

Overview

This chapter provides an overview of some of the programmatic activities that focused, in a balanced manner, on developing and transferring nuclear technologies for peaceful applications, enhancing nuclear safety and security, and strengthening nuclear verification and non-proliferation efforts worldwide.

Although the world was still experiencing the effects of the COVID-19 pandemic in 2022, the Agency continued to deliver on its mandate, with operations close to normal. The Agency also responded to Member States' requests for assistance in overcoming the consequences of regional or global medical emergencies, natural disasters, industrial accidents, and the armed conflict in Ukraine impacting the safe and secure operation of nuclear facilities.

Leveraging the Agency's approved projects distributed across the Departments, the Director General's initiatives, highlighted below, continued to be implemented through enhanced inter-Departmental coordination and in close cooperation with Member States and other interested partners, with a view to making greater impact in addressing global issues.

Rays of Hope

Through Rays of Hope, an initiative launched in February 2022 by the Director General with President Macky Sall of Senegal at the African Union Summit, the Agency, in collaboration with Member States, strives to increase access to affordable, equitable, effective and sustainable radiation medicine services within a comprehensive cancer control system. Benin, Chad, the Democratic Republic of the Congo, Kenya, Malawi, the Niger and Senegal are among the first countries to have developed action plans under Rays of Hope to address existing needs and gaps (see related case study). In addition, long-term training and the procurement of radiotherapy and nuclear medicine equipment have been initiated. The Agency is engaging with Member States that have requested support to assess their needs and prepare respective action plans.



The Director General and President Macky Sall of Senegal at the African Union Summit, February 2022.



Opening of the 2022 Scientific Forum on Rays of Hope: Cancer Care for All, September 2022.

In December, the Agency partnered with 11 of the largest professional societies in cancer care, with the aim of strengthening the Agency's support to its Member States, particularly in the areas of capacity building in radiation oncology, medical physics and diagnostic imaging. Their expertise, educational resources and training will also be channelled through regional Rays of Hope 'anchor centres' to Member States on the ground. Anchor centres are designed to contribute to the sustainability and quality of care in the region.

The Agency and the World Health Organization (WHO), building on their long-standing collaboration, released a joint statement on 4 February 2022 on reducing inequity in access to cancer care through Rays of Hope.

High-level representatives and leading experts met at the Agency's 2022 Scientific Forum on Rays of Hope: Cancer Care for All to discuss how to establish and expand capacities to address cancer challenges at the national and global level. Participating in the forum, the WHO Director-General, the President of Malawi, the Minister of Health of Benin, the Secretary of Energy of the United States of America and the General Administrator of the French Atomic Energy Commission lauded the initiative. While Member States, in addition to non-traditional donors including private companies and development banks, have supported Rays of Hope through record financial contributions, intensive efforts are being made to mobilize sufficient resources with the aim of closing the funding gap.

ZODIAC: Zoonotic Disease Integrated Action

As of December 2022, 150 Member States had designated national coordinators and 126 had designated national laboratories for the Agency's Zoonotic Disease Integrated Action (ZODIAC) initiative. In 2022, some 1000 participants from more than 95 Member States took part in virtual interregional training courses organized through the technical cooperation (TC) programme, and the first ZODIAC fellows from Indonesia, Senegal and Tunisia were trained in whole-genome sequencing at the Agency's Seibersdorf laboratories.

An initial in-person regional training course took place at the Institut Pasteur de Dakar in Senegal on the generic verification of standard operating procedures for new serological and molecular techniques.

Thirty ZODIAC national laboratories received serology and molecular diagnostic equipment and nine received whole-genome sequencing platforms.



Opening of the ZODIAC workshop on mpox (monkeypox) and Lassa fever infections in animal reservoirs and the risks for public health transmission, held with WHO and FAO, June 2022.

Four regional research projects were developed to enhance laboratory preparedness for the detection and control of relevant priority diseases for all regions.

Close coordination with WHO and the Food and Agriculture Organization of the United Nations (FAO) was strengthened.

Regarding ZODIAC's human health component, core research institutions were identified and a research project was initiated to characterize disease-specific patterns in patients infected by zoonotic diseases.

The ZODIAC Portal, an information and resource website offering educational videos and training materials, was launched and is attracting more than 1000 visitors each month.

NUTEC Plastics: Nuclear Technology for Controlling Plastic Pollution

Since its launch in 2021, 78 countries have joined the Agency's Nuclear Technology for Controlling Plastic Pollution (NUTEC Plastics), engaging in upstream and downstream activities that include technology transfer via the Agency's TC programme and research and development through coordinated research projects (CRPs).

