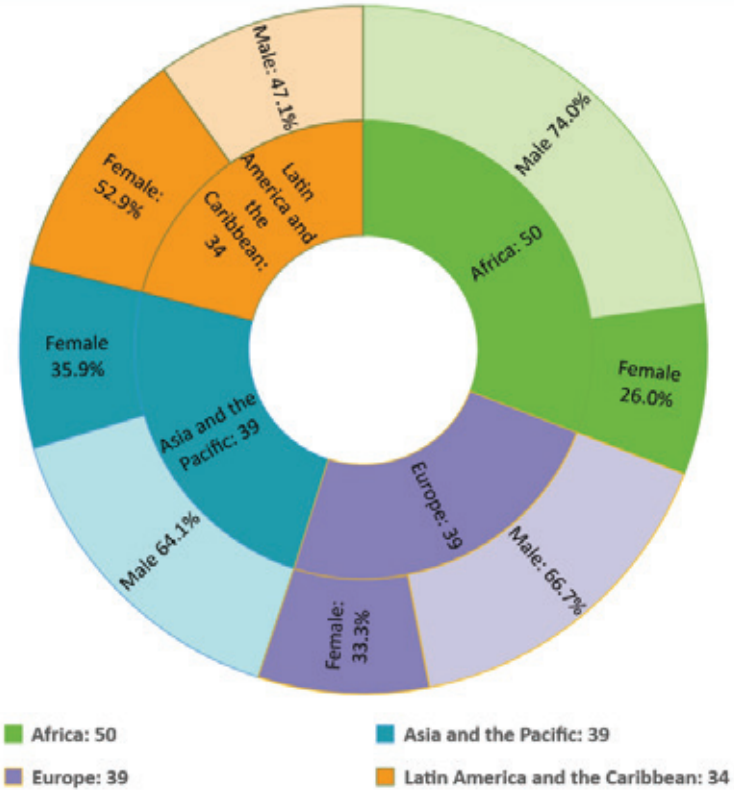


Figure 3: Percentage of male and female NLOs by region.

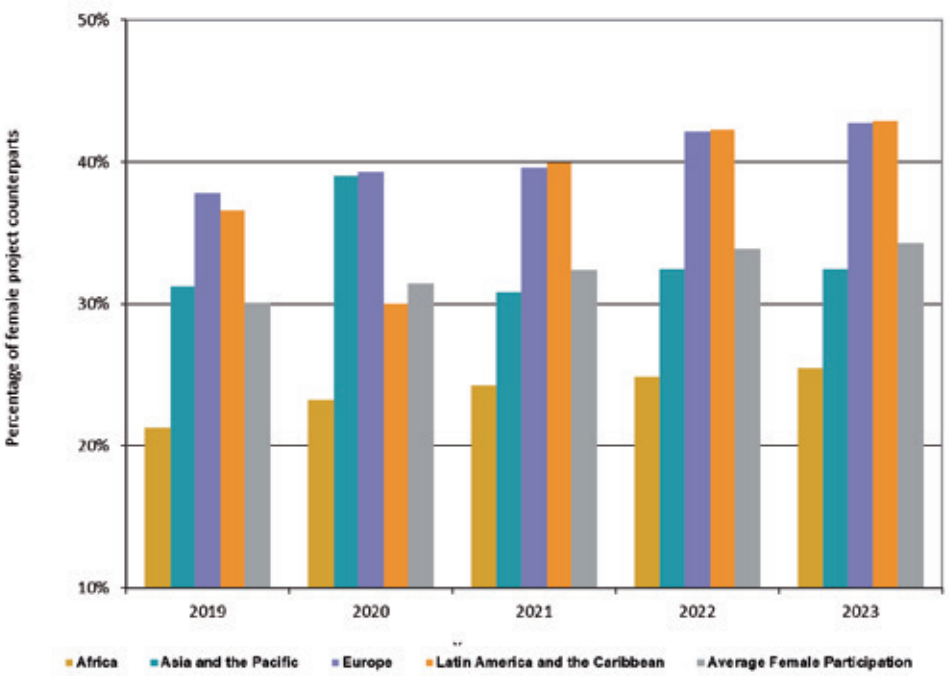


Figure 4: Female project counterparts by region, 2019–2023.

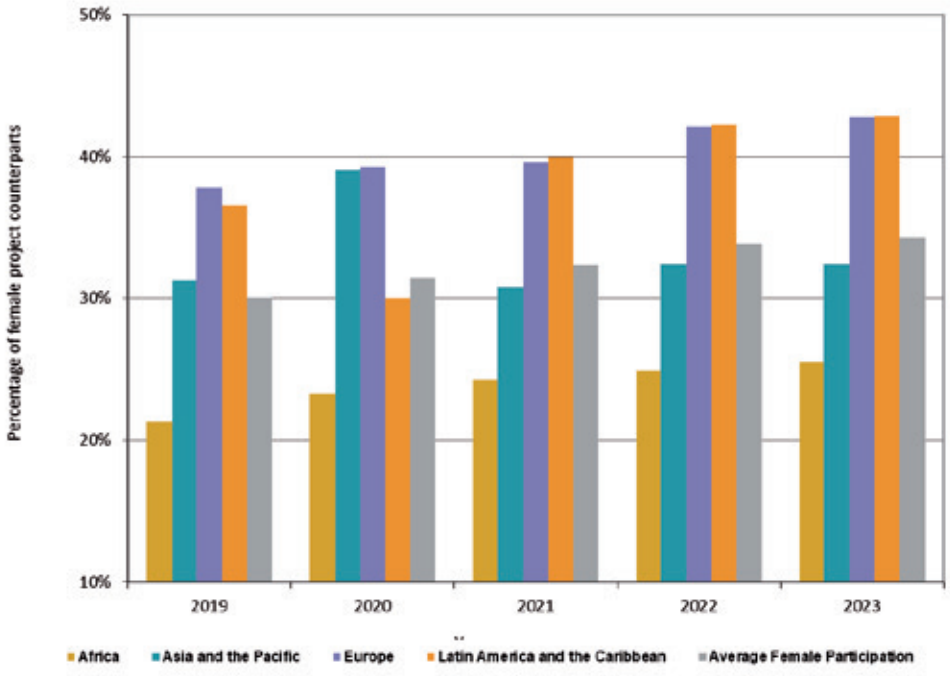


Figure 5: Female participation in training as fellows, scientific visitors, training course participants, meeting participants and other project personnel, 2019-2023.

B.

TC Programme Resources and Delivery

B. TC Programme Resources and Delivery[6]

B.1. FINANCIAL OVERVIEW

B.1.1. Resources for the technical cooperation programme[7]

At the end of 2023, €92.4 million of the €93.7 million target for the 2023 Technical Cooperation Fund (TCF) had been pledged and €91.3 million in payments had been received. Total TCF resources including National Participation Costs (NPCs), Assessed programme cost (APCs) arrears, and miscellaneous income amounted to €96.3 million (€91.3 million TCF, €0.4 million NPCs, and €4.6 million miscellaneous income). New extrabudgetary resources for 2023 came to €30.7 million and in-kind contributions amounted to €0.2 million.

The rate of attainment on pledges at 31 December 2023 was 98.6% and the rate of attainment on payments on the same date was 97.5% (Fig.6). 131 Member States, including 19 least developed countries, paid their TCF target in full or partially. Total payments received in 2023 include €1.9 million either of deferred or of additional payments by 12 Member States. Excluding these payments, the 2023 rate of attainment on payments would have been 95.5%.

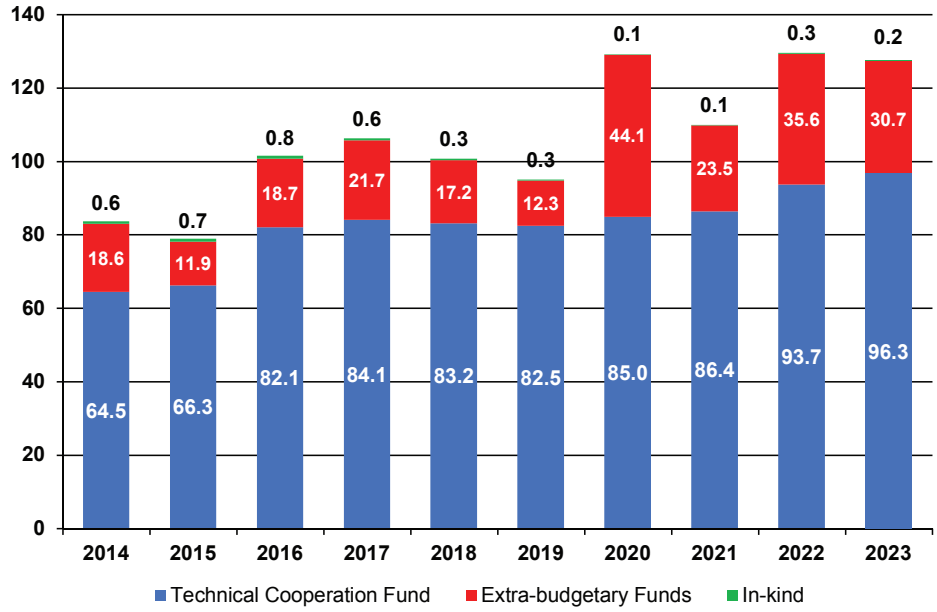


Figure 6: Trends in TC programme resources, 2014–2023.

[6] Section B responds to section A.4. Technical cooperation programme resources and delivery, of resolution GC(67)/RES/9, Strengthening of the Agency's Technical Cooperation Programme.

[7] Unless otherwise stated, all figures are denominated in Euros.

Table 1: TC programme resources in 2023	
2023 target for voluntary contributions to the TCF	93.7 million
Technical Cooperation Fund, NPC, APC, miscellaneous income	96.3 million
Extrabudgetary resources[8]	30.7 million
In-kind contributions	0.2 million
Total new resources for the TC programme	127.3 million

Table 2: Payment of National Participation Costs (NPCs) and assessed programme cost (APC) arrears		
	Received in 2023	Outstanding payments at end 2023
NPCs	0.1 million	0.5 million
APCs	0.0 million	0.7 million

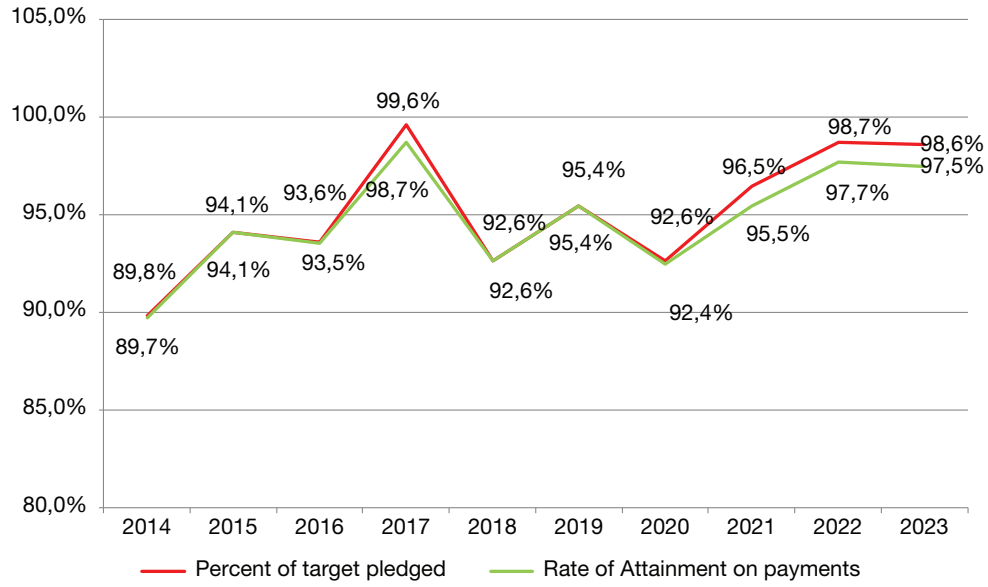


Figure 7: Trends in the Rate of Attainment, 2014-2023.

B.1.2. Extrabudgetary and in-kind contributions

Extrabudgetary contributions from all sources in 2023 (donor countries, international and other organizations, government cost sharing) accounted for €30.7 million. The breakdown of the €30.7 million is as follows: €2.8 million funding for activities where the donor is the recipient (commonly referred to as government cost sharing); €27.1 million from donors, of which €10.1 million was received through the Peaceful Uses Initiative mechanism; and €0.8 million from international and bilateral organizations. 19 African Member States provided extrabudgetary contributions amounting to €0.3 million for regional technical cooperation projects through the AFRA Fund. More detail is contained in Table 3 (extrabudgetary contributions by donor), Table 4 (government cost sharing) and Table 5 (contributions to PACT). In-kind contributions accounted for €0.2 million.

[8] Please refer to Table A.5 of the Supplement to this report for details.

Table 3: Extrabudgetary contributions (where the donor is not the recipient) allotted to TC projects in 2023, by donor

Australia	155 601	Netherlands	130 000
Belgium	250 000	Pakistan	37 000
Chad	59 980	Philippines	4 560
Chile	9 270	Russian Federation	602 000
Czech Republic	104 629	Saudi Arabia	938 000
Finland	100 000	Spain	240 000
France	870 000	Switzerland	20 000
Germany	100 000	United States of America	19 290 840
Israel	41 318	AFRA Fund	253 389
Japan	3 324 900	ARASIA Fund	15 000
Korea, Republic of	711 491	European Commission	499 200
Malta	20 000		
Monaco	50 000	**Total**	**27 827 177**

Table 4: Funding where the donor is the recipient (Government cost sharing) allotted to TC projects in 2023

Chile	260 000	Pakistan	237 138
Costa Rica	350 000	Poland	50 000
Cyprus	2 500	Serbia	35 000
Egypt	576 349	Sudan	48 239
Georgia	40 000	Türkiye	198 410
Ghana	80 000	Uruguay	7 852
Israel	48 150		
Jordan	916 606	**Total**	**2 850 244**

Table 5[9]: Extrabudgetary contributions resulting from PACT resource mobilisation efforts, 2023

Member State	**Amount**
Finland	100 000
France	720 000
Germany	100 000
Israel	41 318
Japan	2 868 000
Korea, Republic of	93 800
Monaco	50 000
United States of America	9 025 600
Total	**12 998 718**

[9] Funds presented under Table 5 are already reported in Table 3 above under the respective donors. Some contributions are made directly to PACT activities, and some in support of TC programme activities.

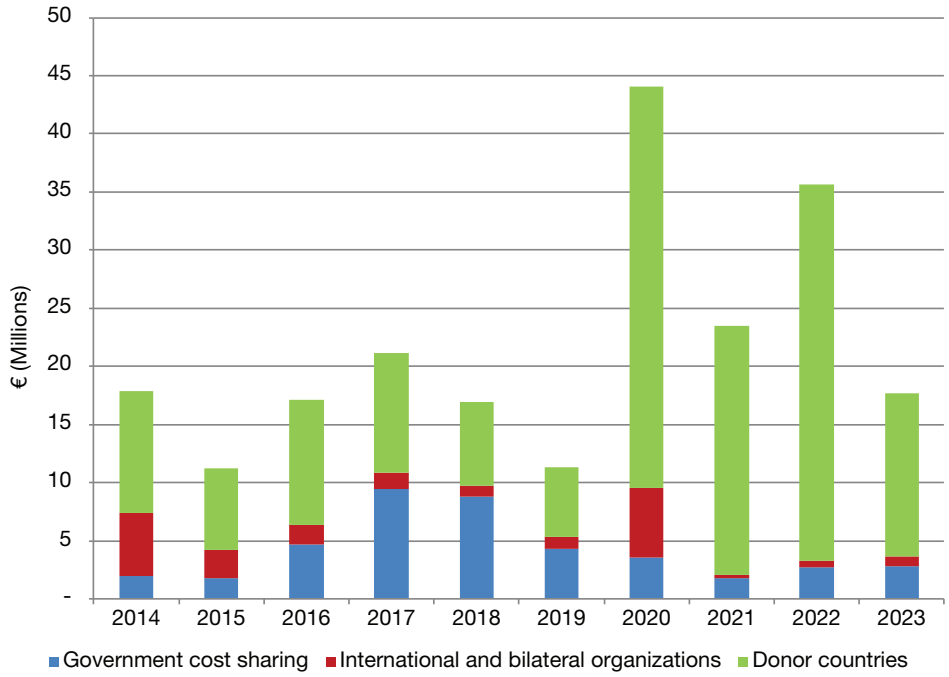


Figure 8: Trends in extrabudgetary contributions by donor type, excluding contributions to PACT, 2014–2023.

As part of its TC programme, the Agency provides support to Member States upon request for the development of Member State owned strategic funding documents (also known as bankable documents) that are intended to enable the mobilization of resources from international financial institutions (IFIs), development agencies and other partners. The Agency ensures that bankable documents are technically sound, financially viable and facilitate the flow of financial resources to Member States. Funds leveraged by Member States from IFIs and other sources with IAEA support are referred to as 'parallel financing' or indirect resource mobilisation.

The Agency, through Rays of Hope, provided countries with assistance to develop bankable documents that will support the mobilization of national resources or from international financial institutions and other donors. In 2023, the Agency provided expert advisory support to Burundi, the Democratic Republic of Congo, Kenya, Liberia, Senegal, Sudan, Togo, Uganda and Zambia for the preparation of bankable documents for the establishment or expansion of radiotherapy services.

Local costs for hosting TC activities are covered by the host countries. Examples in 2023 include local cost coverage by, inter alia, Canada, the People's Republic of China, France, Finland, Republic of Korea, Japan, Kenya, the Russian Federation, and the United States of America. Similarly, under the new Practical Arrangement signed with the China Atomic Energy Authority (CAEA) in May 2023, CAEA and China National Nuclear Corporation covered the local costs for workshops and training courses held in Sanya and Chengdu, China, in September. Such costs have not traditionally been tracked by the IAEA, but are essential to the successful implementation of the TC programme and require extensive behind-the-scenes efforts to mobilize.

The Agency has been made aware that the bankable document for Zambia resulted in the government's commitment to allocate funding[10] to the first phase of an effort to strengthen radiotherapy and nuclear medicine services in the country. This includes decommissioning of the current radiotherapy and imaging equipment as well as redesign and rehabilitation of the radiotherapy bunkers.

[10] The IAEA has been informed in December 2023 that the government of Zambia decided to allocate over USD 17,000,000 to the first phase.

B.2. DELIVERING THE TECHNICAL COOPERATION PROGRAMME

B.2.1. Financial implementation

TC programme delivery is expressed in both financial and non-financial terms. Financial delivery is articulated in terms of actuals and encumbrances. Non-financial delivery (i.e. outputs) can be expressed numerically in terms of, for example, experts deployed, training activities, and purchase orders obligated.

Financial implementation for the TCF, measured against the budget for 2023 at 31 December 2023, reached 85.5% (Table 6).

Table 6: TCF financial indicators for 2021, 2022 and 2023

Indicator	2021	2022	2023
Budget allotment at year end[12]	122 435 851	123 565 216	132 441 535
Encumbrances + actuals	102 940 738	104 347 914	113 296 804
Implementation rate	84.1%	84.4%	85.5%

B.2.2. Unallocated balance

At the end of 2023, the unallocated balance[13] amounted to €4.3 million. €17.8 million were received as advance payments for the 2024 TCF in 2023. Some €0.1 million of cash is held in non-convertible currencies which cannot be used in the implementation of the TC programme.

Table 7: Comparison of the unallocated balance of the TCF

Description	2022	2023
Unallocated balance	€3 193 034	€4 261 209
Advance payment in 2020 and 2021 for TCF for following year	€6 373 727	€17 818 700
Non-convertible currencies that cannot be utilized	€16 606	€21 194
Currencies that are difficult to convert and can only be used slowly	€288 926	€75 541
Adjusted unallocated balance	€9 872 293	€22 176 645

B.2.3. Human resources and procurement

Human resource and procurement indicators show the non-financial delivery of the TC programme. Regarding procurement, a total of 1782 purchase orders were issued in 2023.

Table 8: Delivery of outputs: non-financial indicators for 2023

Expert and lecturer assignments	2699
Meeting participants and other project personnel	5253
Fellowships and scientific visitors in the field	1873
Training course participants	3944
Regional and interregional training courses	196

Note: These figures include 773 virtual activities supported by the Agency in 2023

[11] Actuals are the equivalent of disbursements in line with the terminology in use since the implementation of the Agency-wide Information System for Programme Support (AIPS/Oracle).

[12] 2023 budget allotment at year end includes carry-over from previous years of €9.1 million, already allotted to projects.

[13] Total funds not allocated in 2023 were allocated to TC projects in 2024

Table 9: TC procurement in 2023

Division	Requisitions	Purchase orders issued	Value of purchase orders issued
TCAF	437	639	24 666 866
TCAP	291	452	13 375 261
TCEU	227	289	11 514 141
TCLAC	309	400	15 499 849
PACT	2	2	3 333
Total	**1 266**	**1 782**	**65 059 451**

At the end of 2023, 1104 projects were active, and an additional 600 projects were in the process of being closed. During 2023, 150 projects were closed.

B.2.4. Programme Reserve projects

TC project INS6001, 'Preparatory Support for the Expansion of Radiation Medicine Facilities in Indonesia' was funded from the Programme Reserve in 2023. The amount of €43 044 was spent for the activities of the project.

C.

Programme Activities and Achievements in 2023

Africa 2023

C. Programme Activities and Achievements in 2023[14]

C.1. AFRICA

46 countries receiving TC support

Project status end of 2023

77 closed
303 in closure
0 cancelled

1109 Participants in training courses

1323 Meeting participants and other project personnel

40 Regional training courses

796 Fellows and scientific visitors

590 Expert and lecturer assignments

€35 781 507
Budget allotment at year end

€32 217 904
Encumbrances and actuals

90.0%
TCF implementation rate

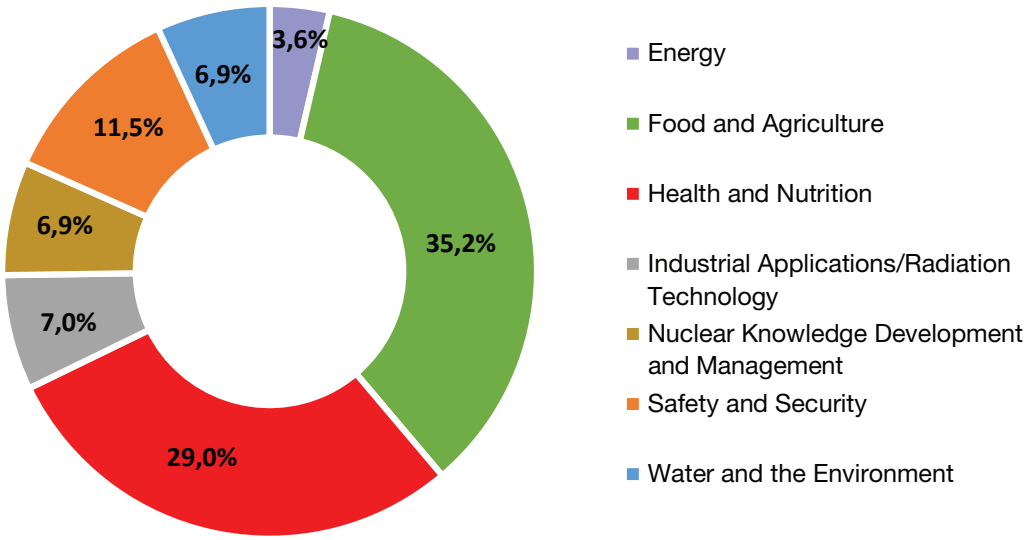


Figure 9: Actuals in the Africa region in 2029 by technical field.

[14] Section C responds to section A.1. General, section A.2. Strengthening technical cooperation activities, and Section B. Programme of Action for Cancer Therapy, of resolution GC(67)RES/9, Strengthening of the Agency's Technical Cooperation Programme

C.1.1. Regional highlights in Africa

In 2023, 46 Member States in the Africa region, of which 27 were least developed countries, participated in the TC programme. By the end of the year, there were 210 national and 40 regional projects active. The programme achieved an implementation rate of 90.05% in the region.

CPFs signed in Africa in 2023

Algeria, Benin, Burkina Faso, Cameroon, Democratic Republic of Congo, Kenya, Lesotho, Nigeria, and United Republic of Tanzania

Nine Member States signed CPFs in 2023. Gambia has acceded to the revised AFRA Agreement. Libya promulgated its nuclear law in August 2023.

The 2024–2025 TC programme in Africa consists of 119 new projects, of which 113 are national and six are regional (AFRA) projects.

The annual regional meeting for National Liaison Officers (NLOs) and AFRA National Coordinators (AFRA NCs) was held in Addis Ababa, Ethiopia, in March 2023.

C.1.2. Project highlights

In March 2023, the Agency delivered a complete brachytherapy system to Madagascar's public radiotherapy facility at the University Hospital Joseph Ravoahangy Andrianavalona. The system was successfully installed and commissioned, and the radiotherapy facility is now fully operational. As a result, the range of treatment options for cancer patients has increased.

IAEA Director General Rafael Mariano Grossi attended a ceremony to lay the foundation stone of the first public radiotherapy centre in the Democratic Republic of the Congo in November. (Photo: IAEA)

Botswana opened its first public radiotherapy centre in July – an important milestone in providing accessible health services for cancer patients. Agency assistance, delivered through BOT6008, 'Increasing Access of Cancer Patients to Quality Treatment', and earlier projects, focused on capacity building through long-term training for professionals, including radiation oncologists, medical physicists, oncology nurses and radiotherapy technologists. In addition, Agency expertise was provided to ensure that the facility bunkers were designed according to the international safety standards.

Under the regional project RAF6058, 'Strengthening the Capacities for Radiopharmacy, Medical Physics and Radiology for Expansion and Sustainability of Medical Imaging Services — Phase II (AFRA)', full clinical training for 6 months has been provided for 15 radiology medical physicists and six nuclear medicine medical physicists from Algeria, Ethiopia, Kenya, Mauritania, Morocco, Niger, Senegal, Sudan and Tunisia. In addition, regional training courses on new topics including internal dosimetry, breast cancer imaging and cardiac imaging have been organized.

An IAEA-supported Master's Programme in Nutrition and Nuclear Techniques was launched at the conference of the Federation of African Nutrition Societies (FANUS) in November, in Dakar, Senegal, supported by the regional project RAF6059, 'Building Capacity to Use Stable Isotope Techniques to Improve Micronutrient Status Among Children (AFRA)'. The programme aims to teach students how to build skillsets on stable isotope and nuclear techniques related to nutrition and how to develop efficient nutrition strategies. Four universities have been designated as official teaching centres: University of Ghana (Ghana), International University of Rabat (Morocco), Cheikh Anta Diop University (Senegal) and North-West University (South Africa).

Participants supported by the IAEA at the 2023 FANUS conference in Dakar, Senegal. (Photo: A. Grigoryan/IAEA)

C.1.3. Regional cooperation

The programme of the African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) continued to contribute to the training of a new generation of African scientists who are applying nuclear science and technology for Africa's development.

The 34th AFRA TWGM was held in Algiers, Algeria, in June 2023. (Photo: M. Edwerd/IAEA)

In 2023, 39 active regional projects were implemented within the framework of AFRA. Under the IAEA regional TC programme for Africa, 40 regional training courses were supported, attended by more than 1100 professionals or scientists.

Six new AFRA projects have been approved for the 2024–2025 TC programme cycle, in the areas of radiation medicine, food and agriculture, food safety, radiation safety, AFRA management, and triangular cooperation with an integrated approach.

The 34th AFRA Technical Working Group Meeting (TWGM) was held in Algiers, Algeria, in June. Participants reviewed the implementation of the AFRA programme in 2022.

The 34th Meeting of AFRA Representatives was held in September in Vienna, Austria, during the 67th IAEA General Conference. At this meeting, Ministers and Ambassadors from AFRA Parties endorsed the AFRA Annual Report for 2022 and agreed that Ethiopia will host the 35th AFRA TWGM in 2024. They also recognized the Kenya Nuclear Regulatory Authority as a Regional Designated Centre for education and training in radiation protection.

IAEA Director General Rafael Mariano Grossi at the 34th Meeting of AFRA Representatives, at the 67th IAEA General Conference in Vienna, Austria. (Photo: D. Calma/IAEA)

As a follow-up to their first annual meetings held in April in Vienna, Austria, the AFRA Management Committees met in Aswan, Egypt, in November. Here, they revised the AFRA Strategic Action Plan, Procedures and Operational Guidelines based on the Plan of Action, and the Political Declaration, subsequently adopted by the AFRA High-Level policy Meeting in December 2022 in Cairo, Egypt. These plans, guidelines and declaration establish AFRA's new strategic directions and address new AFRA governance, the new AFRA committees and their composition, impact assessments of the programme, as well as measures to expand the funding base of the AFRA programme.

A Meeting of Vice Chancellors was held in August 2023 in Johannesburg, South Africa, where participants agreed on a comprehensive roadmap to establish and implement post-graduate academic programmes in nuclear science and technology in accredited universities in Africa. Vice Chancellors of 27 African universities agreed on measures to enhance collaboration between universities, including among others to establish postgraduate academic programmes in nuclear science and technology using available academic curricula. The participants also agreed to increase collaboration among universities to train a critical mass of young Africans in nuclear science and technology.

Participants at the meeting of Vice Chancellors and AFRA-NEST Coordinators in Johannesburg, August 2023, agreed on a roadmap for post-graduate academic programmes. (Photo: M. Edwerd/IAEA)

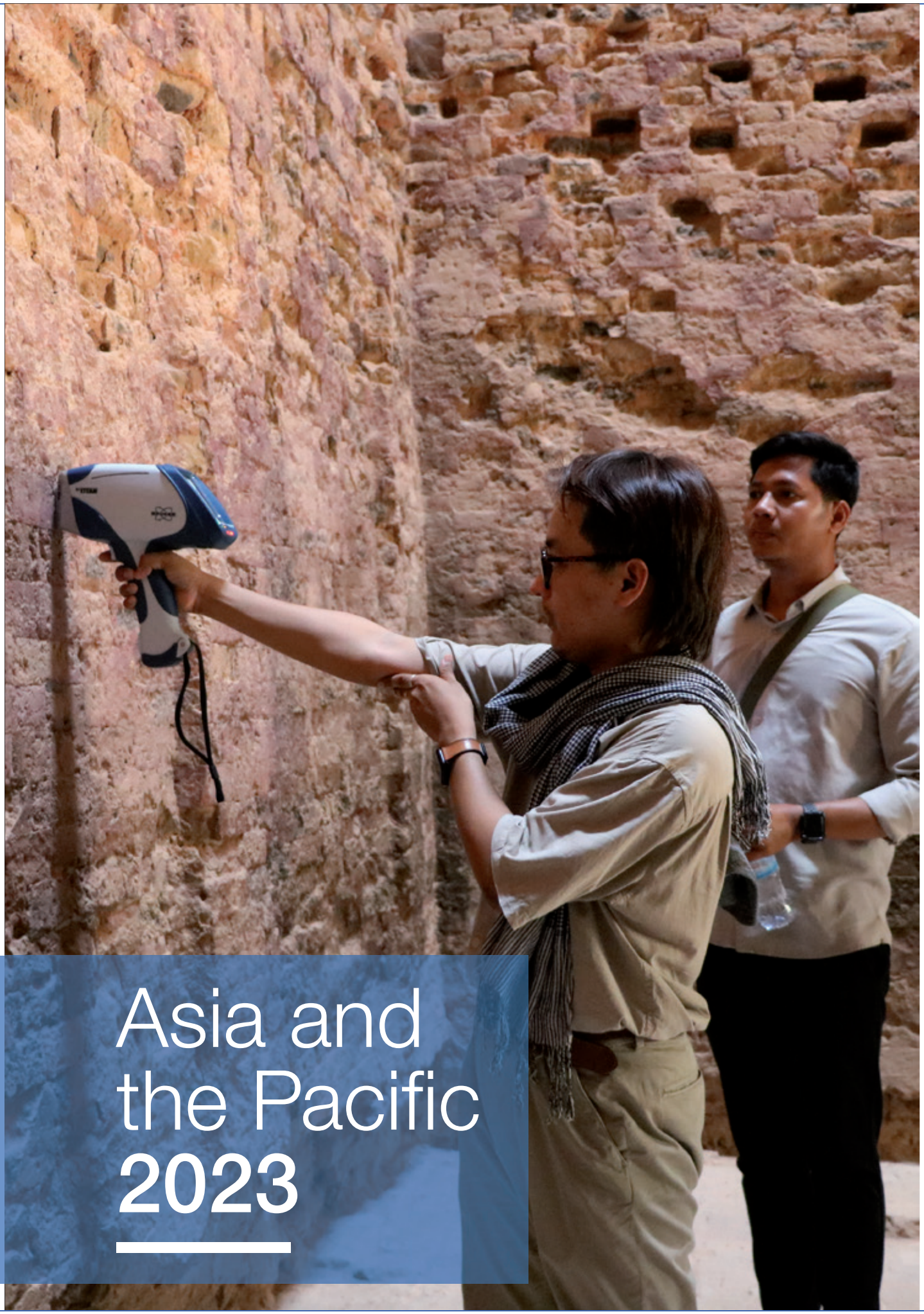
The fourth AFRA-NEST General Assembly took place in August, in Johannesburg, South Africa, supported by regional project RAF0059, 'Supporting the Establishment of the Nuclear Education Science and Technology Network (AFRA)'. At the Assembly, the 29 participants agreed on recommendations and action plans for 2024, including the development of national human resource development plans and resource mobilization strategies to support AFRA-NEST activities.

Contributions to the AFRA Fund

The total contribution of AFRA State Parties to the AFRA Fund in 2023 came to €253 388, demonstrating the Parties' continued commitment to AFRA activities and regional ownership of the programme. The AFRA Fund balance is € 2.1 million. The funding will be allotted to the relevant projects in 2024 to support the implementation of unfunded activities.

Table 10: Voluntary contributions to the AFRA Fund for TC activities, 2023

Country	Amount received	Country	Amount received
Algeria	94,727	Mauritius	3,134
Burkina Faso	4,294	Niger	12,041
Democratic Republic of the Congo	2,849	Uganda	2,318
Egypt	50,996	United Republic of Tanzania	11,727
Eritrea	712	Zambia	6,410
Ghana	13,323	Zimbabwe	3,561
Kenya	35,662	Comoros	712
Lesotho	1,305	Burundi	3,916
Malawi	1,749	Togo	712
Mali	3,240	**TOTAL**	**253,388**



Asia and the Pacific 2023

C.2. ASIA AND THE PACIFIC

40 countries and territories receiving TC support

Project status end of 2023
32 closed
130 in closure
0 cancelled

1022 Participants in training courses

1266 Meeting participants and other project personnel

49 Regional training courses

513 Fellows and scientific visitors

660 Expert and lecturer assignments

€31 048 135
Budget allotment at year end

€26 560 754
Encumbrances and actuals

85.5%
TCF implementation rate

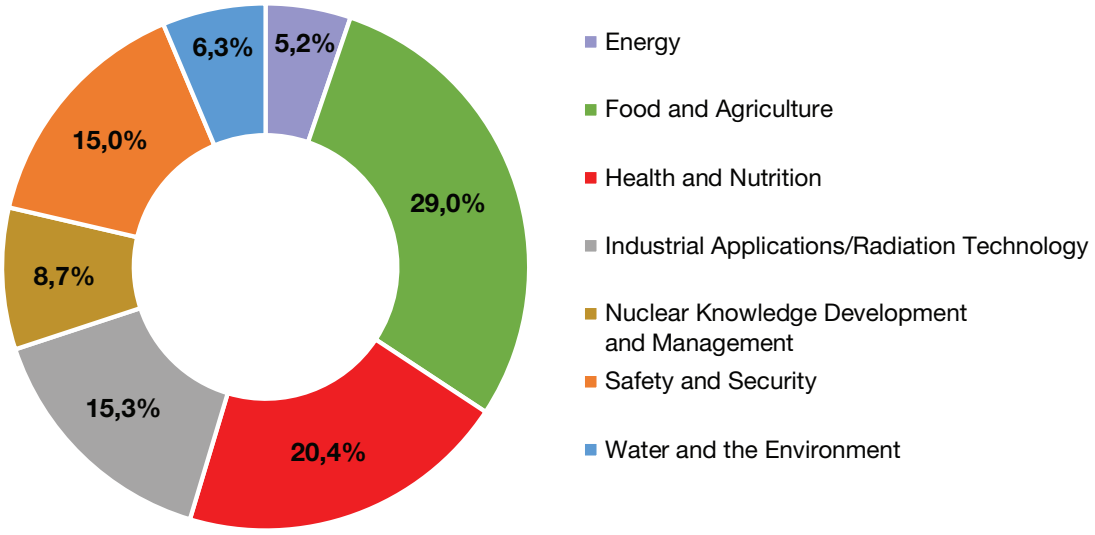


Figure 10: Actuals in the Asia and the Pacific region in 2023 by technical field.

C.2.1. Regional highlights in Asia and the Pacific

In 2023, 40 Member States and territories in the Asia and the Pacific region, including seven least developed countries, participated in the TC programme. By the end of the year, there were 317 national and 70 regional projects active. The programme achieved an implementation rate of 85.5% in the region. .

Two countries in the region signed Country Programme Frameworks in 2023.

CPFs signed in Asia and the Pacific in 2023

Thailand, Bahrain

The TC programme for the cycle 2024–2025 TC cycle was approved by the IAEA Board of Governors in November 2023. The programme in Asia and the Pacific consists of 156 new projects, of which 136 are national and 20 are regional projects.

The first national programmes for new Member States Samoa and Tonga were developed for the 2024–2025 TC cycle following fact-finding missions.

C.2.2. Project highlights

Mongolia's healthcare infrastructure was strengthened in 2023 with the support of MON6022, 'Improving Radiotherapy Capacity Through the Introduction of Linear Accelerator Based Advanced Technologies'. A draft action plan 'Advancing Cancer Management through Enhanced National Capabilities in Nuclear Medicine and Radiation Oncology in Mongolia' was formulated. A second SPECT-CT unit for the First State Central Hospital was procured in December 2023, which will enhance the country's diagnostic capabilities.

IAEA Director General Rafael Mariano Grossi visited the Nuclear Medicine Oncology and Radiotherapy Institute in Pakistan. (Photo: NORI)

A high-yielding mutant rice variety, Saphart 1, developed under LAO5006, 'Enhancing Crop Production with Climate Smart Agricultural Practices and Improved Crop Varieties', has been introduced in Nongdeng agricultural centre and has reached 34 villages in Salavanh province. One hundred and seventeen farmers are now cultivating the variety on 50 hectares. Five thousand kilos of seeds have been disseminated outside the province as well, reaching 120 farmers farming 80 hectares in eight provinces. On-farm demonstrations of best management practice for rice, maize and cassava have been conducted. Rice yield using the best farming practices was higher than standard practice by between 24% and 32%, paving the way for increased yields and improved food security.

The Asia Food Safety Network was further strengthened in 2023 through RAS5096, 'Strengthening Multi-Stakeholder Food Safety Monitoring Programmes for Chemical Contaminants and Residues in Plant and Animal Products Using Nuclear/Isotopic Techniques'. Regional training courses and TC sponsored participation in relevant events enhanced the capacities of over 200 professionals in the areas of food safety laboratory quality management, food safety testing, and risk-based drug residue in food monitoring. A Regional Meeting on Food Safety was held in Faisalabad, Pakistan, in October, with participation from 19 countries in the region. Participants highlighted the importance of harmonized regulatory frameworks and standards, and of strengthening stakeholder coordination throughout the supply chain to enhance full chain monitoring and tracing.

Advances in the use of e-beam technology and the upgrade of the synchrotron for research and development have been made under THA1013, 'Upgrading the Synchrotron

Facility to Support Advanced Scientific and Technical Research and Development Activities', and THA1014, 'Strengthening the Capabilities of the Low Energy Electron Beam Facility for Enhanced Economic Competitiveness of Products and Industries'. The procurement of an electro-spinning machine and a rheometer have been central to these advances. Expert missions in 2023 enhanced national capacity in electron accelerator design and in the use of e-beam for food and packaging, and promoted broader and more mainstream use of nuclear technology in Thai industry. The establishment of a cyclotron facility for radioisotope production and industrial research made substantial progress under THA1015, 'Establishing a Cyclotron Facility for Radioisotope Production and Industrial Research'. This project addresses key areas in healthcare and industrial applications, and will bolster Thailand's cancer control programme and enhance economic competitiveness.

The Electron Beam Facility at Kasetsart University, Bangkok, Thailand, was established with the support of the IAEA. (Photo: Thailand Institute of Nuclear Technology (TINT))

Pakistan has made steady progress in developing its nuclear power programme, with a sixth nuclear power plant (Karachi-3) inaugurated in February 2023 and the start of construction for the seventh nuclear power plant (Chashma-5) in July 2023. The Agency is providing Pakistan with technical support under PAK2008, 'Strengthening National Capabilities to Support the Safe Operation, Environmental Assessment, Radioactive Waste Management and Decommissioning of Nuclear Power Plants – Phase II'. In 2023, 15 expert missions were conducted covering a variety of topics, and training more than 300 Pakistani professionals. Scientific visits on irradiation embrittlement assessment of reactor pressure vessel materials and the operation of a near surface disposal facility were also organized so that Pakistani professionals could learn from international good practices.

China continued to receive Agency support in 2023 to build its first underground research laboratory in the Gobi Desert, under CPR9054, 'Evaluating Underground Research Laboratory Site Characteristics at Depth for High-Level Radioactive Waste Disposal'. Project activities will help to determine the area's suitability for future geological disposal of the high-level radioactive waste (HLW), including spent nuclear fuel, that is generated in China's 51 operational nuclear power plants. Several activities related to China's Beishan underground research facility (URF) Construction and Rock Mass Characterization Project were supported, and as a result a number of issues were highlighted, including in time site characterization data collection and its incorporation into the Site Descriptive Model, safety case development, and underground construction.