In 2022, an integrated action plan on NUTEC Plastics was published on the Agency's website, outlining three major areas of action: the assessment, planning and establishment of pilot plant(s) for plastic waste recycling; marine microplastics monitoring and assessment; and NUTEC Plastics outreach and partnership building.

Also in 2022, harmonized protocols for marine sediment and seawater sampling were developed, to be used by national laboratories during marine microplastics sampling campaigns in 2023.

The Agency launched a CRP on using ionizing radiation to recycle polymer waste for structural and non-structural materials. Seven countries are piloting the use of irradiation for recycling and three have advanced towards technology readiness level 3. Two meetings were held on strengthening the generation of bio-based products that could replace single use petrol-based products through radiation processing.

NUTEC Plastics was again included in a report by the G-20 and featured at the UN Ocean Conference in June 2022, attended by international experts, high-level officials, scientists and global leaders meeting to address ocean pollution, acidification, deoxygenation and warming.



The Director General speaking at the UN Ocean Conference, June 2022.

Nuclear Harmonization and Standardization Initiative

The Nuclear Harmonization and Standardization Initiative (NHSI) was launched by the Director General in June 2022 to reflect the need for the harmonization of regulatory, and the standardization of industrial, approaches for small modular reactors. NHSI aims to advance the effective, safe and secure global deployment of advanced nuclear reactors, in particular small modular reactors, which are expected to play an important role in achieving net zero targets. Under NHSI, regulators, designers, operators and international organizations work together, consistent with respective roles and responsibilities, to harmonize regulatory and standardize industrial approaches.

At the NHSI kick-off meeting, 125 participants from 33 Member States and a number of international organizations reached a consensus on the general scope of the initiative. As a result, the Agency has started work in seven areas split into two tracks. Under the regulatory track led by the Department of Nuclear Safety and Security, the focus is on building an information-sharing framework, developing an international pre-licensing regulatory design review and developing processes to leverage other regulators' reviews. Under the industry track led by the Department of Nuclear Energy, the focus is on harmonizing high-level user requirements, developing common approaches for codes and standards, experiments and simulation codes' validation and accelerating the implementation of small modular reactor infrastructure.

The respective working groups met at least twice in the second half of 2022 to identify key challenges, prepare work plans to 2024, assign tasks and start drafting relevant documentation and discussing the development of information-sharing platforms.

In total, more than 25 regulatory bodies and 30 nuclear industry companies, as well as international and industry organizations, are participating actively in NHSI. An effective interface between the two tracks is ensured by the Agency through the continuous exchange of information and the participation of industry stakeholders in relevant activities under the regulatory track.



NHSI kick-off meeting, June 2022.

IAEA Platform on Small Modular Reactors and their Applications

The IAEA Platform on Small Modular Reactors and their Applications aims to provide consistent and coordinated Agency support related to all aspects of small modular reactor development, deployment, and oversight.

During 2022, the Platform addressed seven requests for assistance covering a wide range of areas, including energy system analysis modelling for small modular reactor deployment, the role of such reactors in the energy transition, nuclear desalination using small modular reactors, and institutional, legal and regulatory aspects related to floating NPPs.

The Platform developed a medium-term strategy through 2029 to establish strategic objectives that ensure timely, relevant and consistent Agency contributions to address the needs and requests of Member States. These strategic objectives range from helping Member States to make informed decisions on the deployment of small modular reactors, to supporting the establishment of relevant frameworks and providing knowledge and technology transfer through technical cooperation. A high-level work plan is under development to implement these objectives.

A web portal for the Platform was launched to enable information exchange, outreach and networking, facilitate internal and external collaboration with Member States, and inform the public about the Agency's work on small modular reactors.

The Agency published a high-level booklet entitled *Small Modular Reactors: A new nuclear energy paradigm* developed within the framework of the Platform. The report addresses factors to be considered by Member States when deciding whether to adopt small modular reactors and how to enable their safe, secure, peaceful and sustainable deployment.

IAEA Marie Skłodowska-Curie Fellowship Programme

The IAEA Marie Skłodowska-Curie Fellowship Programme (MSCFP) aims to encourage women to pursue a career in nuclear-related fields by providing highly motivated female students with scholarships for master's programmes and an opportunity to pursue an internship facilitated by the Agency. Between the programme's launch in 2020 and the end of 2022, a total of 360 students were awarded a scholarship.

The third round of applications closed on 30 September 2022, resulting in 150 selected students from 91 Member States who will be undertaking their studies in 48 countries. With the support of the MSCFP in 2022, 76 students completed their master's studies and 50 pursued internships facilitated by the Agency. The programme also launched the MSCFP Student and Alumni LinkedIn Group, where students have the opportunity to connect with their peers, exchange knowledge and experience, and access information about technical programmes and events that can benefit their personal and professional development.