Following the commissioning of the Philippines PRR-1 SATER research reactor in 2021 and 2022, supported under PHI0016, 'Building Capacity for the Safe Operation and Utilization of the Research Reactor's Subcritical Assembly for Training, Education and Research', PRR-1 SATER began operating in March 2023. In November 2023, an Integrated Safety Assessment for Research Reactors (INSARR) mission to the facility was conducted which concluded that the established practices in the use of the facility and experiments, as well as in radiation protection and waste management, are in line with the IAEA safety standards.

C.2.3. Regional cooperation

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

In 2023, the RCA Chairmanship of Australia, Viet Nam and China met to discuss the operationalization of the RCA Joint Ministerial Declaration, adopted at the RCA IAEA General Conference Meeting in 2022. The Declaration aims to enhance the effectiveness, efficiency and impact of the RCA programme. RCA State Parties have embarked on four social and economic impact assessments of RCA projects on air quality, food safety, nuclear medicine and isotope hydrology.

Hua Liu, Deputy Director General and Head of the Department of Technical Cooperation, delivering opening remarks at the 52nd RCA General Conference Meeting in September 2023 (Photo: D. Calma/IAEA)

The 45th RCA National Representatives Meeting was held in Sydney, Australia in May 2023. Representatives from 21 RCA State Parties discussed policy and management issues related to the RCA and its Programme. As a follow-up to this meeting, RCA committees met during the margins of the IAEA 67th GC, including the RCA Programme Advisory Committee and the RCA Regional Office Standing Advisory Committee. During the Programme Advisory Committee, members reviewed the pre-concepts for the 2026-2027 cycle, and discussed ways to improve and simplify project management procedures, and the work plan for 2024. The 37th Meeting of the RCA Regional Office Standing Advisory Committee (SAC) was held in September 2023 at IAEA headquarters. Delegates reviewed the progress, status, and future plans of RCARO activities, with the aim of better supporting the regional agreement. Finally, at the 52nd RCA General Conference Meeting delegates to the RCA Agreement for Asia and the Pacific met to review ongoing TC activities and to plan for the implementation of the 2024–2029 RCA Regional Programme Framework.

The final project review meeting for RCA project RAS5087, 'Promoting Food Irradiation by Electron Beam and X-Ray Technology to Enhance Food Safety, Security and Trade took place in November to examine the project results. It was concluded that, thanks to the project, commercial food irradiation applications are now firmly established in many countries in the region, and eight countries are now operating commercial food irradiation facilities using electron beams or X-ray sources. This is an increase from five in 2020.

The RCA project RAS6096, 'Empowering Regional Collaboration among Radiotherapy Professionals through Online Clinical Networks', was set up to establish a videoconference-based platform for virtual tumour boards. The platform was expected to enable the discussion of cancer cases to improve individual patient care in the region, and ultimately to strengthen cancer management programmes by facilitating common approaches to diagnosis, treatment, and radiotherapy planning. At the annual coordination meeting for 2023, project participants, including 113 clinicians, noted that because of the network, their process of clinical decision-making has been supported.

Cooperative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA)

Yemen has officially submitted its instrument of accession to ARASIA's open-ended agreement.

The 'ARASIA Fund' was established in 2023. The Fund will facilitate the receipt of voluntary financial contributions from ARASIA State Parties in support of regional ARASIA TC projects. The ARASIA fund received a contribution of 15k Euros from Jordan as of December 2023.

Two new ARASIA committees were set up in 2023: the ARASIA Committee on Outreach and Communication (ACOC) and the Committee for ARASIA Resource Mobilization (CARM). Terms of reference for both committees were finalized with Agency support and approved by the ARASIA Board of Representatives. The committees will facilitate ARASIA efforts to highlight TC programme achievements and will mobilize resources to support implementation of the ARASIA TC programme and in support of the Agreement's strategic and programmatic needs.

A joint meeting for the Asia and the Pacific region was held between both regional agreements, ARASIA and RCA, in Vienna in August. The meeting facilitated the sharing of good practices, as well as lessons learned from the planning, evaluation and monitoring of the medium term strategies of the respective agreements.

ARASIA participated in a side event with the Agency and the OPEC Fund for International Development during COP28. Participants at the event discussed the establishment of a seed gene bank in the ARASIA region, as well as the contribution and added value of nuclear techniques, such as plant mutation breeding, in climate-smart agriculture.

ARASIA National Representatives visit the Cyclotron and Regional Resource Center for nuclear medicine at the American University of Beirut Medical Center, Lebanon, May 2023 (Photo: L.Eid/IAEA)

Europe 2023

C.3. EUROPE

33 countries receiving TC support

Project status end of 2023

8 closed

48 in closure

1 cancelled

828 Participants in training courses

1640 Meeting participants and other project personnel

25 Regional training courses

326 Fellows and scientific visitors

46 Expert and lecturer assignments

€23 488 535
Budget allotment at year end

€19 286 112
Encumbrances and actuals

82.1%
TCF implementation rate

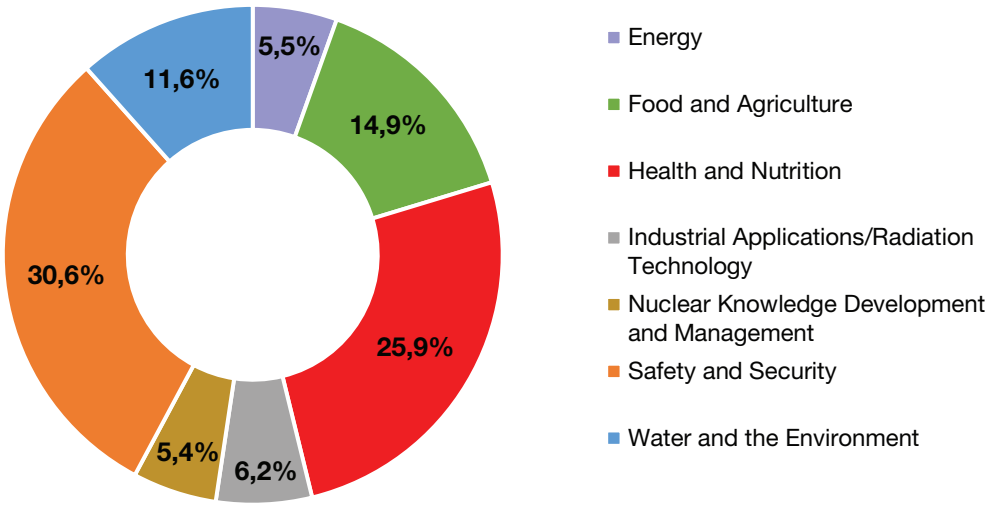


Figure 11: Actuals in the Europe region in 2023 by technical field.

C.3.1. Regional highlights in Europe

CPFs signed in Europe in 2023

Greece, Kazakhstan, Malta, Türkiye

In 2023, the TC programme supported 33 Member States in Europe and Central Asia. By the end of the year, there were 176 national and 36 regional projects active. The programme achieved an implementation rate of 82.1%.

Four CPFs were signed in 2023.

The 2024–2025 TC programme in Europe consists of 80 new projects, of which 69 are national and 11 are regional projects.

Rafael Mariano Grossi, IAEA Director General, and HE Mr Almasadam Satkaliyev, Minister for Energy of Kazakhstan, signed a CPF during his visit to Kazakhstan in April 2023. (Photo: D. Calma/IAEA)

C.3.2. Project highlights

In 2023, under the framework of the regional project RER5024, 'Enhancing Productivity and Resilience to Climate Change of Major Food Crops in Europe and Central Asia', the Agency supported Member States in the region with capacity building to enhance the production of major food crops with higher yields, improved quality, and better resilience to climate change. Project-sponsored training covered topics such as accelerated breeding techniques for the development of crop tolerance to abiotic stress, molecular markers and tilling applications for crop improvement, among others.

Ukraine is receiving assistance under Rays of Hope to address long-term challenges related to national capacity to meet demands for cancer diagnostic, management and treatment services, and to ensure their quality and safety via UKR6014, 'Strengthening Radiation Therapy and Medical Imaging in Ukraine'. While almost every region in Ukraine has local cancer centres, with specialized centres in large cities, the country faces urgent and increasing needs for diagnostic, management and treatment services. The Bukovinsky Medical Oncology Center has been identified as the first recipient of support. During 2023, the project baseline was established, a two-year workplan was developed and agreed upon, a risk analysis was drafted, and procurements for a linear accelerator, CT Simulator, and QA equipment were published for tendering. A six month fellowship to train a radiation oncologist, a radiotherapy technologist, and a medical physicist began in September.

Participants in a regional workshop on the application of a graded approach in regulating the safety of radiation sources, held at the Greek Atomic Energy Commission. (Photo: J. Bosnjak/IAEA)

Project RER9158, 'Strengthening the Regulatory Infrastructure for Radiation Safety', helps countries in Europe and Central Asia strengthen their national regulatory infrastructures for radiation safety in planned and existing exposure situations. In 2023, the Agency organized the School of Drafting Regulations for Radiation Safety in Vienna, Austria. With the support of international experts, 39 specialists from the regulatory bodies drafted and revised their countries' national regulations on nuclear safety. The participants gained sufficient knowledge and expertise to enable them to ensure regulations are properly framed in the future, always within their national legislative framework and in line with international safety standards and best practices. At a regional workshop organized by the Agency with the support of the State Office for Nuclear Safety, Prague, Czech Republic, 51 participants shared their experiences on the management of existing radiation exposure situations, and identified challenges and gaps in their countries and solutions to overcome them. Support under RER9158 was also provided to assist Albania in finalizing its policy and strategy for building a national framework for the safety and protection of radiation sources and associated facilities and activities in the country.

In 2023, Belarus put the second unit of its nuclear power plant into operation. This achievement completes 15 years of Agency assistance to initiate a nuclear power programme in Belarus. In 2023 the Agency provided the operating organization with capacity building to further develop its integrated management system, and assisted the regulatory body to enhance supervision of the nuclear power plant safety structures and components, safety culture and oversight procedures.

Collaboration with Turkmenistan was strengthened in 2023. High-level awareness raising meetings were organized in Ashgabat and Vienna, building understanding of the TC programme.

Climate smart agricultural practices have increased cotton yields on pilot plots in Azerbaijan. (Photo: S. Mammadov)

Yields of cotton in pilot plots in Azerbaijan have doubled with the application of climate smart agricultural practices (CSA), supported by project AZB5004, 'Strengthening Best Soil, Nutrient, and Water Agricultural Practices for Cotton Production'. The project's success has generated tremendous interest from the Ministry of Agriculture and the local cotton industry. In 2023, the reach of the project was extended to include more farmers in additional provinces in Azerbaijan. The country is now planning to extend CSA technologies to wheat and rice with the aim of achieving food security.

In 2023, Agency assistance was provided to procure seven treatment planning systems for the Physics Faculty of Bucharest University, enhancing the faculty's capacity to provide training in methods of cancer diagnosis and treatment to young professionals. The training follows the successful commissioning of linear accelerators under national project ROM6020, 'Establishing a National Training Facility to Improve the Safety and Quality of Radiotherapy Services', carried out in

coordination with a World Bank project to enhance Romanian national infrastructure for cancer diagnosis and treatment. As a result of the cooperation between Romania and the Agency, the national human health infrastructure has been significantly upgraded, and medical physicists have been trained.

Under regional project RER9155, 'Enhancing Regulatory and Metrological Infrastructures Needed to Ensure Radiation Safety in Naturally Occurring Radioactive Materials Industry', 28 radioanalytical laboratories throughout Europe and Central Asia participated in an intercomparison exercise to assess the effective use of gamma and alpha spectrometry, among other techniques, to analyse naturally-occurring radioactive material (NORM) samples for proper radiological characterization, in line with safety standards, GSR Part 3 and GSG-7.

A probabilistic safety assessment is a tool to analyse the safety of nuclear power plant systems and installation components. Two regional events were organized in 2023 under project RER9160, 'Strengthening Capabilities on Safety Assessment and Risk Informed Decision Making for Severe Accidents and Off Site Consequences', to help Member States in Europe and Central Asia better apply probabilistic safety assessments for NPP safety and to share their experiences.

C.3.3. Regional cooperation

The strategic document 'Regional Profile for Europe and Central Asia (2022–2027)' was endorsed by 33 Member States at the NLO meeting on the margins of the IAEA's 66th General Conference. The Profile focuses on key regional priorities and provides a blueprint for future activities. The new planning document has four priority thematic areas: nuclear and radiation safety, nuclear energy, human health, and isotope and radiation technologies. The Profile is a key thematic reference for Member States and the Secretariat to aid in the formulation of regional projects.

Latin America and the Caribbean **2023**

C.4. LATIN AMERICA AND THE CARIBBEAN

31 countries receiving TC support

Project status end of 2023

30 closed

111 in closure

1 cancelled

985 Participants in training courses

1016 Meeting participants and other project personnel

46 Regional training courses

238 Fellows and scientific visitors

563 Expert and lecturer assignments

€26 878 154
Budget allotment at year end

€23 701 525
Encumbrances and actuals

88.2%
TCF implementation rate

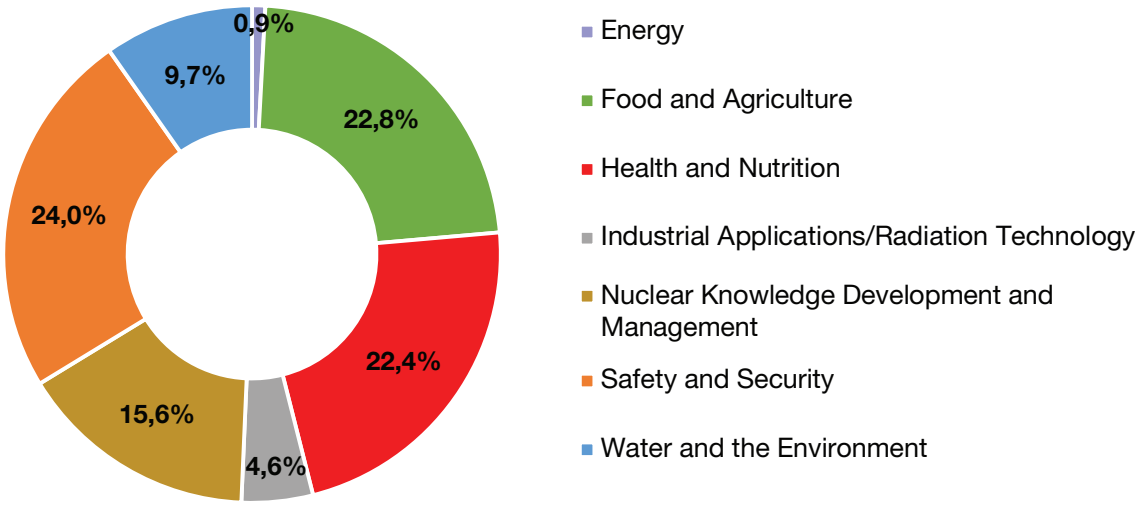


Figure 12: Actuals in the Latin America and the Caribbean region in 2023 by technical field.

C.4.1. Regional highlights in Latin America and the Caribbean

CPFs signed in Latin America and the Caribbean in 2023

Paraguay

In 2023, 31 Member States, including one least developed country (Haiti), were supported through the TC programme. By the end of the year, there were 186 national and 46 regional projects active. The programme achieved an implementation rate of 88.2% in the region.

One Member State, Paraguay, signed a CPF in 2023.

Juan Francisco Facetti, Resident Representative of the Permanent Mission of Paraguay in Vienna, and Hua Liu, IAEA Deputy Director General and Head of the Department of Technical Cooperation, signed the Paraguay Country Programme Framework (CPF) for the period of 2023–2028. (Photo: M. Evans/IAEA)

C.4.2 Project highlights

In Argentina, project ARG6021, 'Advancing Nuclear Medicine and Radiology Through Innovative Data Driven Methodologies', aims to increase the quantity and quality of clinical data and to provide more accurate reporting for better treatment decisions and for the benefit of patients. Throughout 2023, a number of scientific visits were carried out to gain knowledge about artificial intelligence-based systems in healthcare and how data driven strategies, such as machine and deep learning, may boost the diagnostic accuracy and the analysis of clinical information to improve decision-making.

Ecuador's National Health Research Institute Dr. Leopoldo Izquieta Pérez (INSPI-LIP) has made significant progress in in different components of the sterile insect technique (SIT) to control the mosquito *Aedes aegypti* with the support of project ECU5032, 'Building Capacity for Mass Rearing, Sterilization and Pilot Release of *Aedes Aegypti* and Philornis Downsi Males'. The sterile insect technique (SIT) initiative in Ecuador reached several milestones in 2023, including stakeholder engagement, field baseline data collection and the establishment of mosquito rearing capacity. The INSPI's rearing facility, which is now fully operational, includes mosquito rearing equipment and two insectaries, and is equipped for various stages of mosquito production. The INSPI achieved optimized weekly production of up to 100,000 sterile Aedes aegypti males for release in the Galapagos. The first test release of sterile Aedes aegypti in the town of Bellavista on Santa Cruz Island, Galapagos, was successfully carried out in March 2023.

In 2023, a mobile electron beam linear accelerator was installed in a customised trailer for the treatment of industrial wastewater for reuse purposes in the framework of the Brazilian project BRA0025, 'Developing Human Resources in Nuclear Technology', the first time this has been done in Latin America and the Caribbean. Brazil's Institute for Energy

and Nuclear Research (IPEN), with the support of the Agency, successfully completed installation of the accelerator, operation and maintenance training, and commissioning. The mobile unit is expected to be able to provide services next year to demonstrate the efficiency of this technology on-site to solve industrial effluent problems in Brazil. This initiative has been supported by the Agency since 2016 through a series of TC projects.

With Agency support, Venezuela made important progress on the management and storage of disused radioactive sources, such as those used in hospitals and industry, in line with international safety standards. As a result, over 200 disused radioactive sources (DSRS), including some orphan sources, were characterized, packaged and transported to the centralized storage facility at the Venezuelan Institute for Scientific Research (IVIC). With Agency support, Venezuela was also able to optimize the storage space at the IVIC, working towards the overall objective of consolidating the national inventory of DSRS in this facility and ensuring it is in line with international standards.

Educational materials in Spanish in a range of formats, including e-learning platforms, train the trainer courses and webinars, have been prepared through regional project RLA9091, 'Strengthening Regional Capabilities for End Users and Technical Support Organizations on Radiation Protection and Emergency Preparedness and Response in Line with IAEA Requirements', with the goal of expanding knowledge in the field of radiological protection in Latin America. This material includes webinars on radiation protection in medicine, emergency preparedness and response; a train the trainers course for medical physicists; and e-learning material and courses on Medical Response to Radiological Emergencies, Radiation Protection in Dental Radiology, and Reference Levels in Diagnostic Medical Imaging, as well as an online training course for occupationally exposed workers.

C.4.3. Regional cooperation

The Regional Cooperation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) continues to drive initiatives responding to regional priorities in line with AGENDA ARCAL 2030, the Regional Strategic Profile for 2022–2029. In 2023, Chile took the presidency of ARCAL, Costa Rica the vice-presidency, with Peru as secretary.

In May 2023, the 24th Meeting of ARCAL's Technical Coordination Board (OCTA) took place in Viña del Mar, Chile, attended by 16 national ARCAL representatives and Spain. Delegates were briefed on progress achieved over the previous year, as well as on special topics such as partnerships, communication and project evaluation.

IAEA Director General Rafael Mariano Grossi spoke at the meeting of the ARCAL Board of Representatives (ORA), held during the 67th IAEA General Conference, September 2023 (Photo: IAEA)

During the meeting of the ARCAL Board of Representatives (ORA), held during the 67th IAEA GC in September, participants reviewed progress and priorities and approved project designs proposed for the approval of the IAEA Board of Governors for the 2024–2025 TC cycle.

Following the inaugural Regional Steering Committee Meeting in 2022 for the Regional Strategic Framework (RSF) for Technical Cooperation with the IAEA–CARICOM Member States, actions in 2023 focused on capturing data and aligning relevant TC programme activities for IAEA-CARICOM Member States with the RSF targets set for 2023–2024.

C.5. INTERREGIONAL PROJECTS

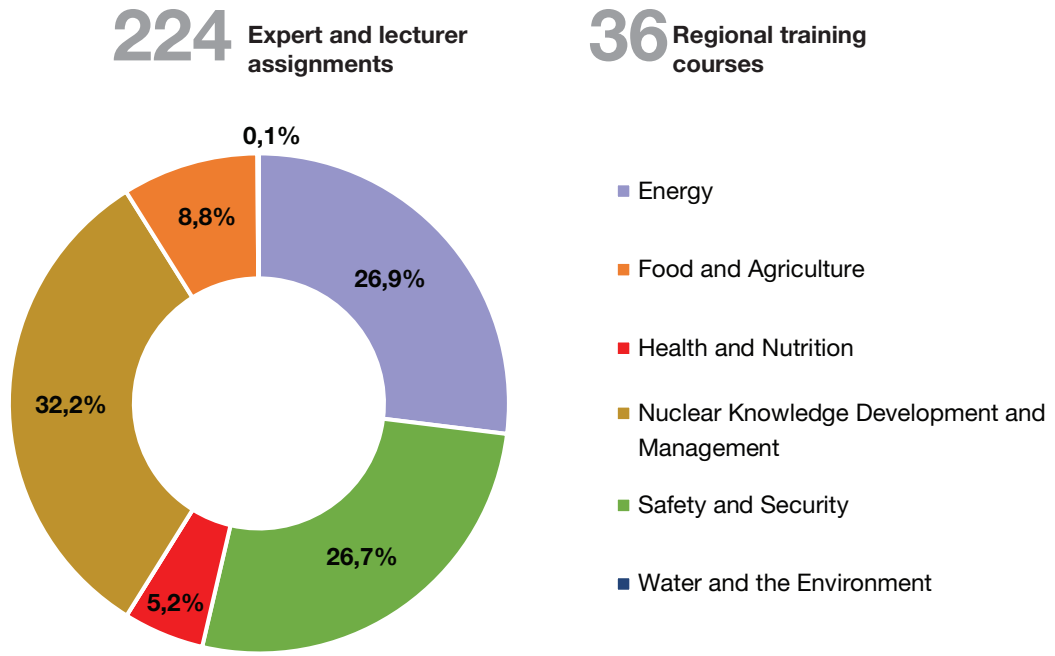


Figure 13: Interregional actuals in 2023 by technical field.

Interregional projects deliver technical cooperation support across national and regional boundaries and address the common needs of several Member States in different regions. By the end of the year, there were 23 interregional projects active.

The interregional TC project INT9185, 'Establishing an Arab Network for Environmental Radiation Monitoring and Early Warning', has fostered strong collaboration between the Agency, the League of Arab States, and the Arab Atomic Energy Agency, and as a result, the Arab Atomic Energy Agency has developed the 2024–2030 *Roadmap for Arab Cooperation in Radiological and Nuclear Preparedness and Response*. The roadmap aims to establish an Arab framework aligning with international standards and best practices that will contribute to infrastructure development and capacity development in Arab countries.

The results of project INT9186, 'Sustaining Cradle-to-Grave Control of Radioactive Sources - Phase II' were presented to project stakeholders in November 2023. Of the polled participating countries, 55% were able to draft and approve national strategies for nuclear safety and security of disused sealed radioactive sources (DSRSs). In addition, 76% reported that nuclear safety and security measures during transport of radioactive sources had been successfully implemented, and 74% had developed or approved safety cases for nuclear waste storage. The approval and implementation of long-term strategies for DSRSs disposal, however, still presented an obstacle—only 18% of the polled countries had an approved strategy. The drafting of such documents, as well as the development of safety cases and assessments, will be one of the outputs of the proposed Phase III project, initiated in January 2024.

Under INT0099, 'Maximizing the Socioeconomic Benefit of the SESAME Lightsource', a mapping of research interests in non-member countries was conducted to widen the scope and benefits of the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME). The Agency also continued to strengthen SESAME through the supply of electronics for BEATS and other beamlines in 2023.

The Agency is currently providing assistance to Member States embarking on new nuclear power programmes, and to ensure continuity of excellence in nuclear power plant performance. Support is being delivered through INT2021, 'Supporting Member

Participants an interregional meeting on Cooperation in Radiological and Nuclear Emergency Preparedness and Response in Aswan, Egypt, November 2023 (Credit: A. Ndiath/IAEA)

States Considering or Planning to Introduce or Expand Nuclear Power Programmes in Developing the Sustainable National Infrastructure Required for a Safe, Secure and Peaceful Nuclear Power Programme', and INT2023, 'Supporting Member States' Capacity Building on Small Modular Reactors and Micro-reactors and their Technology and Applications as a Contribution of Nuclear Power to the Mitigation of Climate Change'.

In 2023, 27 events were implemented under INT2021, with a total of 588 people receiving support through fellowships, meetings and training courses. Over 100 expert lecturers assisted recipient countries in understanding and applying the IAEA Milestones approach across 19 different nuclear infrastructure issues. Technical training courses in 2023 for countries launching nuclear power programmes addressed systematic training approaches, regulation drafting, infrastructure development, licensing, construction oversight, and reactor technology assessment. They also covered crucial elements like project financing, radiation and environmental protection, site selection, stakeholder engagement, operational preparedness, fuel cycle strategies, national requirements, industrial involvement, economic aspects, emergency preparedness, and safety leadership.

In 2023, twelve workshops and four training courses were successfully implemented under INT2023, engaging 675 participants and 45 international experts or lecturers. These activities enhanced effective technology development and capacity-building through technology transfer on the development of SMRs, and facilitated the formulation of national legal and regulatory frameworks. Agency support addressed vital relevant topics such as the IAEA Safety Standards, generic user requirements and criteria for SMR technologies, and emergency preparedness and response.

A Good Practice Document was developed by the Agency with the support of the World Metrological Organization under INT7020, 'Developing Capacity towards the Wider Use of Stable Isotopic Techniques for Source Attribution of Greenhouse Gases in the Atmosphere'. The document provides guidelines for measurements of isotopes in atmospheric methane (CH4) to characterise methane sources. In 2023, equipment for the first regional training and analysis centre in Argentina was procured, and training materials were developed. Two additional regional training and analysis centres in Asia and Africa have also been identified.

Countries engaged in decommissioning and environmental remediation projects received support in 2023 under INT2020, 'Enhancing Capacity Building to Promote Successful Decommissioning and Environmental Remediation', in the form of training courses and workshops that brought together over 100 people. The events focused on topics including

the design and implementation of decommissioning and environmental remediation, safety and impact assessments, and nuclear decommissioning.

Under INT5156, 'Building Capacity and Generating Evidence for Climate Change Impacts on Soil, Sediments and Water Resources in Mountainous Regions', cosmic ray neutron sensors (CRNS) were delivered in 2023 to measure soil moisture in glacial wetlands in Argentina, Bolivia, Chile and Nepal, and purchase orders were issued for portable sensors capable of measuring the water equivalent depth of snow for Argentina, Bolivia, Chile, China and Nepal.

Clinical audit missions were conducted in 2023 to Argentina, Chile, Colombia, Cyprus, Jordan and Mexico, for Quality Management Audits in Nuclear Medicine (QUANUM), Comprehensive Audits of Radiotherapy Practices (QUATRO), and Comprehensive Clinical Audits of Diagnostic Radiology Practices (QUAADRIL), supported by INT6063, 'Improving Quality of Radiotherapy, Nuclear Medicine and Radiology Services Through the Implementation of Quality Management Programs'. The goal was to help countries to check the status of their nuclear medicine, radiotherapy and radiology practices and to provide recommendations for improvements. Training support was also provided in Spanish for the QUATRO auditing methodology. An interregional training course on theranostics, delivered in partnership with the Argonne National Laboratory, provided training for 23 participants on consolidated approaches in diagnostic and therapeutic nuclear medicine to enhance quality.

The Agency organised a study tour in partnership with the University of Queensland under INT5158, 'Strengthening Member State Capacities to Combat Banana Fusarium Wilt (TR4) through Early Detection, New Resistant Varieties, and Integrated Management'. Participants learned about how Australia is addressing Fusarium Tropical Race 4. In addition, two regional training courses were delivered on nuclear-induced mutations and screening methods, and laboratory equipment was procured to increase the capabilities for TR4 early detection of eight national laboratories in Latin America and the Caribbean.

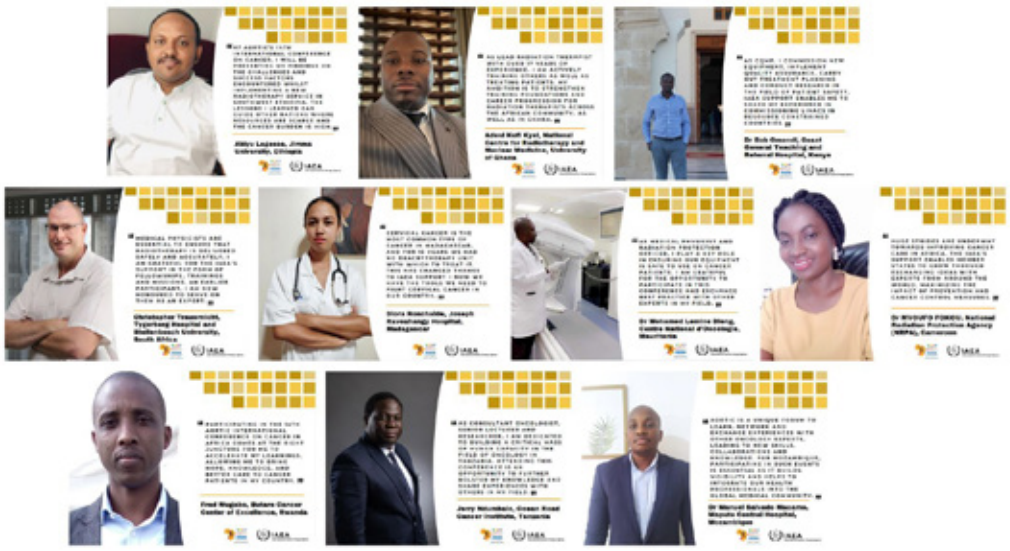
C.6. PROGRAMME OF ACTION FOR CANCER THERAPY (PACT)

C.6.1. PACT highlights in 2023, including Rays of Hope, advocacy and resource mobilisation

196 Expert and lecturer assignments

In 2023, the Agency, through PACT, continued to support the efforts of low- and middle-income countries to integrate radiation medicine into national comprehensive cancer control programmes. PACT activities focused on analysing cancer control capacities, providing expert advice for national cancer control planning, assisting with the development of strategic documents, and mobilizing resources for cancer-related projects.

The Agency hosted the fifth Annual Strategic Consultation on Cancer Control with the International Agency for Research on Cancer (IARC) and World Health Organization (WHO) in December. The Annual Strategic Consultations facilitate planning for effective collaboration between the three UN agencies in global cancer control. The discussions focused on progress in the development of tools for cancer prioritization and planning, ways to improve data collection and sharing among the three agencies, coordinated action at regional and country-level, and strengthening collaboration with centres of expertise to support to Member States to develop their cancer control capacity.



The Agency sponsored the participation of ten emerging cancer leaders at the AORTIC conference. (Photos kindly provided by the conference participants)

PACT also participated in several high-level events, including the 11th Annual Symposium on Global Cancer Research, the World Cancer Leaders Summit, the African Organisation for Research and Training in Cancer conference (AORTIC) and the London Global Cancer Week, where Agency experts emphasized the need to integrate radiation medicine into national cancer control planning. The Agency, through PACT, supported and facilitated the attendance of ten emerging cancer leaders from across Africa to AORTIC, all of whom presented posters or oral presentations on radiation medicine projects from their respective countries. The Agency continued to raise awareness of the role of radiation medicine in the global health community, including with Ministers of Health and other senior government officials, by participating in the World Health Organization (WHO) Regional Committee meetings..

C.6.2. imPACT Reviews

The IAEA applies a unique assessment tool – the integrated mission of PACT, otherwise referred to as an imPACT Review – which supports Member States in their efforts to improve comprehensive cancer control in their country. imPACT Reviews are coordinated by the IAEA and conducted jointly with the World Health Organization (WHO) and the International Agency for Research on Cancer (IARC). imPACT Reviews assess a country's cancer control capacities and needs and identify priority interventions to effectively respond to its cancer burden.

imPACT Reviews completed in 2023

Cambodia, Comoros, Djibouti, El Salvador, Ethiopia, Fiji, Guinea, Jordan, Papua New Guinea, Venezuela

imPACT Reviews are a foundation piece for Rays of Hope planning and assess coverage and financial access to cancer services; inclusion of radiation medicine for cancer care in essential benefits packages; and integration of cancer control within existing non-communicable diseases service delivery platforms. imPACT Review recommendations highlight areas where the Agency and its partners can offer programmatic interventions to enhance national cancer control systems, or can contribute, for example, to the establishment of safe and high-quality radiation medicine practices. Ten imPACT Reviews were conducted by the Agency, IARC and WHO in 2023, in Cambodia, Comoros, Djibouti, El Salvador, Ethiopia, Fiji, Guinea, Jordan, Papua New Guinea and Venezuela; follow-up meetings on imPACT Review recommendations were conducted in Iraq and Syria, and virtual follow-up meetings took place with Uruguay.

An imPACT follow up mission to Iraq was conducted in 2023. (Photo: A. Juric/IAEA)

Cambodia

Current situation

A decade after Cambodia's 2013 imPACT Review, the recent assessment highlighted remarkable progress. The country formulated cancer-related policies and expanded from one radiotherapy unit in 2013 to four in 2023. The imPACT Review recommendations will shape future strategies, including planning of the new national cancer centre at Luang Mè hospital. The team discussed with the national focal team high out-of-pocket payments, improving the referral system for patients to be treated at different levels of care, and raising awareness about health seeking behavior in communities.

The Agency, the International Agency for Research on Cancer (IARC) and the World Health Organization (WHO) collaborated on the imPACT Review to Cambodia. (Photo: I. Veljkovikj/IAEA)

Next steps

As an immediate next step, the Ministry of Health plans to use the imPACT Review report to inform the new National Cancer Control Plan.

Comoros

Experts from Burkina Faso, Cameroon, Côte d'Ivoire, Guinea, Senegal and Tunisia participated in the imPACT Review to Comoros. (Photo: L. Haskins/IAEA)

Current situation

Comoros received its first imPACT Review after joining the IAEA in 2021. The request was prompted by the Government's plans to open the first medical oncology unit in the country, possibly integrating radiotherapy services. The mission highlighted strengths in human resources already trained for cancer control. It also identified needs for support in cancer governance, particularly to establish a National Cancer Control Plan to guide development of the cancer registry, the strengthening of palliative care and an increase in coverage of screening for breast and cervical cancers. Recommendations from the mission will provide a solid foundation to inform future technical cooperation projects.

Next steps

The Government plans to use the recommendations to develop the first National Cancer Control Plan in the country.

Djibouti

Current situation

Djibouti requested to join the Rays of Hope Initiative and to receive a baseline assessment of cancer control in the country. These requests were made in the context of plans from the Ministry of Health to establish a national cancer centre, including the first radiotherapy facility in the country. The imPACT Review focused on governance, with the theme of integrating cancer control activities into the broader non-communicable disease agenda, and establishing national cancer and non-communicable disease plans. The mission emphasized the importance of integrating future plans for the radiotherapy facility into the broader governance agenda.

Next steps

In terms of immediate follow up, the report is a reference for the national authorities to inform a large project to establish the first national cancer centre, and in the development of the country's first National Cancer Control Plan.

El Salvador

Current situation

The imPACT Review to El Salvador noted that the country has made progress in implementing its National Cancer Control Plan. The Review commended achievements, such as a new national law for cancer prevention, and emphasized collection of data and streamlining of cancer care services as ongoing needs. The recommendations from the Review, which included visits to 18 hospitals, highlighted the importance of harmonizing diagnostic and therapeutic services and strengthening the national Health Information System. This mission built on progress since 2015, including the construction of a national radiotherapy centre.

Next steps

The Ministry of Health is using the recommendations from the imPACT Review to chart the course and direct the important investments that the Government is preparing to further strengthen the health system and specifically for cancer prevention and control.

Members of the imPACT team conducted site visits during the imPACT Review to El Salvador. (Photo: G. Saporiti/IAEA)

Federal Democratic Republic of Ethiopia

Current situation

The Federal Democratic Republic of Ethiopia joined the Rays of Hope Initiative and the WHO Global Initiative for Childhood Cancer (GICC) in 2023, increasing the country's opportunities to improve access to cancer care. The imPACT Review included visits to public and private health facilities in Addis Ababa, Jimma and Hawassa; education centres; the Ministry of Health; the Ethiopian Radiation Protection Authority; and civil society.

Senior leadership at the Ministry of Health for Ethiopia were briefed on the preliminary findings of the imPACT mission, as well as on potential UN follow-up support and expert recommendations (Photo: Ministry of Health, Ethiopia)

Next steps

The Review recommendations will inform the development of the new National Cancer Control Plan, including the expansion of radiation medicine services, the opening of the first comprehensive oncology center under a public-private partnership, the training of a radiation therapy workforce, and the integration of childhood cancer into the national cancer control strategy.

Fiji

Current situation

The imPACT Review to Fiji took stock of progress since the 2014 imPACT Review and assessed feasibility for establishing the country's first radiotherapy facility, within the framework of the IAEA's Rays of Hope initiative. The expert team focused on supporting the development of Fiji's National Cancer Control Plan, identifying needs to strengthen human resources in oncology, and analyzing the financing of cancer control. Women's cancers were an important focus of this imPACT Review. The team collaborated to develop a roadmap for the planned radiotherapy center, emphasizing the importance of radiotherapy in cancer management. The Review also addressed the legislation framework for radiation safety, with support in this area being provided through the IAEA technical cooperation programme.

Next steps

In terms of next steps, the Government plans to utilize the recommendations from the imPACT Review for planning of the first radiotherapy facility in the country.

The imPACT review team met the Acting Minister of Health for Fiji during the imPACT mission. (Photo: I. Veljkovikj/IAEA)

Republic of Guinea

Current situation

The Republic of Guinea became an Agency Member State in September 2023, and an imPACT Review took place soon after to assess cancer control capacities and needs, as well as to provide technical assistance, in collaboration with WHO, for the development of a National Cancer Control Plan.

Next steps

Recommendations from the Review, including on radiation safety and security, will contribute to the Government's plans to establish its first cancer centre, and will support the related necessary partnerships with international and regional bodies.

Jordan

Current situation

The Government of Jordan is launching its inaugural National Cancer Control Plan and Action Plan (2023–2030) in response to the escalating cancer burden. This plan will benefit from the imPACT Review recommendations. The mission included visits to key health facilities such as the Al Basheer Hospital, King Hussein Cancer Centre (KHCC), Royal Medical Services and University Hospitals. Recommendations focus on improvements in medical imaging and radiation therapy. KHCC expressed interest in participating in the IAEA's Rays of Hope initiative and signed an agreement with the Agency as a regional Anchor Center. The Jordan Atomic Energy Commission emphasized the prominent role of Jordan's Research and Training Reactor (JRTR) in providing medical radioisotopes for cancer diagnosis and treatment.

WHO Country Representative Dr Jamela Al-Raiby facilitated the first day of the imPACT Review mission discussions in Jordan, with Ministry of Health, IAEA, WHO and IARC representatives, international experts and key national stakeholders. (Photo: A. Juric/IAEA)

Next steps

The national authorities will use the imPACT Review Report to strengthen the NCCP Action Plan 2023-2030, including in areas of radiotherapy, imaging and nuclear medicine, as well as coordinated and integrated cancer care across the Jordanian health care providers.

Papua New Guinea

Current situation

In response to the 2013 imPACT Review, Papua New Guinea has taken steps to enhance cancer services with the construction of a new radiotherapy center. The 2023 imPACT Review emphasized the need for a sustainable approach to radiotherapy services, including the long-term planning of workforce development and equipment maintenance. Pediatric cancers were prioritized as part of the imPACT Review, with recommendations to further strengthen the referral system to improve early diagnosis, ensure the availability of essential medicines and build capacity at national referral centers.

During the in-country mission to Papua New Guinea, experts from the IAEA, WHO and IARC reviewed plans for the new cancer care centre to be built by the end of next year. (Photo: I. Veljkovikj/IAEA)

Next steps

As a next step, the Ministry of Health will develop a new cancer control programme in Papua New Guinea with support from the Agency and partners, and expressed interest in joining Rays of Hope.

Venezuela

Current situation

A first imPACT Review was conducted in Venezuela with the objective of developing a roadmap to strengthen cancer diagnosis and treatment services across the country. The Review was essential to provide the Government with a baseline assessment of capacities for cancer control and recommendations to resume a number of services under the National Cancer Control Programme. Findings from the imPACT Review will be addressed, amongst others, through a national project for the 2024–2025 IAEA technical cooperation programme aiming to strengthen capacity for quality radio diagnostic, radiotherapy and nuclear medicine services.

Full national and international team for the imPACT mission to Venezuela. (Photo: Vice Presidency/ Venezuela)

Next steps

As a next step, the national authorities have prioritized critical actions, including partnerships, for cancer care.

C.6.3. Development of strategic documents

Six countries received expert advisory support to develop or finalize a National Cancer Control Plan (NCCP), including through in-country workshops held in partnership with WHO and IARC (Benin, Botswana, Burundi, Guinea, Guyana, and Kenya). PACT also coordinated IAEA technical feedback for final drafts of NCCPs, including for Nigeria and Sudan.

To enable Member States to move from project planning to implementation, the Agency, through PACT, provided countries with assistance to develop bankable documents that will support the mobilization of national resources or from international financial institutions and other donors. In 2023, the Agency provided expert advisory support to Burundi, the Democratic Republic of Congo, Kenya, Liberia, Senegal, Sudan, Togo, Uganda and Zambia for the preparation of bankable documents for the establishment or expansion of radiotherapy services.

C.6.4. Advocacy, partnership building and resource mobilization for cancer activities

The Agency, through PACT, co-organized a series of workshops with WHO and IARC on National Cancer Control Plans (NCCPs), with the participation of more than 100 cancer control counterparts from all regions. One of the workshops, hosted by PACT, focused on monitoring and evaluation of NCCPs. Speakers from WHO Regional and Country Offices shared their own experience in developing, implementing, evaluating and monitoring NCCPs. The online event was supported by IARC, technical officers at the IAEA, and other cancer partner organizations such as the Union for International Cancer Control, St Jude Global and City Cancer Challenge.