According to MScFP recipient Carolina Gutiérrez Bolaños from Mexico, *“The MScFP programme will help more women enhance their education in nuclear-related fields, which is very important for present and future generations. We need to keep working together, women and men, to create opportunities for a more balanced workforce in nuclear. Both men’s and women’s creativity are needed to improve research in many scientific areas.”*

Beatrice Boatema, an MScFP fellow from Ghana, recalled that *“My dream of becoming a researcher and a consultant in nuclear engineering was nearly abandoned until I applied for the MScFP. My tuition and stipend were adequately paid, giving me peace of mind to concentrate on my studies. I could also afford books and other research materials.”*



Sara Ahmad from Portugal, another recipient of an MScFP fellowship, said that *“This programme allowed me to travel to a foreign country to complete my master’s and to entirely dedicate myself to my research project, where I worked among other qualified professionals in the nuclear field and had the opportunity to learn from them. I hope to apply my nuclear physics knowledge for medical purposes in my future career — preferably in medical physics research in hospitals or universities, especially the improvement of proton beam therapy and mitigation of its uncertainties.”*

IAEA Lise Meitner Programme

The IAEA Lise Meitner Programme offers an opportunity for women to boost their career development in the nuclear field by enhancing their technical and leadership skills during a multi-week visiting professional programme hosted by partnering Member States. This new initiative was announced by the Director General in October 2022 at the International Ministerial Conference on Nuclear Power in the 21st Century.

Nuclear Safety, Security and Safeguards in Ukraine

Since 24 February 2022, when information was received on the imposition of martial law on the territory of Ukraine and an alert at Chernobyl NPP, the Agency has established regular contact with the Ukrainian authorities and has been closely monitoring and assessing the situation in Ukraine, focusing on its implications for nuclear safety, security and safeguards.

Soon after the start of the armed conflict, the Agency formulated seven indispensable pillars for ensuring nuclear safety and security during an armed conflict (the ‘Seven Pillars’), which derive from and are aligned with IAEA safety standards and nuclear security guidance. Since their formulation, the Agency has used the Seven Pillars to tailor its independent and impartial assessment of the nuclear safety and security situation in Ukraine in the context of the ongoing armed conflict. Throughout the year, the Seven Pillars were either partially or fully compromised at almost all nuclear sites in Ukraine, in particular at Zaporizhzhya NPP (ZNPP).

Since the start of the armed conflict, the Agency has worked in a transparent, fact-based and authoritative manner by publishing relevant information on its 24/7 secure communication channel, the Unified System for Information Exchange in Incidents and Emergencies, issuing public statements and updates, publishing summary reports and issuing reports to the Agency’s Policy-Making Organs regarding the nuclear safety, security and safeguards situation in Ukraine. In 2022 the Agency issued 138 public statements, produced two summary reports on nuclear safety, security and safeguards in Ukraine (28 April and 6 September) and presented to the Board of Governors two oral briefings (March and June) and two detailed reports (September and November). The Board of Governors adopted by a vote three resolutions on the safety, security and safeguards implications of the situation in Ukraine, on 3 March, 15 September and 17 November.

The Agency drew up and agreed with Ukrainian officials a concrete and detailed technical plan for the provision of nuclear safety and security assistance to Ukraine in four areas: in-person technical assistance, delivery of equipment, remote assistance and rapid deployment assistance.

The Agency conducted nine in-person missions to Ukraine to help stabilize the situation, closely assess nuclear safety and security and assess corresponding needs. Three of these missions, including the IAEA Support and Assistance Mission to Zaporizhzhya (ISAMZ) in September 2022, when the continuous presence of Agency staff was established at ZNPP, were led by the Director General. The Director General paid two additional visits to Kyiv in 2022 to further assist in stabilizing the nuclear safety and security situation in Ukraine. In addition, the Agency arranged seven deliveries of nuclear safety- and security-related equipment to the country, intended for nine different organizations and comprising radiation monitoring and personal protective equipment, IT and communication equipment and portable power supply systems. Lastly, in 2022, the Agency agreed with Ukrainian officials that a continuous Agency presence would also be established at Khmelnytsky, Rivne, South Ukraine and Chernobyl NPPs. These missions were conducted with the support of the Department of Safety and Security and the Department of Operational Support of the United Nations Secretariat.

The Agency exerted intensive efforts to attain agreement on the establishment of nuclear safety and security protection around ZNPP with the aim of preventing a nuclear accident.