PACT also participated in several Sustained Dialogue on Peaceful Uses (SDPU) events jointly organised by the U.S. Department of State's Office of Multilateral Nuclear and Security Affairs and the U.K. Department for Energy Security and Net Zero. This included participation in a workshop on strengthening radiation medicine in West Africa held in Ghana, and a presentation on the Agency's work in radiation medicine capacity-building and cancer control planning on the margins of the AORTIC conference in Senegal.

A workshop on the development of a National Cancer Control Plan was held in Burundi in 2023. (Photo: Ministry of Health/Burundi)

List of frequently used abbreviations

AfDB	African Development Bank
AFRA	African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
Agency	International Atomic Energy Agency
APCs	assessed programme costs
ARASIA	Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology
ARCAL	Regional Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean
ASEAN	Association of Southeast Asian Nations
COP28	28th meeting of the Conference of the Parties
CPF	Country Programme Framework
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
GPAP	Global Plastic Action Partnership
G20	Group of 20
GloWAL Network	Global Water Analysis Laboratory Network
IAEA	International Atomic Energy Agency
imPACT	integrated mission of PACT
IARC	International Agency for Research on Cancer
IOC/ UNESCO	Intergovernmental Oceanographic Commission of UNESCO
IsDB	Islamic Development Bank
IMF	International Monetary Fund
LDC	least developed country
LDC5	Fifth United Nations Conference on the Least Developed Countries
NPP	Nuclear power plant/programme
NCCP	National cancer control plan/programme
NLA	National Liaison Assistant
NLO	National Liaison Officer
NPCs	National Participation Costs

NPP	nuclear power plant
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
PACT	Programme of Action for Cancer Therapy
RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
SDPU	Sustained Dialogue on Peaceful Uses
SIDS	small island developing States
SIT	Sterile insect technique
SDG	Sustainable Development Goal
TC	technical cooperation
TCF	Technical Cooperation Fund
UICC	Union for International Cancer Control
WHO	World Health Organization
UICC	Union for International Cancer Control
UNCSTD	UN Commission on Science and Technology for Development
UNDP	United Nations Development Programme
UNDESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UN-OHRLLS	UN Office of the High Representative on Least Developed Countries, Landlocked Developing Countries and Small Islands Developing States
UNOSSC	United Nations Office for South-South Cooperation
WHO	World Health Organization
WHO AFRO	WHO Regional Office for Africa
WHO EMRO	WHO Regional Office for the Eastern Mediterranean
WHO PAHO	WHO Pan-American Health Organization
WHO WPRO	WHO Regional Office for the Western Pacific

Annex 1.

Achievements in 2023: Project Examples by Thematic Sector

Annex 1. Achievements in 2023: Project Examples by Thematic Sector

A. Health and Nutrition

A.1. REGIONAL HIGHLIGHTS

In **Africa**, the TC programme continued to support Member State efforts to establish or enhance access to quality cancer diagnosis and treatment through radiotherapy, nuclear medicine, medical physics, and diagnostic radiology. Assistance was provided through Rays of Hope, especially to the first wave of Member States participating in the initiative, to establish and to enhance radiotherapy services for cancer diagnosis and treatment. The TC programme in Africa also helped Member States to assess the efficacy of nutrition intervention campaigns using nuclear and nuclear-related techniques and a Master's programme in nutrition, supported by the IAEA and hosted by Morocco, was launched in October. The TC programme continued to provide short and long-term training for medical physicists involved in diagnostic radiology, nuclear medicine physicians and medical physicists, as well as full clinical training leading to academic qualifications for personnel earmarked to work in radiotherapy and nuclear medicine centres.

Health was a priority area for Member States in **Asia and the Pacific** in 2023, especially radiotherapy and cancer care. The focus was on developing human resources through fellowships, expert missions and specialised training courses. In addition, vital equipment was procured for many Member States to enhance national health care strategies. Capacity building efforts over the years led to the establishment of Anchor Centres in Jordan and Pakistan for the Rays of Hope initiative. The Anchor Centres will train fellows, organize training courses for healthcare providers, participate in IAEA Coordinated Research Projects, promote networking, and provide experts and mentorship to other radiotherapy and medical imaging centres in their region.

In **Europe and Central Asia**, Member States prioritize keeping up with technology development and its effective and safe use. In response to continuing high demand for education and training of medical professionals, the Agency offered various training opportunities, ranging from basic to specialized courses. Radiation safety is crucially important in radiation medicine, and as technology advances in the region, corresponding changes in the practice of radiation medicine are required. In this regard, efforts were made to support Member States in raising awareness about the importance of radiation safety, and to establish quality management systems for the improvement of clinical services in the region.

Human health and nutrition remained a priority in **Latin America and the Caribbean**, where many countries are affected by both communicable and non-communicable diseases. In 2023, the Agency helped Member States expand access to cancer services through the provision of training and equipment for radiotherapy, nuclear medicine and diagnostic imaging at public hospitals across the region.

A.2. RADIATION ONCOLOGY IN CANCER MANAGEMENT

Brachytherapy treatment was introduced in May at Côte d'Ivoire's Alassane Ouattara National Centre for Medical Oncology and Radiotherapy, which was inaugurated in 2017 as the country's first public radiotherapy service. Under the framework of TC projects IVC6012, 'Establishing Secondary Standards Dosimeter Laboratories for Radioprotection, Radiology, Radiotherapy and Nuclear Medicine', and IVC6013, 'Developing Regional Radiotherapy Services', the Agency supported long-term training for three medical physicists, three radiation oncologists and 16 radiation therapy technologists. Supported

by the same TC projects, Abidjan's nuclear medicine facility started operations in July. The Agency provided comprehensive training for physicians and state-of-the-art gamma camera.

The State of Palestine received assistance through PAL6004, 'Building Capacity for Nuclear Medicine, Radiation Oncology, and Radiation Therapy'. Under the project, which started in 2022, two fellows are being trained in radiation oncology in Amman for a period of four years. This will contribute to improved cancer control by increasing the pool of qualified human resources. Two further fellows are participating in two long term, four-year fellowships in nuclear medicine in Jordan. These fellowships will contribute significantly to strengthening national capacity for nuclear medicine and radiation oncology.

Under YEM6016, 'Rehabilitating National Capabilities in Radiotherapy and Nuclear Medicine – Phase II', a technical expert team is providing inputs to cancer management in Aden through document reviews and virtual meetings. The expert team assessment has led to the initiation of new requisitions for dosimetry and quality control equipment. Seven group fellowships were provided to 19 professionals on breast imaging, nuclear medicine and radiotherapy, greatly updating and strengthening their knowledge and hands-on experiences. The Agency also sponsored Yemen's participation in the International Congress of Radiology, where attendees learned about international good practices and exchanged experiences with their peers, bolstering knowledge sharing.

In Europe and Central Asia, a regional training course supported by project RER6040, 'Enhancing Radiotherapy Delivery Through Improved Use of Advanced Dosimetry and Radiotherapy Techniques', allowed 48 participants to improve their knowledge of image-guided radiotherapy for cervical cancer, with a focus on brachytherapy. Using an online platform, 34 participants received training in 2023 to improve their knowledge of advanced treatment planning for head and neck cancer. The project also supported a virtual training course for 45 participants who advanced their knowledge in treatment planning workflow. More than 200 medical practitioners in Europe and Central Asia also received training through seven courses on specialized topics offered through partnership with the European Society for Radiotherapy and Oncology (ESTRO) and Inholland Academy.

A.3. NUCLEAR MEDICINE AND DIAGNOSTIC IMAGING

In Africa, complementary e-learning modules for a Master's programme in radiopharmacy were developed with the support of RAF6058, 'Strengthening the Capacities for Radiopharmacy and Medical Physics and Radiology for Expansion and Sustainability of Medical Imaging Services — Phase II (AFRA)'. In June 2023, the Agency established a network of nine universities in Algeria, Egypt, Ethiopia, Ghana, Kenya, and South Africa that will host the harmonized curriculum for this Master's programme. The harmonized curriculum will be launched by September 2025. The Agency also organized a Summer School on the fundamentals of radiopharmaceutical applications in collaboration with France's National Institute of Sciences and Nuclear Techniques (INSTN). The school contributes to Agency efforts to build capacities in French-speaking countries by providing training to radiopharmacists on the preparation and quality control of radiopharmaceuticals, and by updating the knowledge and skills required to adapt to the latest developments and trends in this field.

Nepal received its first SPECT-CT unit in December 2023 under NEP6006, 'Strengthening Nuclear Medicine Services'. This technology enables more precise and efficient imaging, especially in oncology, cardiology and neurology, leading to earlier and more accurate diagnosis of various health conditions.

National capacities in diagnostic radiology, nuclear medicine, and radiotherapy were enhanced in Thailand in 2023 with the support of THA6045, 'Advancing National Capacity in Diagnostic Radiology, Nuclear Medicine, and Radiotherapy', including through the procurement of a web-based Radiation Dose Management Software/System (DMS). This

system expands upon existing software to include eight additional CT units, building on the foundation of nine connected hospitals. The expansion has enabled a more comprehensive dose data collection, which is sent to the central server at the Office of Atoms for Peace for National Dose Registration.

In Estonia, a project to improve the safety and quality of radiation medicine, EST6023, 'Improving Access to State of the Art Diagnostic and Therapeutic Services for Non-Communicable Diseases, including Cancer', is helping to ensure better patient care and protection of personnel. Under the project, the Agency conducted a Quality Management Audits in Nuclear Medicine Practices (QUANUM) audit at the North Estonia Medical Center in Tallinn and provided the centre with appraisals and recommendations to further improve clinical practice and services to patients. An expert mission provided technical advice and preliminary studies, together with an example of a roadmap for planning, building and maintaining a cyclotron site, in order to help the counterpart understand what would be required if Estonia decides to construct a cyclotron. Medical personnel also received training on advanced radiotherapy techniques and nuclear medicine applications.

In 2023, a fellowship on the application of physics in diagnostic and interventional radiology was supported under project HUN6004, 'Implementing a Formal Quality Assurance Programme in Diagnostic Radiology at End User Level', to enhance quality assurance/quality control programmes at Hungary's National Institute of Oncology (NIO). Instrumentation to carry out quality control tests was also procured through the project, and an IAEA guidance document on quality control tests for diagnostic radiology was published in Hungarian.

Improvements to the capacity of Kyrgyzstan's National Centre of Oncology and Haematology (NCOH) in Bishkek to provide quality diagnostic and treatment services for cancer patients are being supported through KIG9008, 'Improving Radiation Protection of Patients and Staff in Diagnostic and Interventional Radiology Services'. In 2023, nuclear medicine staff, radiation oncology specialists, medical physicists and diagnostic radiologists received training with project support. Infrastructure for radiation protection, medical imaging, quality control and radiation measurements was also improved. The Agency is also helping to improve radiation protection of patients and staff in diagnostic and interventional radiology services. A national training course held in 2023 trained 55 specialists including radiologists, doctors, x-ray technicians and interventional radiologists on radiation safety during diagnostic studies using ionizing radiation sources.

A national training course on Improving Radiation Protection of Patients and Staff in Diagnostic and Interventional Radiology Services took place in Kyrgyzstan in 2023. (Photo: National Centre of Oncology and Haematology,Kyrgyzstan)

In Chile, the Agency completed the commissioning of NephroCam equipment at the MATER Children's Renal Corporation, improving the early diagnosis performed by a non-profit corporation dedicated to the prevention and treatment of kidney disease in underprivileged children across the country.

A.4. RADIOISOTOPES, RADIOPHARMACEUTICALS AND RADIATION TECHNOLOGY

Cuba has obtained good results with the support of project CUB6031, 'Enhancing the Production of Theranostic Radiopharmaceuticals Following Good Manufacturing Practice'. In 2023, production and quality control procedures for the theranostic pair 68Ga/177Lu-DOTATATE were established, and all related standard operating procedures were written.

Procedures to produce and perform the quality control of 90Y/177Lu-PSMA were also written. 99mTc- and 18F-PSMA were produced for the first time in mid-2023, and all radiopharmaceuticals were in accordance with good manufacturing practice.

In Latin America, a regional workshop on the use of blood irradiators was jointly organized with PAHO in November. More than 30 participants from 14 countries discussed the status of the technology in the region and identified opportunities for technical cooperation assistance. The Agency also conducted its first regional training course on Dual Energy Computed Tomography (DECT) – a type of Computed Tomography (CT) that offers enhanced imaging capabilities – for medical professionals from 13 countries across Latin America and the Caribbean.

A.5. DOSIMETRY AND MEDICAL PHYSICS

Substantive progress was made in the Lao People's Democratic Republic in 2023 under LAO6006, 'Enhancing the Quality of Radiation Therapy Services'. Two important fellowships were completed: a three year radiation oncologist residency programme concluded in July 2023 at Siriraj Hospital in Bangkok, Thailand; and a one-year training at Chiangmai University in Thailand. The fellow trained in Bangkok now works as a radiation oncologist at Mittaphab Hospital in Lao PDR. Guidelines and protocols for dose measurement and calibration were also developed and adopted in 2023, producing quality assurance standards for Lao's hospitals.

Under ISR6030, 'Establishing a Master-Level Degree Programme in Medical Physics', and ISR6032, 'Strengthening Radiopharmacy Capabilities', a series of scientific visits and national training courses tailored for Israeli professionals were conducted in 2023. These educational initiatives provided valuable hands-on experience and knowledge exchange, crucial for advancing professional expertise in medical physics. Strategic procurement of critical laboratory equipment, phantoms and internal dosimetry software tools, informed by detailed facility reviews, was also achieved in 2023.

In 2023, with the support of BAH9011, 'Establishing a National Protocol for Controlling Radiation Doses in Diagnostic and Interventional Radiology Modalities', specialist training was provided to the nuclear medicine department at Bahrain's Salmaniya Medical Complex. The training enhanced staff operational and diagnostic skills, and helped develop a quality assurance system to ensure accurate and safe doses of radiation are provided for the treatment of patients. The newly trained personnel will form the basis for future national train-the-trainers programmes.

B. Food and Agriculture

B.1. REGIONAL HIGHLIGHTS

In 2023, food and agriculture continued to be one of the highest priority areas for the Agency's technical cooperation programme in **Africa**. At the 67th IAEA General Conference, a side event brought together delegates from Africa and other parts of the world to showcase the successful applications of advanced and climate-smart technologies as well as the results being achieved at the national level for food security in Africa.

In the **Asia and Pacific** region several achievements were made in 2023 through multi-year projects, including new mutant crop lines, and national successes resulting in best practices and lessons learned were shared at the regional level through training courses, meetings and workshops. In Sri Lanka, for example, the formulation of an irradiated vaccine against a parasite worm infection in goats was achieved with the support of SRL5049, 'Supporting Control of Stomach Worm Infection in Goats'. Production was scaled up and the vaccines were tested under field conditions, assisting goat production, improving milk and meat consumption in rural areas, and improving farmers' income. Following this success, a strategy on how to apply the vaccine in sheep was developed. Experts in Bangladesh acquired the knowledge and practical skills to develop SOPs and guideline for mass rearing of *Aedes aegypti*, bringing the country closer to scaling up its laboratory facilities for the mass-rearing of *Aedes* mosquitoes to combat dengue in Bangladesh.

The Agency is helping to strengthen food monitoring programmes in Member States in **Europe and Central Asia** through national projects focused on developing capacities for testing and monitoring food contaminants and residues. The Agency is providing training for staff and supporting improvements to the analytical infrastructures of the laboratories. These efforts are directly contributing to food safety and boosting trade in foodstuffs. The Agency is also enhancing the preparedness capacities of the veterinary sector to confront emerging and re-emerging diseases of livestock and wildlife.

Food and agriculture continue to play a pivotal role in the **Latin America and Caribbean** region, and in 2023, the Agency worked with Member States to train staff and equip food safety laboratories throughout the region. The Ministry of Agriculture in Saint Lucia has been working towards building capacity in food safety and, with assistance from the TC programme, analytical capabilities at the laboratory at the National Agricultural Diagnostic Facility have been strengthened. The laboratory can now conduct a series of tests more usually outsourced to regional and international laboratories. Another major milestone in the region was reached when Uruguay's law for the establishment of the New World Screwworm eradication programme, including the use of the Sterile Insect Technique, entered into force. Finally, the genomics laboratory for the mutation breeding of tree species adapted to climate change, located at the headquarters of the INFOR research institute of the Ministry of Agriculture in Chile, became operational.

IAEA Technical Officer, James Sasanya, Food Safety and Control Section, Joint FAO/IAEA Centre of Nuclear Techniques in Food & Agriculture (left) with staff of the Food Safety Laboratory at the National Agricultural Diagnostic Facility in Saint Lucia. (Photo: H. Romain/National Agricultural Diagnostic Facility, Saint Lucia)

B.2. CROP PRODUCTION

In Cambodia, progress has been made under KAM5007, 'Improving Cotton for Enhanced Resilience to Climate Change', with the harvesting of M3 generation seeds, and the discovery that 5 mutant lines/plants among the M2 generation of plants showed a promising high yield (over 30% more than control plants). Two fellows received five months of training in 2023 Nakhon Field Crop Research Centre, Thailand. The training focused on cotton breeding for drought tolerance, and the fellows will assist in the selection and analysis of cotton mutants, examining for high yield, good fibre and drought tolerance. They will also contribute to training students and young researchers at Preak Leap National Institute of Agriculture (NIA) and the Cambodian Agricultural Research and Development Institute. Another fellow spent five months at the Chinese Academy of Agricultural Science Institute of Animal Science, in Beijing, China, being trained on mutation breeding for crop improvement. Finally, two experts provided lectures and training to 150 students and ten NIA staff on mutation breeding.

In Lao PDR, farmers learned how to maximize the potential of a high yielding rice variety at practical demonstrations of crop management practices. (Photo: Department of Science, Ministry of Education and Sports, Lao PDR)

Under YEM5016, 'Enhancing Sorghum and Legume Crop Productivity through Induced Mutations with Supportive Breeding and Biotechnologies — Phase II', a scientific visit to the Research Centre for Radiation Process Technology in National Research and Innovation Agency (BRIN) of Indonesia and a group fellowship to Jordan National Agricultural Research Centre (NARC) were conducted. Participants built their knowledge of topics related to plant breeding and gained hands-on experience to build their technical knowledge.

Following six years of collaboration between the Agency and the agricultural institutions and organizations of the State of Palestine, four new variants of local durum wheat seed have been adapted to withstand the harsh environmental conditions and drought, through PAL5011, 'Enhancing Food Security via Nuclear Based Approaches'. The most important local wheat varieties (Kahla) were improved using induced mutation. The productivity of the six best lines is greater by 3 to 21 per cent than common local varieties. The new lines were included in the national seed multiplication programmes at the Ministry of Agriculture and are being disseminated to local wheat farmers, directly increasing food security.

In Syria, twenty advanced mutant lines of barley were developed by the Atomic Energy Commission of Syria (AECS) with the support of SYR5026, 'Using Accelerated Mutation Breeding of Staple Crops for Enhanced Resilience to Climate Change through Speed Breeding, Phenotyping and Genotyping'. The new lines are currently being tested in collaboration with the General Commission for Scientific Agricultural Research (GCSAR) in multiple locations with the aim of improving yields under drought conditions. In addition, ten advanced mutant lines of cotton developed by AECS are being tested in collaboration with the Cotton Research Administration (CRA) in multiple locations to improve yields under conditions of drought and heat.

Laboratory staff screen drought tolerant barley mutant lines in Syria (Photo: Atomic Energy Commission of Syria (AECS))

Banana (Musaceae) cultivation in Venezuela has an important socioeconomic role, generating direct and indirect employment. Cultivation of Musaceae is essential for the agrifood security of the population, as banana is an important source of calories and vitamins for the poorest regions. In 2023, Fusarium Wilt TR4 was detected in the country. TR4 has the potential to cause great losses to banana producers. The Agency has been helping Venezuela's National Institute of Agricultural Research (INIA), to strengthen the national Musaceae production system, building capacities for monitoring and early detection of diseases, as well as in mutation breeding. The country participates in interregional and national TC projects (INT5158, 'Strengthening Member State Capacities to Combat Banana Fusarium Wilt (TR4) through Early Detection, New Resistant Varieties, and Integrated Management' and VEN5023, 'Improving Banana Productivity through Mutation Breeding Techniques for Enhanced Disease Resistance') which are strengthening their laboratory capacities, training human resources and supporting the exchange of knowledge and experience with other countries facing the same challenges.

B.3. AGRICULTURAL WATER AND SOIL MANAGEMENT

Farmers participating in RAF5081, 'Enhancing Productivity and Climate Resilience in Cassava-Based Systems through Improved Nutrient, Water and Soil Management (AFRA)', were able to double and even triple their cassava yields by improving nutrient, water and soil management practices. In Ghana, over 70% of all farmers are engaged in cassava production, which contributes to about 22% of agricultural GDP, making the country one of the top five cassava producers in Africa. Field demonstration trials under the TC project showed an increase in production from around 20 tonnes per hectare to over 70 tonnes. Similar and even higher results were observed in other countries: in Burundi, where the conventional farming approach yields around 12 tonnes per hectare, nuclear-based methods helped to collect over 33 tonnes, while in Rwanda, the use of climate-smart agricultural practices increased yields from under 15 tonnes to almost 62 tonnes per hectare. In the Central African Republic, harvests from field trials reached around 50 tonnes per hectare, compared with an average of 10 tonnes.