The Agency worked closely with Ukraine, Member States and international organizations to ensure efficient coordination and avoid duplication in the provision of technical support and assistance to Ukraine.

The Agency implemented safeguards in Ukraine throughout the year, including in-field verification activities, in accordance with Ukraine’s comprehensive safeguards agreement and additional protocol. On the basis of the evaluation of all safeguards relevant information available to the Agency, the Agency did not find any indication giving rise to a proliferation concern.



Pillar 1 – Physical integrity

The physical integrity of facilities — whether it is the reactors, fuel ponds or radioactive waste stores — must be maintained.



Pillar 2 – Safety and security systems and equipment

All safety and security systems and equipment must be fully functional at all times.



Pillar 3 – Operating staff

The operating staff must be able to fulfil their safety and security duties and have the capacity to make decisions free of undue pressure.



Pillar 4 – Off-site power supply

There must be a secure off-site power supply from the grid for all nuclear sites.



Pillar 5 – Logistical supply chain

There must be uninterrupted logistical supply chains and transportation to and from the sites.



Pillar 6 – Radiation monitoring and emergency preparedness and response

There must be effective on-site and off-site radiation monitoring systems, and emergency preparedness and response measures.



Pillar 7 – Communication

There must be reliable communication with the regulator and others.

The seven indispensable pillars for ensuring nuclear safety and security during an armed conflict.

Agency Missions to Ukraine



The Director General meeting Ukrainian staff at South Ukraine NPP, 29 March 2022.



The Director General meeting Ukrainian officials during his visit to the Chornobyl Exclusion Zone, 26 April 2022.



The Director General, accompanied by IAEA nuclear safety, security, and safeguards staff, setting off on their first visit to ZNPP, 29 August 2022.



The Director General meeting with Ukraine's President Volodymyr Zelenskyy in Kyiv during the IAEA Support and Assistance Mission to Zaporizhzhya, 30 August 2022. (Photograph courtesy of the Ukrainian Presidential Press Service)



The Agency's ISAMZ arrives at ZNPP, 1 September 2022.

First International Conference on Nuclear Law: The Global Debate

The Agency held its First International Conference on Nuclear Law: The Global Debate from 25 to 29 April 2022 at Headquarters in Vienna. The conference provided a unique forum for leading global experts from governments, international and non-governmental organizations, industry, academia and civil society to discuss and share experiences of topical issues in international and national nuclear law, and emerging issues and trends regarding current and evolving peaceful applications of nuclear science and technology, with a view to identifying areas for possible further development. The conference also provided an opportunity to discuss capacity-building programmes in this field and opportunities and challenges for the next generation of nuclear lawyers. In addition, it enabled an examination of the role of nuclear law in the context of other areas of law, including energy law, environmental law, maritime law and the law of the sea. Held in a hybrid format, with both in-person and virtual participation, the event was attended by a total of 1124 people from 127 Member States and 31 organizations.

In preparation for the conference, the Agency published a book entitled *Nuclear Law: The Global Debate*, available in Arabic, Chinese, English, French, Russian and Spanish. On the sidelines of the conference, the Director General launched a partnership initiative with six academic institutions in Africa, the Americas and the Middle East to increase educational and professional development opportunities for students and aspiring professionals in the field of nuclear law.



Opening plenary session of the conference, on “Nuclear Law: The Vision”, April 2022.

NUCLEAR TECHNOLOGY

Nuclear Power, Fuel Cycle and Nuclear Science

Status and trends

For a second successive year, the Agency revised up its annual projections of the potential growth of nuclear power during the coming decades, reflecting a shift in the global debate around energy and the climate amid growing concerns over energy security.

In its new outlook for global nuclear capacity for electricity generation, the Agency increased its high case projection to 873 gigawatts (electrical) (GW(e)) in 2050. To be realized, this would require large scale implementation of long term operation (LTO) across the existing fleet and nearly 600 GW(e) of new build in the coming three decades.

At the end of 2022, the world's total nuclear power capacity was 393.8 GW(e), provided by 438 nuclear power reactors in operation in 32 countries. During the year, over 7.4 GW(e) of new capacity was connected to the grid, from 6 pressurized water reactors; 3.3 GW(e) of capacity was retired, with the permanent shutdown of 5 nuclear power reactors. Supplying 2486.8 terawatt-hours of greenhouse gas emission-free electricity, nuclear power accounted for approximately 10% of total global electricity generation and more than a quarter of the world's low carbon electricity production. At the end of the year, 59.3 GW(e) of capacity was under construction, comprising 58 reactors, including 8 reactors (9.1 GW(e)) where construction started in 2022.

International conferences

The International Ministerial Conference on Nuclear Power in the 21st Century provided a forum for high-level talks involving around 800 participants from 69 countries and 9 international organizations. The participants agreed that nuclear power can make a significant impact on the decarbonization of the power sector, which is a necessary condition to reach net zero, in line with the Paris Agreement.

The Fifth International Conference on Nuclear Power Plant Life Management gathered 540 participants from 61 Member States and 8 international organizations who exchanged information on programmes for safe and reliable operation, ageing management, modernization and innovation to ensure a sustained contribution to climate change and energy security objectives.



The Director General together with Jennifer Granholm, US Secretary of Energy, opening the International Ministerial Conference on Nuclear Power in the 21st Century, Washington DC, October 2022.

The International Conference on Fast Reactors and Related Fuel Cycles: Sustainable Clean Energy for the Future brought together about 680 participants from 52 Member States and 3 international organizations who discussed national and international programmes for the deployment of fast reactors, their fuels and fuel cycles.

The Agency's first International Conference on Accelerators for Research and Sustainable Development: From Good Practices Towards Socioeconomic Impact enabled some 400 participants from 71 Member States and 3 international organizations to share the latest advances concerning the use of different particle accelerators for cutting edge research and various applications.



The Director General opens the first International Conference on Accelerators for Research and Sustainable Development, May 2022.



Conference participants visit the Vienna Environmental Research Accelerator facility at the University of Vienna optimized for accelerator mass spectrometry.

Energy assessment services

The Agency continued to assist Member States in energy planning to address sustainable development and climate change mitigation. At 51 events, specialists from Africa, Asia, Europe, and Latin America and the Caribbean learned how to evaluate their energy needs, including by using the Agency's energy assessment tools.

The Agency signed a memorandum of understanding with the Latin American Energy Organization on cooperation in the area of energy. The Agency also took part in COP27 held in Sharm el-Sheikh, Egypt.

The publication *Economic Evaluation of Alternative Nuclear Energy Systems: Supplement for the INPRO ASENES Service* (IAEA-TECDOC-2014) assists Member States in conducting economic evaluations of nuclear energy system alternatives and explains the limits of the models used for these evaluations.

Digital innovation and artificial intelligence for nuclear power

The Agency launched a working group focusing on the deployment of AI solutions for nuclear power plants (NPPs) to share knowledge and experience and to address related challenges. A meeting bringing together representatives of regulators, operators, national laboratories, technical organizations and academia initiated the development of a new publication entitled *Deployment of Artificial Intelligence Solutions for the Nuclear Power Industry: Considerations and Guidance*.

The Agency launched a global initiative to support nuclear decommissioning that will collect experiences of the practical application of, and case studies on, new and emerging tools and technologies, such as AI, automation and digitalization, used in data management, planning, licensing and implementation of decommissioning.

Support for operating nuclear power plants

The Agency launched an international network on NPP life management. The network's five working groups focused on good practices and lessons learned, activities during the pre-operational phase of new nuclear power projects, risk-informed decision making, the need to adapt to climate change, and equipment reliability during beyond design basis accidents, all in the context of extended plant operation.

An online training course on Nuclear Supply Chain Management and Procurement was released for the first time in a recorded format, ensuring continuous availability. It provides information about good practices for managing procurement and supply chain activities related to the construction, operation and maintenance of NPPs.

Launching nuclear power programmes

The Agency continued its assistance to newcomer countries. It conducted a Phase 1 Integrated Nuclear Infrastructure Review (INIR) mission to Sri Lanka, and delivered the final Phase 1 INIR report to Uganda (see related case study).

Economics and financing of nuclear power projects

Meeting the goals of the Paris Agreement will require a substantial increase in the level of investment in clean energy technologies. Increased recognition of nuclear energy's climate credentials may open up sustainable financing options that are already accessible to other low carbon technologies. The Agency organized 12 workshops on nuclear financing and on the macroeconomic impacts of investments in the nuclear sector, providing awareness of existing financing approaches.

Capacity building, knowledge management and nuclear information

Six Nuclear Energy Management (NEM) Schools (Canada, China, Italy, Japan, Russian Federation and South Africa) and four Nuclear Knowledge Management Schools (Chile, Italy, Russian Federation and USA) were conducted. Owing to ongoing COVID-19 restrictions, the annual Abdus Salam International Centre for Theoretical Physics (ICTP) NEM School and the China-IAEA NEM School were hosted virtually.

The Agency conducted 14 Knowledge Management Assist Visits, to Chile, Ethiopia, Indonesia, Jordan, Mauritius, Mexico, Nigeria, Rwanda, South Africa, Syrian Arab Republic, and two each to Kenya and Tunisia, reviewing their knowledge management programmes and providing recommendations for enhancements.