By applying improved nutrient, water and soil management practices, farmers participating in a regional TC project in Africa were able to double and even triple the yields of cassava, Africa's most widely grown cash crop and a food staple in many countries in the region. (Photo: M. Zaman/IAEA)

Many field experiments were conducted in 2023 at different sites in Iraq under IRQ5022, 'Developing Climate-Smart Irrigation and Nutrient Management Practices to Maximize Water Productivity and Nutrient Use Efficiency at Farm Scale Level Using Nuclear Techniques and Advanced Technology', to study the response of strategic crops (corn, wheat, sunflower, potato and rice) to more effective agricultural practices. Soil and plant samples were analysed, providing data for a future final report. In addition, a number of workshops were held in Iraqi provinces for interested farmers, building their knowledge of best practices for irrigation and soil nutrient management. A gas chromatograph was also provided under the project.

B.4. LIVESTOCK PRODUCTION

Myanmar received laboratory equipment, chemicals and reagents in 2023 through MYA5028, 'Reducing the Incidence and Impact of Transboundary Animal and Zoonotic Diseases' and MYA5030, 'Advancing National Capacities to Detect and Respond to Transboundary Animal Diseases'. With this new equipment and materials, the country can now test for transboundary animal diseases, including SARCOV-2. The laboratory is also now able to test a wide range of animal feed samples, as well as eggs, milk, tissue and fish for residues, toxins and other contaminants. Test results can be utilized for key follow-up actions related to surveillance, vaccination policy and disease control strategy development.

In 2023, a regional workshop in Nicosia, Cyprus, conducted under project RER5027, 'Enhancing Preparedness Capacities of the Veterinary Sector to Confront with Emerging and Re-emerging Diseases of Livestock and Wildlife', improved the knowledge of 40 specialists from Europe and Central Asia about the biology and epidemiology of the most important wildlife species, potential carriers of infectious animal and zoonotic diseases. Moreover, 30 specialists were trained in capturing and handling wildlife and collecting appropriate samples for laboratory testing at the Veterinary Specialized Institute Kraljevo in Serbia. With the support of the project a draft manuscript was developed on the use of modern GIS technology applications in animal production and health. Due to the rapid spread of African Swine Fever (ASF) in central European countries, emergency support was provided to Bosnia and Herzegovina, Croatia, Montenegro and Serbia for the early detection and characterization of ASF in local laboratories. This is making a significant contribution to the control of the disease in these areas. By strengthening the capacities of veterinary laboratories in Member States in Europe and Central Asia, the project is facilitating animal production and contributing to improved livelihoods in farming communities.

The laboratory at the Faculty of Veterinary Medicine and Animal Science in Sri Lanka was set up with the support of the IAEA's technical cooperation programme. (Photo: P. Salame/IAEA)

Infectious animal diseases pose a significant health and socioeconomic problem for Montenegro. In 2023, the Agency upgraded the National Veterinary Laboratory with modern equipment and trained six staff members to promptly identify and report a wide range of animal diseases in the country. Support was provided through MNE5005, 'Enhancing Capacity of the National Veterinary Laboratory for Detection of Highly Contagious Animal Diseases'.

B.5. INSECT PEST CONTROL

With the support provided under the TC project SAF5017 "Assessing the Sterile Insect Technique for Malaria Mosquitoes — Phase III", South Africa has managed to develop standard procedures for mass rearing, quality control and mosquito handling and transportation for the primary vector of malaria in Africa, *Anopheles arabiensis*. Weekly releases of 50 000 sterile males were sustained over nine months to support the ongoing small-scale field SIT trial. The sterile males were competitive, and their release resulted in a decline in the *An. arabiensis* wild population density. The optimised workflow procedures for mass-rearing African vector mosquitoes for vector control purposes has the potential to be used as a template for all genetically based control methods currently under development. The project has also developed novel community engagement approaches using art and

entertainment (songs and drama) which have increased community acceptance of the SIT technology and improved health care seeking behaviour. The project also developed a mosquito surveillance system that has been transferable to the malaria control programme and can be used to monitor vector populations under low mosquito density settings.

Baseline data collection in Myanmar continued in 2023 with the support of MYA5029, 'Improving Fruit Yield and Quality by Using Sterile Insect Techniques as Part of Area-Wide Integrated Pest Management of Fruit Flies in the Mandalay Region'. This included fruit fly surveillance and suppression in mango, guava, jujube, banana and tropical almond cultivation orchards in Kyaukse Distinct and in the Mya Nadi Governmental Orchard in Myit-thar Distinct.

A comprehensive economic feasibility assessment was carried out in 2023 under ISR5022, 'Establishing the Sterile Insect Technique Methodology for the Management of the False Codling Moth, *Thaumatotibia Leucotreta*, And Enhancing Integrated Pest Management Against the Peach Fruit Fly, *Bactrocera Zonata*'. The assessment focused on controlling the False Codling Moth using an integrated pest management-sterile insect technique (IPM-SIT) approach. The study laid the groundwork for the future procurement of essential equipment, establishing a foundation for a broader implementation of SIT.

In 2023, under the framework of the regional project RER5026, 'Enhancing the Capacity to Integrate Sterile Insect Technique (SIT) in the Effective Management of Invasive *Aedes* Mosquitoes', the Agency built capacity in Member States to enhance the application of SIT within integrated, environment-friendly mosquito control approaches for invasive *Aedes* mosquitoes. Several training courses, expert missions, and fellowships were organized, covering a range of topics. SIT related equipment for participating Member States was also procured through the project.

Singapore's experience in conducting SIT trials was shared under RAS5082, 'Managing and Controlling *Aedes* Vector Populations Using the Sterile Insect Technique', and RAS5095, 'Enhancing the Capacity and the Utilization of the Sterile Insect Technique for *Aedes* Mosquito Control'. Regional experts were trained in 2023 through regional training courses hosted by Singapore on key components of SIT such as mass-rearing, irradiation and release of sterile male *Aedes* mosquitoes. The country also provided experts to support other events in the region, including a TC regional training course on Surveillance, Handling and Release of *Aedes* Mosquitoes, hosted by Malaysia in June 2023.

Ecuador is one of the largest producers of tropical fruit in the Western Hemisphere but has had significant problems with the Mediterranean fruit fly damaging crops. With technical assistance from the Agency and the Food and Agriculture Organization of the United Nations, populations of the pest have been successfully reduced by using an integrated approach that includes the sterile insect technique (SIT). This achievement has enabled farmers to increase production and exports of non-traditional fruits such as dragon fruit, tree tomato and golden berry. As a result of project ECU5031, 'Enhancing the Application of the Sterile Insect Technique as Part of an Integrated Pest Management Approach to Maintain and Expand Fruit Fly Low Prevalence and Free Areas', exports of

The South African team in the field to collect mosquitoes and to engage communities in understanding what fighting malaria mosquitoes can bring as benefits. (Photo: Dr. G. Munhenga/ WITS/NICD)

Reviewing the trial rearing of Aedes mosquito in BAEC Laboratory (Photo: M. Khan/Bangladesh)

Training course on Enhancing the Capacity to Integrate Sterile Insect Technique (SIT) in the Effective Management of Invasive Aedes Mosquitoes (Photo: J. O'Brien/IAEA)

these fruit crops to markets in China, Peru and the United States, amounted to more than USD 83 million dollars in 2022. Also through ECU5031, a unique environmental impact assessment of the Mediterranean fruit fly was carried out for the first time in the four Galapagos islands. The invasive Mediterranean fruit fly, introduced to the Galapagos Islands in 2008, poses a major threat to the subsistence production of fruits and vegetables consumed by around 33,000 island inhabitants. Given the fragile nature of the Galapagos islands, the only technology that could achieve eradication of this pest in a sustainable manner is SIT using an area-wide approach.

B.6. FOOD SAFETY

An analysis of pesticide residue in Nepal resulted in a comprehensive assessment of needs in the national laboratories. Under NEP5007, 'Supporting Analysis of Pesticide Residues in Agricultural Products', a high-speed rotor centrifuge and a state-of-the-art water purification system, alongside other crucial items, were procured. The equipment enhances Nepal's laboratory capabilities to ensure safer food production. With the support of NEP5006, 'Enhancing Productivity of Crops and Fruit Employing Nuclear and Molecular Techniques', essential equipment unavailable locally was identified in early 2023 and an expedited approach for its delivery was put in place. This strategic move was pivotal to strengthening the National Biotechnology Research Centre (NARC), enhancing its ability to foster food security and contribute to economic growth.

Staff conduct tests at the State Laboratory of Agriculture of Georgia. (Photo A. Gulbani/SLA)

In 2023, through project GEO5001, 'Enhancing National Programmes for Testing and Monitoring Food Contaminants and Residues', four specialists from the State Laboratory of Agriculture of Georgia received practical training at the Institute of Food Safety, Animal Health and Environment in Riga, Latvia, to enhance their knowledge of mycotoxin analysis in targeted food matrices, as well as analysis of pesticide residues. The project also supported participation in the Food for Future FoodTech World Summit in Bilbao, Spain. The project is strengthening national food monitoring programmes for testing and monitoring food contaminants and residues.

The Data Sharing Committee (DSC) of the Regional Analytical Network of Latin America and the Caribbean (RALACA-DSC) was launched in May at a meeting on the margins of the Latin American Congress on Pesticide Residues, supported by project RLA5080, 'Strengthening

the Regional Collaboration of Official Laboratories to Address Emerging Challenges for Food Safety (ARCAL CLXV)'. Through RALACA-DSC, fourteen countries in the region agreed to strengthen their collaboration and to share analytical food safety data on pesticide residues and other chemical contaminants in food to support the formulation of risk-based monitoring programmes. A database for food residues and contaminants was created, which is securely housed at the Agency. Officially nominated and authorized users can input national data and view aggregated data for subsequent risk assessment exercises. A review process was put in place to ensure that data submissions are standardized, and a data input tool has been established to harmonize data collection.

Regional food safety specialists met at the launch of the RALACA Data Sharing Committee. (Photo: SENACYT)

C. Water and the Environment

C.1. REGIONAL HIGHLIGHTS

In 2023, the technical cooperation programme in **Africa** contributed to building the capacities of Member States in using isotope techniques to assess water resources and manage surface and groundwater on local and national scales, as well as shared transboundary water resources in the region. Member States were also assisted to deal with pollutants, radioactive waste and contaminated sites. In addition, the programme supported human resource development – especially long-term training in leading to the academic qualification of young Africans at the PhD level.

Member States in **Asia and the Pacific** conducted key laboratory experiments and assessments in the area of water and the environment in 2023, and focused on procurement of essential equipment to build national capacities to conduct further experiments.

The Agency supports public and environmental protection through the enhancement of the environmental monitoring and assessment capabilities of Member States in **Europe and Central Asia**. In 2023, a regional project, RER7014, 'Improving Environmental Monitoring and Assessment for Radiation Protection in the Region', enabled the mapping of the status of environmental monitoring capacities in the region, including the legal framework and existing technical analytical capabilities. This analysis helped to develop the implementation strategy for delivering the project. Agency support also included enhancing the technical analytical capacities of the laboratories in each participating country for conducting environmental monitoring. Through these efforts, the Agency is contributing to radiation protection and safety of the public and the environment in different exposure situations in Europe and Central Asia.

Water resource management continues to be an area of major importance in the **Latin America and the Caribbean** region. In 2023, through RLA0063, 'Using Nuclear Techniques for Climate Change Adaptation and Mitigation', the Agency helped Member States to use isotope hydrology to improve their water resource management. Regional capabilities to conduct water sample analysis are being enhanced through the provision of a liquid water isotope laser analyser system and training in its use, along with other laboratory supplies, to the Caribbean Institute for Meteorology and Hydrology. This institute, located in Barbados, is a regional training and research organization for 16 countries in the Caribbean, including 11 IAEA-CARICOM Member States.

C.2. WATER RESOURCE MANAGEMENT

An IAEA-supported sandwich PhD fellow is now supporting analytical services at the University of Lomé, Togo. (Photo: Laboratory of Applied Hydrology and Environment Geology, University of Lomé, Togo).

Under TC project RAF7021, 'Enhancing, Planning, Management and Sustainable Utilization of Water Resources (AFRA)', Member States received assistance to characterize groundwater's contribution to shared basins using isotope hydrology. The regional project is strengthening laboratory capacity for the determination of stable isotopes in water samples. In Togo, the Laboratory of Applied Hydrology and Environment Geology of the University of Lomé, Togo, received an IAEA-sponsored laser isotope analyser. In an intercomparison exercise, the laboratory performed very well, and it is now supplying analytical services for samples collected under the regional programme. A PhD sandwich student, supported through the project, who recently completed his degree, is

operating the laboratory. He is also providing services to the region by assisting with the installation of laser isotope analysers, thus contributing to regional self-reliance in isotope hydrology analytical capacity.

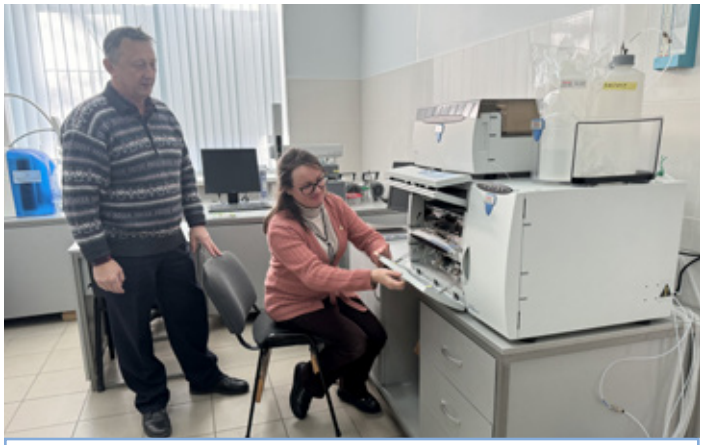
Bahrain received equipment, laboratory consumables and training under BAH7001, 'Enhancing Analytical Capabilities for Improved Environmental Monitoring', and BAH7002, 'Introducing Inductively Coupled Plasma Techniques in Environmental Analyses', and now has enhanced analytical capabilities to perform marine and terrestrial environmental analysis.

In Thailand, progress under THA5057, 'Enhancing Capabilities for the Application of Isotopic Techniques for Enhanced Water Resource Management', in 2023 included the procurement of equipment which has significantly enhanced national analytical capabilities, particularly for the processing of soil and sediment samples for alpha spectrometer measurement. Additionally, the implementation of an extensive human resource programme of fellowships and scientific visits built expertise and capability and strengthened the sustainable management of Thailand's water resources.

Findings from an analysis of groundwater in Syria, carried out under SYR7005, 'Assessing Groundwater Quality Using Nuclear and Isotope Techniques', revealed key information on prevalent rock formations, and will be instrumental in determining the groundwater's suitability for agricultural purposes.

The overall objective of SLO5005, 'Strengthening Agricultural Land Use and Management to Reduce Emerging Contaminants and Improve Water Quality' was to identify land uses and agricultural practices that could help reduce sources of emerging pollutants in groundwater and surface water on a national scale. A final workshop was organized in September 2023 with stakeholders (municipalities, policy makers) and farmers to present the expert guidelines for improved agricultural practices, and the groundwater vulnerability maps of the case study sites were also presented. By monitoring land use and groundwater quality in the Krško plje gravel aquifer in Slovenia, a better understanding of sources and site zones, as well as environmental conditions (inadequate wastewater treatment and failing municipal wastewater systems, and agricultural land organically fertilized by manure application), has been gained. Measures to prevent the release and spread of pollutants in agriculture were also identified. As a result of the project, by the end of 2023, Slovenia has improved infrastructure capacity and trained personnel able to provide fast measurements of stable isotope composition of water with high accuracy and precision. This was achieved through the training by Agency expert missions at the Geological Survey of Slovenia. In addition, thanks to a grant to University of Ghent, the counterpart was able to improve the groundwater vulnerability maps using the Modflow groundwater model. This helped to identify and delineate agricultural and urban pollution sources.

The Laboratory of Environmental Quality Monitoring, Institute of Chemistry, State University of Moldova, is receiving assistance through project MOL7001, 'Establishing Capacities for Isotope Hydrology Techniques for Water Resources and Climate Change Impact Evaluation'. In 2023, the Agency supported the verification of operational procedures for stable isotope analysis and examined the laboratory's infrastructure and operation. Laboratory specialists also attending four training courses at the Agency's Isotope Hydrology Laboratory focusing on water isotope analysis by laser spectroscopy, isotope-enabled water balance modelling, and nitrate isotope analysis by laser spectroscopy and isotope ratio mass spectroscopy. Moreover, one fellow received advanced training on the use of the laser spectrometry system at



Staff from the Laboratory of Environmental Quality Monitoring, Institute of Chemistry, State University of Moldova, received training on water isotope analysis. (Photo: C. Jimenez/IAEA)

Groundwater samples were taken from the Tempate area, Santa Cruz, Costa Rica, in April 2023. (Photo: S.Briceño/CICA)

the Institute of Geology in Innsbruck University. Laboratory equipment was also procured with the support of the project. Overall, the project is supporting the Republic of Moldova in improving its national environmental monitoring system for water resource management.

Costa Rica is using isotope hydrology to improve management of the water resource in the province of Guanacaste with the support of project COS7006, 'Strengthening National Capacities to Identify Sources of Contamination that Affect Highly Vulnerable Aquifers Using Isotopic and Conventional Techniques'. In 2023, the counterpart, the Center for Research on Environmental Pollution (CICA) received new equipment and training on methodology. The project is expected to produce a baseline of the contamination status of aquifers, together with up-to-date information on the condition of the main aquifers for better management of water resources, and a methodology to discern the origin of pollutants.

In Saint Lucia, the sample collection and monitoring capabilities of the Water Resources Management Agency (WRMA) are being improved with hydrology field equipment through the support of STL0001, 'Strengthening Institutional Capacities in the Application of Nuclear Technology'. WRMA personnel have also been trained on topics including sample analysis and field work, data interpretation and visualization, and the development and implementation of a national monitoring plan.

The Barbados Water Authority has received hydrology field equipment from the Agency under BAR0002, 'Building National Capacity through the Applications of Nuclear Technology', to collect water samples and conduct monitoring activities. This is complemented by analytical capabilities at the Government Analytical Services laboratory, enhanced through the provision of equipment.

C.3. MARINE, TERRESTRIAL AND COASTAL ENVIRONMENTS

In Kuwait, experimental data was collected for five microalgae species under different pH scenarios simulating the current and future climate change scenarios, with the support of KUW7008, 'Studying the Influence of Climate Change on Contaminant Transfer in Marine Organisms and Assessing the Impact of Pollutant Bioaccumulation on Seafood Safety Using Nuclear and Isotopic Techniques'. Capacities to conduct toxicity evaluations using receptor binding assay for harmful algal blooms are now well established for future progress as a result of the data previously collected which was further built on and integrated in 2023.

Through COL7004, 'Strengthening National Capacities for Detecting Marine Biotoxins during Harmful Algal Blooms', the Agency is assisting the José Benito Vives de Andréis Marine and Coastal Research Institute in Santa Marta (INVEMAR) in the establishment of national surveillance and an emergency response network for harmful algal blooms, in cooperation with national partners. In 2023, two fellowships were organized to train staff on the identification of cyanobacteria toxigenic species, including the use of a recently donated microscope for the identification of harmful algae. With IAEA expert advice, a national workshop on the Management of Economic and Environmental Risk and Impact Evaluation was organized in March 2023. The event helped to strengthen the national cooperation network of relevant authorities and stakeholders in the public sector responsible for implementing the monitoring and emergency response system protocol.

D. Industrial Applications

D.1. REGIONAL HIGHLIGHTS

In 2023, the TC programme in **Africa** focused particularly on research reactors and on building Member States' capacities to adopt radiation-based techniques for cleaner and safer industrial processes. The TC programme provide support to several countries wishing to applying radiation technology for the management of industrial and agricultural waste and the decontamination of biological agents. It also helped countries embarking on the development of a research reactor programme to follow the IAEA Milestones approach.

Member States in **Asia and the Pacific** made significant progress in installing and utilizing procured equipment in 2023. Several projects included a focus on human resources development, primarily through scientific visits and fellowships, which bolstered the region's ability to engage in substantive activities through industrial applications and radiation technology projects.

The Agency is actively contributing to the expansion of the use of radiation technologies in the industry, cultural heritage conservation, and environmental contexts, while also advancing Quality Assurance (QA) and Quality Control (QC) standard procedures for the application of radiation technologies in the Member States across **Europe and Central Asia**. As part of the TC regional project RER1021, 'Enhancing the Use of Radiation Technologies in Industry and Environment', an intercomparison exercise was conducted in 2023. The exercise included 12 Gamma facilities and 5 electron beam facilities across 13 Member States. When compared to the outcomes of the first and second intercomparison exercises conducted between 2017 and 2019, the outcome of the third exercise in 2023 demonstrated improvements in dosimetry and quality management, as a result of the collaborative efforts between the Agency and Member States in enhancing the safe and efficient operation of radiation technologies.