Over the year, 124 854 new records were added to the International Nuclear Information System (INIS), including 14 180 full-text documents. The INIS repository was accessed by over 2 million users, who viewed over 4.7 million pages and performed nearly 3 million unique searches.

The Agency officially launched the IAEA Preprint Repository, providing users with Agency publications in advance of their final editing and approval. As of the end of 2022, over 100 preprints had been made available.

Stakeholder engagement

The Technical Meeting on Stakeholder Involvement and Public Communication and the Technical Meeting for Municipalities with Nuclear Facilities provided a forum for information exchange on current programmes and for interaction between different stakeholders. The meetings served to highlight capacity-building needs in stakeholder engagement.

Assurance of supply

The IAEA Low Enriched Uranium Bank in Kazakhstan, which became operational in 2019, continued safe operations at the Ulba Metallurgical Plant.

A low enriched uranium reserve in Angarsk, established following the agreement of February 2011 between the Government of the Russian Federation and the Agency, remained operational.

Fuel cycle

The Agency conducted a Uranium Production Site Appraisal Team (UPSAT) mission to review Mongolia's uranium exploration and mining regulations and the Badrakh in situ recovery pilot test project.



UPSAT review mission coordinated by the Agency in Mongolia, May 2022.

Reactor technology development, innovation and preparation for deployment

The Agency held a Regional Workshop on Advances in the Modelling and Simulation of Thermal Hydraulics in Liquid Metal Cooled Fast Reactors in India and a joint ICTP–IAEA Workshop on Physics and Technology of Innovative Nuclear Energy Systems.

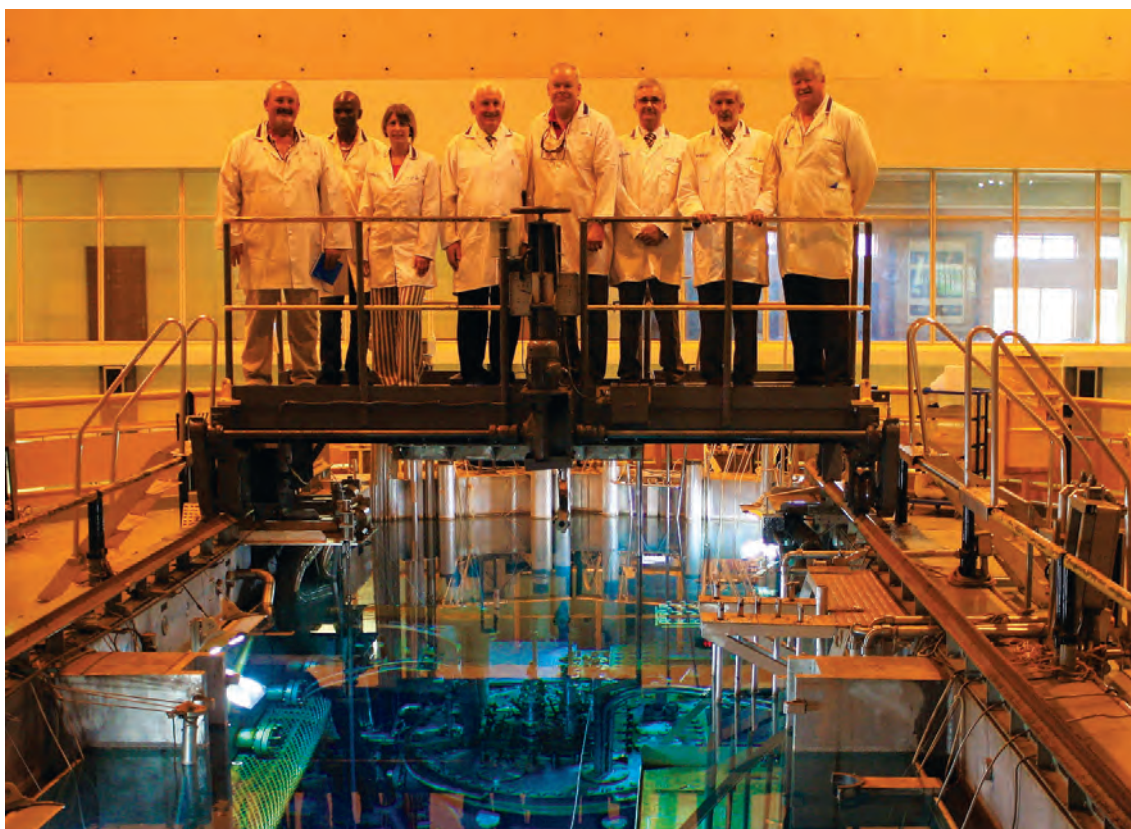
The Agency published the 2022 edition of *Advances in Small Modular Reactor Technology Developments* — a supplement to its Advanced Reactors Information System — which provides an overview of existing small and medium sized or modular reactor (SMR) designs.