Latin America and the Caribbean is vulnerable to natural events such as earthquakes, floods and hurricanes that can cause widespread damage to physical infrastructure. The Agency is providing assistance to the region in leveraging non-destructive testing (NDT) techniques to assess the safety and integrity of built structures following natural disasters. The Agency is also supporting Member States in using nuclear technology for other industrial applications.

D.2. RESEARCH REACTORS

Participants at a regional workshop on Marketing Strategy and Business Plans of Research Reactors, Cairo, March 2023. (Photo: Egyptian Atomic Energy Authority)

Eight Member States in Africa with research reactors, namely Algeria, Democratic Republic of Congo, Egypt, Ghana, Morocco, Nigeria and South Africa have received assistance through RAF1011, 'Strengthening Research Reactor Safety, Operation, and Utilization (AFRA)'. A regional workshop on Marketing Strategy and Business Plans of Research Reactors was held in Cairo, Egypt, in March to allow managers and staff from organizations operating research reactors to exchange experiences and best practices in strategic and business planning. After the workshop, a number of participating countries requested additional Agency support to review their strategic and business plans.

A walk through the research reactor of Ghana during the RASCA meeting in July 2023. (Photo: Ghana Atomic Energy Commission)

The Annual Meeting for Regional Advisory Safety Committee for Research Reactors in Africa (RASCA), also supported through RAF1011, was held in Accra, Ghana, in July, and provided a forum for participating Member States to share information and knowledge on research reactor safety issues of common interest within the region. These include maintenance, periodic testing and inspection programmes, and preparations for the decommissioning of research reactors.

An IAEA-organized training course on Ageing Management of Research Reactors took place in Pretoria, South Africa in December. The training enhanced Member State capacities in operation and ageing management by providing practical guidance on establishing, implementing and improving ageing management, as well as on refurbishment and modernization programmes for research reactors.

The eight Member States in Africa that are considering the establishment of their first research reactor, namely Ethiopia, Kenya, Niger, Rwanda, Senegal, Uganda, United Republic of Tanzania and Zambia, are receiving tailored support through regional project RAF1009, 'Supporting Embarking Countries in Establishing National Infrastructure for Research Reactors (AFRA)'. For example, an INIR-RR mission was fielded to Kenya in December to assist the counterpart institute in determining the status of its national nuclear infrastructure in line with the IAEA Milestones approach and in identifying further development needs to support the establishment of a research reactor facility in Kenya.

Human resource capacity building was enhanced in Saudi Arabia in 2023 as the country prepares to put its first low power research reactor into operation. Supported by SAU1007, 'Strengthening Operational Safety and Maintenance Best Practices at the Low Power Research Reactor', the team in King Abdulaziz City for Science and Technology (KACST) deepened their knowledge and skills on planning, commissioning, safe operation, maintenance and effective utilization of research reactors through several hands-on training events. Topics covered included integrated management systems, safety culture, operational radiation protection programmes and emergency operating procedures.

Argentina is building a new multipurpose nuclear research reactor, RA-10, to replace the current RA-3 and increase capacity for radioisotope production to cover national demand. The reactor is also expected to provide irradiation facilities for the testing of nuclear fuel and materials, and to produce thermal and cold neutron beams for applications in science and technology. A project for the establishment of the Argentinean Neutron Scattering Laboratory is also on-going, aimed at providing neutron beams to feed a suite of instruments for scientific and technological research at both national and international levels. This will open up opportunities for novel experimental research using neutrons, not only in Argentina but in Latin America and the Caribbean, where these techniques are currently scarcely used. The TC project ARG0019, 'Strengthening the Capacities of the Argentine Neutron Beam Laboratory', is building capacity for the use of the sophisticated instruments that will use the neutron beams produced by the RA-10 reactor. Long-term fellowship trainings have been supported in leading global institutes on the use of the neutron instruments, and visits to similar facilities around the world have been arranged so

that Argentinian staff learn about the management of such centres and discover strategies to build strong communities of users.

Operation and Maintenance Assessment of Research Reactors (OMARR) missions aimed at enhancing the availability, reliability and operational performance of RR facilities were carried out with the support of technical cooperation projects for the TRR research reactor in the Islamic Republic of Iran and for the TRR-1/M1 in Thailand. A pre-OMARR mission for the IEA-R1 research reactor in Brazil also took place, and expert missions were undertaken to support in-service inspections of the TRICO-II research reactor in Democratic Republic of Congo, the TRR research reactor in the Islamic Republic of Iran, and three research reactors in Indonesia: KARTINI-PSTA, RSG-GAS and TRIGA Mark II, Bandung.

D.3. RADIOISOTOPES AND RADIATION TECHNOLOGY FOR INDUSTRIAL, HEALTH CARE AND ENVIRONMENTAL APPLICATIONS

Thailand received support under THA1016, 'Enhancing Industrial and Research Utilization of Ion Beam Facilities', through a series of expert missions for the reviewing and revision of Site Acceptance Test (SAT) protocols. This included a virtual expert mission focusing on the SAT for the CC30/15 Cyclotron, alongside the procurement of essential equipment and laboratory supplies for the national laboratory. These efforts contributed towards developing higher standards in equipment and facility testing, crucial for the efficient and safe operation of Thailand's nuclear technology infrastructure.

In 2023, the upgrade of the Philippines' Multipurpose Gamma Irradiation Facility (MIF) was completed under PHI1019, 'Enhancing the Safety and Throughput of the Gamma Irradiation Facility Through Full Automation'. The MIF is now a fully automated commercial irradiator with newly installed Co-60 sources and an automatic conveyor system, and offers enhanced services to the food and medical sectors.

Several activities were initiated under SYR1011, 'Building National Capacity in Advanced Non-Destructive Testing Techniques', including a national workshop on Non-destructive Testing for Civil Engineering and Cultural Heritage Applications. Two training courses on ultrasonic testing of materials and radiography testing of materials were also carried out, with the goal of supporting the qualification and certification of NDT personnel in Syria. Under SYR1012, 'Building National Capacity in the Protection, Conservation and Restoration of Historical Objects and Documents Using Radiation Processing of Monomers/Polymers', the commissioning of the dynamical mechanical analyser (DMA) which arrived in May 2022 was initiated. A two-day online training course on DMA was carried out for local personnel. As a result, DMA can now be utilized in different experiments to test the stability of mechanical properties.

Six technical staff in Lao People's Democratic Republic have completed training on non-destructive testing technology under LAO1001, 'Establishing Basic Non-Destructive Testing Infrastructure'. Training covered radiographic testing, ultrasonic testing, magnetic particle testing and penetration testing level 1 in accordance with ISO 9712, and resulted in the certification of staff members. A workshop on the industrial applications of NDT technology was also completed in 2023, and the country received equipment including ground penetration radar for concrete.

An expert mission was conducted in Kuwait in October 2023 under KUW1009, 'Enhancing Core Analysis and Characterization of Reservoir Formation Through Advanced Nuclear Techniques', to provide local training on the application of nuclear techniques in reservoir core analysis. Atomic force microscopic (MAF) equipment was installed in December 2023. This equipment has been essential for measuring the molecular level of various materials.

In Latin America, progress has been made on linking national technical research and development institutions with national phytosanitary agencies to develop feasibility studies

and draft business plans on the potential for the deployment of irradiation facilities with phytosanitary purposes. Within RLA1021, 'Strengthening Capacities and Promoting New Trends Related to Irradiation Technologies for Quarantine Purposes (ARCAL CLXXXI)', regional courses were held at Texas A&M, a regional workshop on the Establishment of an Irradiation Facility for Phytosanitary Purposes was conducted, and technical visits to existing plants operating in the region were supported. Also, technical and economic challenges were addressed, as well the legal framework required at the regional level. The two regional phytosanitary organizations, the International Regional Organization for Plant and Animal Health (OIRSA) and the Southern Cone Regional Committee on Plant Health (COSAVE), are active partners within this project.

Erosion and sediment transport analysis, supported under TC project PAN1002, 'Strengthening the Operation of the Panama Canal through Erosion and Sediment Transport Analysis using Nucleonic Control System Applications, Radiotracers and FRN and CSSI methodologies', has enhanced the operation of the Panama Canal. Local capacities have been enhanced with the provision of equipment and training, as well as by expert assistance to apply nuclear techniques as a complement to traditional methods to determine the amount of soil erosion or deposition within a landscape, and to identify the main source or origin of the redistributed soil. The project findings will contribute to erosion analysis and control in the Panama Canal, helping to maintain the navigability of the canal and to enhance resilience to environmental challenges. This will help to assure Panama's key role in international maritime trade, and foster national economic stability.

D.4. NUCLEAR INSTRUMENTATION

In 2023, the Agency provided Albania with support to use nuclear and related techniques to characterize, conserve and restore cultural heritage artifacts through the national project ALB1009, 'Establishing Analytical Nuclear Techniques for Characterization and Conservation of Cultural Heritage Artefacts'. Three fellowships were hosted at relevant institutes in Italy, Austria and the United Kingdom. The fellowships covered topics such as X-ray fluorescence (XRF) spectroscopy, Mossbauer spectroscopy for characterization of culture heritage artefacts, and techniques for the restoration and conservation of different culture heritage objects. The project also supported the procurement of a Fourier Transform Infrared Spectroscopy (FTIR) Microscope, an energy dispersive X-ray fluorescence (EDXRF) spectrometer, and items for the XRF laboratory.

Applying nuclear techniques to characterize cultural heritage artefacts in Albania. (Photo: Institute of Applied Nuclear Physics/ Albania)

Following the conclusions of the regional project RLA1017, 'Applying Nuclear Analytical Techniques to Forensics for Analysing Firearms Crime Evidence', the Agency published a technical document *Establishing a Nuclear Forensic Capability: Application of Analytical Techniques* in 2023.

E. Energy Planning and Nuclear Power

E.1. REGIONAL HIGHLIGHTS

In 2023, the TC programme in **Africa** focused on assisting Member States in charting out their energy strategies, taking into consideration all possible energy supply and demand options. It also assisted Member States embarking on nuclear power programmes in planning and building their national nuclear infrastructures. Member States interested in Small Modular Reactors (SMRs) received support to participate in the interregional workshop on Technology Development and Applications of Small Modular Reactor (SMRs), which was held in China in September.

In **Asia and the Pacific** in 2023, efforts in the field of energy planning and nuclear power focused on national capacity building through human resource development.

The countries in **Europe and Central Asia** operate the largest fleet of nuclear power plants (NPPs) in the world. In 2023 the TC programme continued to assist Member States in their efforts to ensure the safe operation of these complex facilities, including long term operation, and provided support for infrastructure development and capacity building on SMRs, and for those embarking and expanding nuclear power programmes. An important milestone was achieved at the nuclear power plant (NPP) in Belarus, where unit 2 became fully operational. Embarking countries such as Kazakhstan and Uzbekistan continued to prepare for their first NPP following the IAEA Milestones approach. The Agency provided support to Romania to help with the first Small Modular Reactor technology development in the country. Member States continue to cooperate on energy planning and receive assistance in achieving their Paris Agreement target by strengthening their institutional capacities and human resources building to develop national energy and climate plans and strategies.

Participants on a field visit during a workshop on Small Modular Reactors, Sanya, China. (Photo: IAEA)

The **Latin American and the Caribbean** region faces growing energy demands and has identified the need for a comprehensive analysis of energy supply and demand scenarios.

E.2. ENERGY PLANNING

The Agency has collaborated with the African Union Commission and the International Renewable Energy Agency on the development of the African Continental Power Master Plan (CMP), supported by regional project RAF2013, 'Developing, Expanding, and Reinforcing Energy Planning Capabilities — Phase II (AFRA)'. The CMP was finalized in September 2023 and adopted by the African Ministers of Energy. A side event presenting the benefits of the CMP for African Member States was held on the margins of the 67th IAEA General Conference, with participation from the Agency, the Africa Union Development Agency (AUDA-NEPAD), the European Union and the South African Power Pool.

Syria was able to successfully construct a laboratory for complete solar panel testing with the support of SYR2006, 'Developing Strategic Studies for the Sustainable Development of the Energy Sector by Taking Reconstruction Needs into Account'. A number of key procurements were made in 2023, including for a solar module tester, and a temperature-humidity test climatic chamber for evaluation of photovoltaic panels.

Saint Lucia is working to improve its capacity in the area of energy planning with the support of STL0001, 'Strengthening Institutional Capacities in the Application of Nuclear Technology'. Four professionals from the Ministry of Infrastructure, Ports, Transport, Physical Development and Urban Renewal received IAEA-supported training to develop their capacities to analyse energy and electricity demand in various sectors of the economy and to finalize projections for future energy or electricity needs under different socioeconomic scenarios. They also built their skills on the use of IAEA's Model for Analysis of Energy Demand (MAED) tool. Another twenty national experts from power utilities and various government entities in charge of energy planning, regulation, finance, statistics or other energy related institutions were trained on energy supply analysis and economic comparison of supply options.

E.3. INTRODUCTION OF NUCLEAR POWER

Under projects EGY2019, 'Contributing to Capacity Building for the Construction and Pre-Commissioning Stages of the Nuclear Power Plant Project', and EGY9050, 'Improving Regulatory Framework and Infrastructure during Nuclear Power Plant Construction Phase', which focus respectively on the operator and regulator, the IAEA provided Egypt with assistance during the construction of the country's first nuclear power plant at El-Dabaa. The capacity of the two major role players, the Nuclear Power Plants Authority (NPPA) and the Egyptian Nuclear and Radiological Regulatory Authority (ENRRA), has been strengthened to manage and provide regulatory oversight for the construction and commissioning phase. The inputs provided address a gap analysis performed in December 2022 during the updating of the Integrated Workplan (IWP) which is currently being followed by Egypt. According to the IAEA's Milestones in the Development of a National Infrastructure for Nuclear Power, the country is in Phase III: "Activities to implement the first nuclear power plant" with the goal of attaining Milestone 3: "Ready to commission and operate the first nuclear power plant".

Since March 2019, in response to Ethiopia's decision to consider the integration of nuclear energy into its rapidly expanding economy, the IAEA has been supporting the country through national and regional projects offering expert guidance and assessments on the development of nuclear power infrastructure. Ethiopia has also signed strategic partnerships with Russia, China and Korea to enhance collaboration in nuclear science and technology. Additionally, Ethiopia has established a Centre of Excellence for Nuclear Science and Technology at the Addis Ababa Science and Technology University, offering undergraduate and postgraduate programmes in related fields.

Within the framework of projects GHA2006, 'Establishing Nuclear Power Infrastructure for Electricity Generation — Phase VI, GHA2007, 'Establishing a Nuclear Power Infrastructure for Electricity Generation and Enhancing Nuclear Science and Technology',

Figure taken from the 2024 Nuclear Technology Review

and GHA9009, 'Sustaining Regulatory Infrastructure — Phase II', the IAEA assisted Ghana in developing the infrastructure needed to develop its nuclear power programme. The assistance contributed to strengthening the nuclear regulatory infrastructure and to the implementation of activities under Ghana's Integrated Workplan. This included human resources development through the training of nuclear professionals on different aspects necessary for the development of the first nuclear power plant. Ghana is in Phase II of the IAEA's Milestones approach for the nuclear power infrastructure.

Under the framework of NIR2010, 'Enhancing National Capacity for Optimal and Synergized Participation and Management in Nuclear Power Plant Construction Stage', nuclear professionals were trained in project development, procurement, and legal and regulatory aspects of NPP construction, including public awareness and stakeholder involvement, with the aim of enhancing Nigeria's capacities for the optimal management of the construction stage of their nuclear power programme. Assistance was provided through the implementation of activities included in Nigeria's revised Integrated Workplan. Nigeria is currently in Phase II of the IAEA's Milestones in the Development of a National Infrastructure for Nuclear Power. Site selection has been completed and Nigeria is ready to invite bids and negotiate contracts for its first nuclear power plant.

Bangladesh's nuclear power programme advanced with the receipt of the country's inaugural shipment of uranium fuel in 2023. Under project BGD2018, 'Developing Infrastructure for the First Nuclear Power Plant: Commissioning and Startup', stakeholders in Bangladesh acquired a better understanding of market standards for power purchase agreements in the nuclear industry; the long-term costs of the Rooppur nuclear power plant; and options for pricing its output in a long-term power purchase agreement.

The IAEA also supported Bangladesh in 2023 under BGD9019, 'Strengthening the Nuclear Regulatory Supervision Process During the Nuclear Power Plant Commissioning Phase', through which a workshop on Self-assessment of Emergency Arrangements and Use of Emergency Preparedness and Response Information Management System (EPRIMS) was organized, as well as a follow up expert mission on completing the self-assessment. Additionally, the IAEA provided expert support to review the Bangladesh Atomic Energy Regulatory Authority's regulatory documents.

Jordan receives assistance to enhance national capacities in exploiting uranium ores under JOR2017, 'Enhancing the National Capabilities in Exploiting Uranium Ores in a

Safe and Environment Friendly Manner'. The project aims to establish indigenous mineral resources extraction in a safe and environment friendly manner to fulfil the national strategy on energy security. Several procurements were accomplished in 2023, as well as scientific visits, fellowships and other training opportunities. As a result, Jordan was able to significantly strengthen its capabilities in uranium extraction.

In 2023, under the framework of JOR2015, 'Supporting the Implementation and Construction Activities of the First Nuclear Power Plant', the Agency assisted Jordan with several expert missions and fellowship training, contributing to Jordan's enhancement of its human capacity in this area. One important mission under the NPP project was held in August 2023 at IAEA headquarters, when 18 IAEA staff members and three external experts evaluated Jordan's studies to support decision making on deploying SMRs. Areas covered by the review included nuclear power technology and safety, siting and licensing, nuclear desalination, nuclear law and stakeholder engagement, among others.

The IAEA supported Saudia Arabia in 2023 under SAU2011, 'Continuing National Nuclear Infrastructure Development for Phase 3' through the organization of national workshops on Funding for Decommissioning and Long-Term Management of Radioactive Waste, and Design Safety Principles for Nuclear Power Plants. Additionally, an expert mission was organized to support the country regarding stakeholder analysis and on the functional specifications for a research reactor.

Saudi Arabia was also supported through SAU9012, 'Enhancing Regulatory Capabilities of the Nuclear and Radiological Regulatory Commission'. In 2023, the IAEA organized a national training course for customs officers on Preparedness and Response to Nuclear and Radiological Emergencies, as well as a national training course on radiation safety. A National School of Radiation Emergency Management: Enhancing Regulatory Capabilities of the Nuclear and Radiological Regulatory Commission was also delivered in the country.

In 2023, under the framework of POL2020, 'Strengthening National Nuclear Power Infrastructure and Nuclear and Radiation Safety', the Agency organized several expert missions in Poland, offering support in nuclear power human resource modelling, the development of a waste disposal facility, review of the national communication strategy, and the self-assessment of safety culture. As a result, Poland's national capabilities and competencies for the successful implementation of nuclear power and the regulatory framework for nuclear and radiation facilities were enhanced. The Agency has been providing support to Poland for the introduction of nuclear power through the technical cooperation programme since 2012.

Agency missions to Poland have strengthened national capabilities for nuclear power. (Photo: National Atomic Energy Agency/Poland)

In 2023, under KAZ2009, 'Supporting the Development of Infrastructure for a Nuclear Power Programme (continuation)', the Agency assisted Kazakhstan by providing expert missions on site evaluation, integrated work plan coordination, the regulatory oversight framework and the development of the feasibility report.

The IAEA has been providing support to Uzbekistan for nuclear power development since 2018, initially as ad-hoc support and through a TC Reserve Fund project, and since 2020 under TC project UZB2002, 'Building Human Resources Capacity and Developing National Nuclear Infrastructure for a First Nuclear Power Plant'. An Integrated Nuclear Infrastructure Review (INIR) mission was conducted in 2021 and presented to the Government of Uzbekistan during GC65. In January 2023, a Site and External Events Design Review Service (SEED) mission was carried out at the request of the government, hosted in Tashkent by UzAtom, the State agency for the development of nuclear energy. The IAEA is continuing to support Uzbekistan's efforts to embark on a nuclear power programme through the projects UZB9008, 'Strengthening the Regulatory Framework and Infrastructure for Effective Regulation and Regulatory Oversight of Nuclear Power Plants, Radiation Facilities, and Sources — Phase II', and UZB2004, 'Enhancing National Capacity for the Development of Nuclear Infrastructure for the First Nuclear Power Plant — Phase II'. Uzbekistan is also receiving support for the development of nuclear infrastructure through two interregional TC projects: INT2024, 'Supporting Member States Introducing or Expanding Nuclear Power Programmes to Develop a National Infrastructure for a Safe, Secure and Peaceful Nuclear Power Programme', and INT2023, 'Supporting Member States' Capacity Building on Small Modular Reactors and Micro-reactors and their Technology and Applications as a Contribution of Nuclear Power to the Mitigation of Climate Change'.

E.4. NUCLEAR POWER REACTORS

The Agency is providing Armenia with support through project ARM2005, 'Enhancing Nuclear Safety for the Extended Design Operation Lifetime of the Armenian Nuclear Power Plant'. In 2023, the project supported the exchange of knowledge, as well as practical training for two specialists on ageing effects and equipment degradation evaluation methods through a fellowship at the Nuclear Power Plant in Paks, Hungary. A Knowledge Management Assist Visit (KMAV) level 2 took place to the Armenian Nuclear Power Plant (ANPP) to assess human resources development, competence and knowledge management for the long-term operation of the plant. Moreover, an observer from the ANPP participated in a Safety Aspects of Long Term Operation (SALTO) Mission at the Forsmark Nuclear Power Plant in Sweden. Six Armenian specialists also attended a project progress review meeting and received advice from invited experts. The project is contributing to ensuring a reliable electric power supply for the socioeconomic development of Armenia.