Research reactors

Two new training services were introduced. The pilot National Workshop on the Use of Decision Support Tools in Research Reactor Spent Fuel Management, held in Malaysia, supported the development of recommendations concerning the disposition of spent research reactor fuel. The pilot National Training Course on Human Resource Development Plan assisted in planning human resources for Senegal's research reactor programme.

The Integrated Nuclear Infrastructure Review for Research Reactors (INIR-RR) follow-up mission in Nigeria reviewed the development of national nuclear infrastructure for the planned multipurpose research reactor.

The Agency piloted its Integrated Research Reactor Utilization Review (IRRUR) by conducting three missions, to Chile, Peru and South Africa, and provided recommendations for improving and expanding the utilization of research reactors in these countries.



Agency and Necsa teams taking part in the IRRUR mission at the SAFARI-1 research reactor, November 2022. (Photograph courtesy of Necsa)

Radioactive waste management

The Agency launched the Disused Sealed Radioactive Sources Technical Centre peer review to scale up support for the safe and secure management of such sources.

The Agency published the second edition of *Status and Trends in Spent Fuel and Radioactive Waste Management* (IAEA Nuclear Energy Series No. NW-T-1.14 (Rev.1)), which provides a global overview of the status of radioactive waste and spent fuel management concerning inventories, programmes, current practices, technologies and trends.

Decommissioning and environmental remediation

The Agency conducted a peer review requested by the Indonesian National Research and Innovation Agency (BRIN) on the programme for decommissioning and storage of radioactive waste and spent fuel, and provided BRIN with an independent review of back end activities of three research reactors in Indonesia.

The Joint ICTP–IAEA International School on the Physical Basis for Radionuclide Migration trained participants on how to approach contaminated site assessment to support further decision making regarding storage, disposal and other practices.

The Agency published *Management of Naturally Occurring Radioactive Material (NORM) in Industry: Proceedings of an International Conference, Vienna, Austria, 18–30 October 2020*, summarizing discussions at the conference.

Nuclear fusion

The Agency and the US Department of Energy's Princeton Plasma Physics Laboratory signed Practical Arrangements to strengthen education, training and outreach programmes in nuclear fusion research internationally.

The Agency published *World Survey of Fusion Devices 2022*, which provides a worldwide survey of over 130 public and private fusion devices with experimental and demonstration designs currently in operation, under construction, or planned.

The Agency initiated a new INPRO collaborative project to investigate legal and institutional issues of the prospective deployment of fusion facilities.

Nuclear data

The Agency signed Practical Arrangements with the China Nuclear Data Center in Beijing with a focus on new web technology for efficient nuclear data retrieval and machine learning methods applied to nuclear reaction and nuclear structure physics.

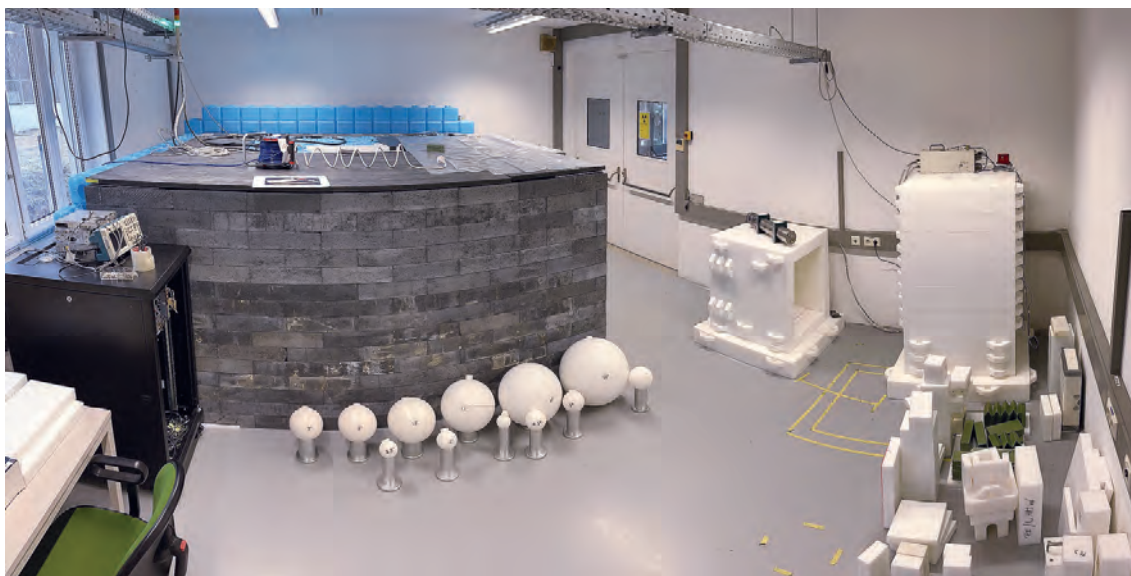
Accelerator technology and its applications