In 2023, Unit 2 of the nuclear power plant in Belarus became fully operational. (Photo: Belarus NPP)

F. Radiation Protection and Nuclear Safety

F.1. REGIONAL HIGHLIGHTS

The IAEA technical cooperation programme contributed to building the capacities of Member States in **Africa** to strengthen national safety infrastructures in all the thematic safety areas. Targeted assistance was provided to Member States participating in the first wave of the Rays of Hope initiative to improve their safety infrastructure with a view to establishing their first radiotherapy facilities. In 2023, several candidates received training through the five-month Postgraduate Education Course (PGEC), which is designed to enhance the capacities of national regulatory bodies to perform their technical services.

In **Asia and the Pacific**, several advances were made in 2023 in the areas of nuclear, radiological and waste safety. Nepal comprehensively updated its national RASIMS profile, encompassing TSA1, TSA2, and TSA3. This process, a collaborative effort spanning more than one and a half years, involved Agency staff and national stakeholders in Nepal. The upgrade of the RASIMS profile is a crucial element in the procurement of radiation sources.

In 2023 the Agency continues to support Member States in **Europe and Central Asia** in the safe, effective and efficient management of their radioactive waste, and decommission and environment. Member State knowledge was improved in various areas such as predisposal planning and integrated waste management, storage and final disposal of waste, and the decommissioning of facilities and sites. Regulatory bodies, service providers and operators enhanced their capacity regarding radiation protection of workers occupationally exposed to ionizing radiation and patients, and on radiation safety in NORM industries. In Moldova, documentation to develop the safety case for decommissioning of the radon type facility, radioactive waste characterization, radiation protection program, and emergency response program was prepared. In Hungary, the Agency built national knowledge about personal dosimetry services through scientific visits to France and Switzerland, and organized workshops in drafting regulations on radiation safety in line with IAEA safety standards.

Hands-on training at the regional Train-the-Trainers course on Medical Physics Support in the Event of Nuclear or Radiological Emergencies, CCHEN, Santiago, Chile, August 2023. (Photo: L. Vironneau)

Nuclear safety and radiation protection remains a priority for the **Latin America and the Caribbean** region. Various project activities on radiation protection were supported through RLA9091, 'Strengthening Regional Capabilities for End Users and Technical Support Organizations on Radiation Protection and Emergency Preparedness and Response in Line with IAEA Requirements'. Approximately 70 professionals from secondary standard dosimetry laboratories (SSDLs) and medical physicist from 14 countries received assistance through specialized practical courses and meetings on the calibration of radiation protection equipment and other instruments. The project also supported regional interlaboratory comparisons in coordination with the Network for Optimization of Occupational Radiological Protection in Latin America and the Caribbean (REPROLAM), which contributed to the development of plans for improving calibration and personal dosimetry services in the region. Regarding medical preparedness and response to radiation emergencies, 73 healthcare professionals from the region, working in medical or related institutions, underwent training which included practical simulated accident scenarios.

Regional course for SSDL on calibration of devices using neutron sources, IRD, Rio de Janeiro- Brazil, March 2023. (Photo: W. W. Pereira)

F.2. GOVERNMENTAL REGULATORY INFRASTRUCTURE FOR RADIATION SAFETY

Saudi Arabia's nuclear regulatory authority, the Nuclear and Radiological Regulatory Commission (NRRC), made significant progress towards the establishment of its National Radiological Monitoring Programme. Under SAU9012 'Enhancing Regulatory Capabilities of the Nuclear and Radiological Regulatory Commission', a roadmap for this task was developed in January. Saudi Arabia has set up a country-wide network for monitoring ambient dose rates as well as radionuclide concentrations in environmental media. The NRRC laboratories are equipped with state-of-the-art equipment for radioanalytical measurements. The laboratories performed well in the proficiency tests organized by the Agency in 2023.

Under NEP9006, 'Enhancing National Infrastructure for Radiation Safety', essential radiation safety equipment was procured in 2023, including a pressurized ionization chamber survey meter, an advanced radionuclide identification device, and a handheld dual survey meter. These acquisitions have strengthened Nepal's capacities to maintain high standards of radiation safety.

In 2023, Singapore conducted a study on the holistic management of radioactive contaminated wastewater during and after a potential radiological dispersal device (RDD) incident, supported by SIN9028, 'Enhancing Capability in Nuclear Safety, Radiation Protection, and Emergency Preparedness and Response'. The study led to the development of robust remediation and mitigation plans, as well as plans for preparatory actions in the event of an RDD incident. Agency assistance included the review of methodologies used in the study, identification of gaps and recommendations for further improvement of the study in line with relevant IAEA guidance and standards and international best practices in the management of radioactive contaminated wastewater.

Several capacity building events were held in Latin America and the Caribbean in 2023 to enhance radiation safety infrastructure and achieve and maintain a sustainable national regulatory system for radiation safety and the safe transport of radioactive material. The events were supported under project RLA9090, 'Strengthening the Regulatory Infrastructure to Enhance Radiation Safety in Latin America and the Caribbean', which aims to improve the safe management of radioactive waste and the protection of the public and the environment, to contribute to increase capacities for preparedness and response with regard to radiological emergencies, and to develop national strategies for education and training in radiation safety. Training events addressed, inter alia, control of orphan sources in scrap metal industry, strengthening the capacities of first responders when responding to a radiological emergency, capacities for emergency preparedness and

response during transport, and national strategies for education and training in radiation safety. Coordination meetings with relevant stakeholders from the different Thematic Safety Areas (TSAs) were also organized, which contributed to the exchange of experiences and lessons learned, and facilitated networking and enhanced coordination at the regional level among regulatory bodies from the Latin America and the Caribbean.

F.3. GOVERNMENTAL AND REGULATORY INFRASTRUCTURE FOR NUCLEAR INSTALLATIONS SAFETY

The Bangladesh Atomic Energy Regulatory Authority (BAERA) conducted a comprehensive review of its draft regulatory documents. The evaluation was conducted under TC project BGD9019, 'Strengthening the Nuclear Regulatory Supervision Process During the Nuclear Power Plant Commissioning Phase', with a keen consideration of alignment with the IAEA safety standards and other internationally recognized practices in the field.

Turkmenistan received a multidisciplinary IAEA mission in 2023 to assist the country in establishing regulatory safety infrastructure and individual workplace monitoring and calibration services. Support for the mission was provided under TKM9002, 'Strengthening Radiation Safety Through the Development of a National Regulatory Infrastructure in Line with IAEA Safety Standards', and TKM6001, 'Establishing Dosimetry and Calibration Services to Improve Radiation Safety'. The mission experts visited several facilities, and conducted a workshop on Radiation Safety Regulatory Framework in accordance with the IAEA Basic Safety Standards. This allowed the mission experts both to present the Agency safety standards and guidelines and be informed on Turkmenistan's regulatory infrastructure.

Türkiye received assistance to conduct a gap analysis of its regulatory authority's competences in 2023 with the support of project TUR9023, 'Strengthening the Nuclear Regulatory Authority's Regulatory Capabilities on Safety and Security'. Existing competencies were mapped and compared with required competencies, and priorities for action were identified. Under the same project, the country received support in 2023 for a range of topics, including regulatory functions related to nuclear power programmes.

Romania operates a large fleet of nuclear facilities, including a nuclear power plant, a research reactor and research facilities. The country is also participating in the Small Modular Reactor development project and the Advanced Lead Fast Reactor European Demonstrator (ALFRED) project. In 2023, under ROM9039, 'Enhancing National Capabilities and Infrastructure in Nuclear and Radiation Safety', the Agency conducted an Integrated Regulatory Review Service, with the aim of strengthening and enhancing the effectiveness of the country's regulatory infrastructure for nuclear, radiation, radioactive waste and transport safety.

F.4. RADIATION PROTECTION OF WORKERS, PATIENTS AND THE PUBLIC

Under MON9010, 'Establishing Capacity to Develop a Radon Risk Map — Phase I', Mongolia enhanced its radon monitoring capability through training courses on radon mapping, data analysis and measurement protocols. Key procurements included a radon passive detector system and a portable HPGe spectrometer, which enhanced on-site investigations and environmental monitoring. The new equipment has allowed Mongolia to develop more efficient and accurate data collection and analysis, which is essential for advancing national nuclear safety and research. A human resources capacity building component helped ensure the effective implementation and sustainability of the radon risk mapping initiative.

The current air monitoring network setup of Malta's Environment and Resources Authority (ERA) does not allow for the measurement of iodine-131, an important radioisotope that may be released in the case of a nuclear emergency. The Agency is helping to enhance the monitoring capabilities of the existing network through project MAT9010, 'Monitoring of Gaseous Radioactive Iodine in the Air'. In 2023, the IAEA procured a gaseous iodine monitor that was installed at the end of the year. Fellowships for two ERA staff at the National Inspectorate for Nuclear Safety and Radiation Protection in Italy were also supported. The new equipment can monitor gaseous iodine in real-time and will strengthen the country's emergency monitoring programme.

Radiological laboratory equipment to enhance the air monitoring network in Malta. (Photo: R. Camilleri)

National radiation protection societies from Latin America and the Caribbean gathered in the Dominican Republic in October to prepare an action plan to strengthen radiation protection in the region, and to strengthen ties among the existing eighteen professional societies for radiation protection. Fifteen of the eighteen societies, plus the coordinating society, the Federation of Radioprotection in Latin America and the Caribbean (FRALC), attended the IAEA-facilitated meeting. The action plan includes 46 concrete tasks, directed either to a specific society or to the group as a whole. Interactions between societies are essential for the development of each action point, as well as their sustainability, and will support the building of alliances with other stakeholders, such as regulatory bodies, users and service providers.

Efforts also continued to strengthen and expand national capacity in the area of radiation safety within IAEA-CARICOM Member States. Radiation detection equipment was provided to customs agencies in nine countries. Thirty personnel from ten Member States in the region were trained on customs activities regarding radioactive materials, including on the use of the equipment procured for the countries.

Dedicated support was provided to the Customs and Excise Division of Antigua and Barbuda to assess radiation protection measures in place at the V.C. Bird International Airport and St. John's Seaport. This provided valuable information on the existing operational radiation safety systems, as well as recommendations for improvements to minimize the exposure of staff and the public to ionizing radiation, including the implementation of a radiation programme for customs operations..

F.5. TRANSPORT SAFETY

In 2023, countries participating in regional project RAF9063, 'Strengthening Competent Authorities for the Safe Transport of Radioactive Material (AFRA)', were provided with inspection tools and equipment, and received assistance in drafting regulations for the safe transport of radioactive materials. As a result, 23 participating countries from Africa now have drafts of regulations on the safe transport of radioactive material, in compliance with the IAEA safety standards.

TC Regional Workshop to review draft national regulations on the safe transport of radioactive material within the School of Drafting Regulations for English speaking countries, December 2023. (Photo: J. O'Brien/IAEA)

F.6. RADIOACTIVE WASTE MANAGEMENT, DECOMMISSIONING AND ENVIRONMENTAL REMEDIATION

Following meetings, consultations and workshops in 2023, Iraq approved a national strategy for the management of naturally occurring radioactive material and NORM waste in the oil and gas industry, as a result of discussions between the Iraqi Atomic Energy Commission and British Petroleum. The process was supported through IRQ9017, 'Managing Naturally Occurring Radioactive Material Waste in the Oil and Gas Industry'. The strategy covers the responsibilities and roles of the government, the regulatory body, operators, and the beneficiary body, as well as the limits of exemption and release, based on the standards of the IAEA.

Efforts by the Iraqi Atomic Energy Commission and the Ministry of Environment led to the successful release of 57 out of 67 contaminated sites from regulatory control. A collaborative approach and diverse decontamination methods, supported by IRQ9016, 'Enhancing Radioactive Waste Management', played a crucial role in these accomplishments. Ten sites in southern Iraq are still undergoing remediation for depleted uranium contamination.

The Agency is providing the Republic of Moldova with assistance to enhance its technical capabilities to decommission and manage legacy radioactive waste from the country's inadequate RADON type near surface disposal facility under MOL9009, 'Enhancing Technical Capabilities for Decommissioning of Near Surface Radon Type Facility and Environmental Remediation'. In 2023, project experts supported the development of the safety case for decommissioning the facility, covering chapters on the radiation protection programme, radioactive waste characterization, and the emergency response programme. In support of the safety case, project activities supported the establishment of a light containment facility for the removal of legacy waste and the decommissioning of the RADON type disposal facility. Technological and radiation protection equipment required by the safety case was provided through the project, including dry-heating equipment for wet solid radioactive waste. Moldova's Radioactive Waste Management Organization now has the capacity to bring legacy radioactive waste into a stable form that will prevent further environmental contamination of ground water and soil and will reduce the exposure of personnel and the public in general.

The Agency is providing the Republic of Moldova with assistance to enhance its technical capabilities to decommission and manage legacy radioactive waste. (Photo: IAEA)

Regional workshop on brachytherapy calibrations and measurements, Seibersdorf, Austria. April 2023. (Photo: Graciela Vélez)

Project RER9154, 'Enhancing the Implementation of Integrated Programmes for the Safe Management of Radioactive Waste', aims to enhance radioactive waste management capabilities by leveraging regional cooperation, knowledge sharing and the development of infrastructure. In 2023, 14 regional workshops and training courses were carried out under the project, addressing gaps identified at the outset of the project and covering all relevant subject areas under waste management.

Jamaica has received Agency assistance through JAM9005, 'Strengthening National Capacities in Radiation Safety and Protection for the Regulatory Body, End Users and Technical Service Organizations', for the safe conditioning and temporary storage of disused brachytherapy sources that had to be removed from Cornwall Regional Hospital due to ongoing construction works at that location. The Agency provided expert advice to the national authorities for the safe conditioning of the sources, as well as for their safe and secure transport and storage.

Transport convoy leaving Cornwall Regional Hospital in Montego Bay with disused radioactive sources of medical use (Photo: Ministry of Health and Wellness, MoHW, Jamaica)

G. Nuclear Knowledge Development and Management

G.1. REGIONAL HIGHLIGHTS

Nuclear technology requires a high level of technical knowledge and experience that must be developed and kept available for current and future generations. In 2023, support for nuclear knowledge development and management was an important component of the technical cooperation programme in **Africa**. Human resource development in Africa was supported through short and long-term training, leading to professional and academic qualifications including postgraduate degrees. In September 2023, the winners of a competition for students from African countries on the benefits of nuclear science and technology were celebrated at a side event during the 67th IAEA General Conference.

IAEA Director General Rafael Mariano Grossi with committee members and experts from ANENT, IAEA and partner organizations at an event held on the margins of the 67th IAEA General Conference to celebrate ANENT's 20th birthday (Photo: Dean Calma/IAEA)

In **Asia and the Pacific**, several Member States made progress on nuclear knowledge development and management with Agency support. The Asian Network for Education in Nuclear Technology (ANENT) celebrated its 20th anniversary at a side event at the 67th IAEA General Conference, showcasing ANENT's progress and achievements over the past two decades. The International Nuclear Science and Technology Academy (INSTA) became fully operational in 2023 with the ambition of supporting nuclear science and technology (NST) educators in universities who can contribute to the safe, secure, peaceful and beneficial use of nuclear science and technology around the world.

In **Europe and Central Asia**, the Agency supported a Knowledge Management Assist Visit (KMAV) mission in 2023 which provided guidance to Georgia for the implementation of knowledge management practices. The focus was on the Learning Management System (LMS) and the strategic coordination with academia and other training centres at the national level to ensure sustainable workforce pipelines for nuclear professionals to address the skill shortage.

Latin America and the Caribbean faces challenges in training and retaining talented human capital in the nuclear field. The Agency is working to strengthen education, training and management of nuclear knowledge in the region.

G.2. CAPACITY BUILDING, HUMAN RESOURCE DEVELOPMENT AND KNOWLEDGE MANAGEMENT

The Agency supported a joint regional training course with Argonne for teachers and educators from Africa that focused on introducing nuclear sciences in secondary schools using innovative approaches. The course was supported under RAF0060, 'Educating Secondary School Students and Science Teachers on Nuclear Science and Technology (AFRA)'. Seventeen teachers from sixteen African countries participated in the training course, which helped secondary school teachers to develop the skillset needed to effectively convey nuclear science and technology knowledge by strengthening their technical knowledge and exposing them to engaging educational approaches.

In Asia and the Pacific, participants in regional project RAS0091, 'Supporting Nuclear Science and Technology Education at the Secondary and Tertiary Level', achieved significant milestones. A working document for a five-part guidebook five series was launched, providing a comprehensive framework for introducing nuclear science and technology at the secondary level. The project participants adopted five strategic approaches to enhance educators' skills, ensuring sustained and effective facilitation of learning on NST topics. During a Seminar in Oman in October, 80 participants and experts from 21 countries in the region met to share best practices, fostering collaboration and knowledge exchange on integrating NST into secondary level education. The scope of the initiative has expanded to include students with special needs and non-science students.

Eighty participants and experts shared insights on effective practices in integrating Nuclear Science and Technology into Secondary Science Education in the Asia-Pacific region during a seminar held in Muscat, Oman. (Photo: I. Lim/Philippines)

The infrastructure of the Lebanon Atomic Energy Commission's (LAEC) Time-of-Flight Secondary Ion Mass Spectrometry Laboratory, Surface Chemical Characterization Laboratory and Individual Monitoring Service Laboratory is currently being upgraded, with new equipment including an inductively coupled plasma mass spectrometry unit under procurement. This is taking place under LEB5017, 'Strengthening Technical Capabilities by Introducing Metal Speciation Techniques to Support Health and Environmental Safety'. LAEC staff have been trained through four scientific visits and six have been sponsored to participate in international conferences on topics including forensic sample analysis, health and environment safety monitoring, food safety and industrial applications, among others. The Agency continues to support the improvement of the regulatory authority's capabilities for inspection and licensing.

In Syria, the Agency supported Syria's educational programme by following up on the results of the 2022 Nuclear Knowledge Management Assist Visit.to the country. Six knowledge management fellowships were implemented with the support of SYR0023, 'Strengthening Human Resource Capacity Building and Nuclear Knowledge Management in Nuclear Science and Technology', and an action plan was developed to support the development of skills in young professionals.

Bulgarian experts gained insights into human resources management and development. (Photo: NRA)

In 2023, under the framework project BUL0012, 'Implementing an Integrated Approach for Capacity Building at the Nuclear Regulatory Agency', Bulgarian experts benefited from scientific visits on the organization and implementation of human resources development systems, as well as introductions to various knowledge management systems and methodologies, hosted by regulatory authorities in Finland and Spain. These visits allowed the Bulgarian experts to gain insights into human resources management and development, knowledge management practices, the organization of specialized training, the integrated management system of the organization, and education and training systems. Additionally, experts obtained further information on the state-of-the-art developments in the field of nuclear knowledge management and preservation.

Latin American representatives and members of LANENT attended the Nuclear Educational Networks Meeting in Vienna in July. During the event, the results of project RLA0065, 'Furthering Knowledge Management Implementation in Nuclear Organizations and Strengthening Nuclear Education', were shared with 60 participants from 34 Member States, including representatives from nuclear education institutions and OECD's Nuclear Energy Agency (NEA). The meeting provided a forum for discussion and experience sharing, and an opportunity to engage and strengthen collaboration in nuclear education.

Annex 2. TC Programme Fields of Activity[15]

Nuclear Knowledge Development and Management
Capacity establishment, programme knowledge management and facilitation of cooperation among Member States (01)
Building national nuclear legal infrastructures (03)
Industrial Applications/Radiation Technology
Reference products for science and trade (02)
Research reactors (08)
Radioisotopes and radiation technology for industrial, health-care and environmental applications (18)
Accelerator technology (32)
Nuclear instrumentation (33)
Energy
Energy planning (04)
Introduction of nuclear power (05)
Nuclear power reactors (06)
Nuclear fuel cycle (07)
Food and Agriculture
Crop production (20)
Agricultural water and soil management (21)
Livestock production (22)
Insect pest control (23)
Food safety (24)
Health and Nutrition
Comprehensive cancer control (25)
Radiation oncology in cancer management (26)
Nuclear medicine and diagnostic imaging (27)
Radioisotopes and radiopharmaceuticals production for medical applications (28)
Dosimetry and medical physics (29)
Nutrition for improved health (30)
Water and the Environment
Water resources management (15)
Marine, terrestrial and coastal environments (17)
Safety and Security
Governmental and regulatory infrastructure for radiation safety (09)
Safety of nuclear installations, including siting and hazard characterization (10)
Governmental and regulatory infrastructure for nuclear installations safety (11)
Radiation protection of workers and the public (12)
Transport safety (13)
Nuclear security (14)
Emergency preparedness and response (16)
Radioactive waste management, decommissioning and remediation of contaminated sites (19)
Radiation protection in medical uses of ionizing radiation (31)

[15] Updated in 2020 for the IAEA TC programme 2022–2023. The field of activity number is shown in parentheses.

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