Japan's Okayama University was designated as an IAEA Collaborating Centre in the area of boron neutron capture therapy, a non-invasive therapeutic technique for treating invasive malignant tumours.

The Agency continued its endeavours under the 'Atoms for Heritage' initiative by organizing advanced training courses and workshops, where some 200 participants from 63 Member States enhanced their knowledge about advances in accelerator technology concerning analysis and characterization of heritage objects.

Nuclear instrumentation

After successful completion of its commissioning phases, the Agency's Neutron Science Facility delivered its first hands-on training on operation and applications of neutron generators.



After full commissioning of the Agency's Neutron Science Facility, shielding structures housing deuterium–deuterium (right) and deuterium–tritium (left) neutron generators were employed to deliver the first two-week hands-on training course on neutron science and applications.

The Agency at COP27

Led by the Director General, the Agency's prominent presence at COP27 in Sharm el-Sheikh, Egypt, helped to ensure high visibility for nuclear power, science and technology at the world's main climate change conference. In cooperation with international partners, the Agency for the first time hosted a nuclear-themed pavilion at a COP, the '#Atoms4Climate' pavilion, offering numerous stakeholders a venue to showcase the role of nuclear power, science and technology in climate change mitigation, adaptation and monitoring.

Over the two weeks, the #Atoms4Climate pavilion hosted 44 events, including 20 Agency-led events, the highest number of nuclear events at a COP. These brought together governments, associations, civil society, academia and the media to discuss the nexus between nuclear and climate change, including the contribution of nuclear power to climate-resilient energy systems, the role of nuclear power alongside renewables in reaching net zero, the financing of clean energy transitions, nuclear technologies for climate monitoring and adaptation in mountains, climate-smart agriculture, and the management of marine ecosystems and sustainable water resources.

At a United Nations Framework Convention on Climate Change side event jointly organized by the Agency, the United Nations Economic Commission for Europe (UNECE) and the United Nations Industrial Development Organization (UNIDO), IAEA Director General Rafael Mariano Grossi, UNECE Executive Secretary Olga Algayerova and UNIDO Director General Gerd Müller elaborated the benefits and challenges of deploying resilient low carbon technology and highlighted the importance of synergies between low carbon technologies to collectively address climate crises and facilitate the net zero transition. The Agency and FAO jointly organized an event in the FAO pavilion on the nexus of food, energy and water, and best practices for integrating closely interlinked global resource systems and value chains to mitigate the impact of climate change. The Agency presented its Energy Compact, submitted for the SDG 7-related High-level Dialogue on Energy, in the SDG pavilion. The Agency also organized or participated in a number of events at the French, Science, Water and other pavilions.

The Director General launched the Atoms4NetZero initiative at COP27. It aims to model the potential contribution of nuclear energy to the pathway to net zero. Through this initiative, the Agency will support its Member States and other stakeholders, such as industry, financial institutions and other international organizations, by providing scientific and engineering evidence on the potential of



The IAEA Director General with the UNECE Executive Secretary and the UNIDO Director General during the COP27 side event on the “Interplay of Low Carbon Technologies for Resilient Net Zero Energy Systems”, November 2022.

nuclear technologies to help decarbonize not only the power sector, but also hard-to-abate sectors in industry and transport.

The Agency implemented an effective communication strategy and conducted impactful outreach and engagement with different stakeholders including policymakers, international organizations, civil society, and youth and women's groups, to highlight the indispensable role of nuclear at the climate debate table. The #Atoms4Climate logo and hashtag were prominent in media coverage.



The IAEA Director General engages with Maria Helena Semedo, FAO Deputy Director-General; Petteri Taalas, Secretary-General of the World Meteorological Organization; Juergen Voegelé, Vice President of the World Bank; and Anil Mishra of UNESCO at the “Science for the Future” high-level event at the #Atoms4Climate pavilion, November 2022.



The Agency's #Atoms4Climate pavilion at COP27 in Sharm el-Sheikh, Egypt, November 2022.

Nuclear Sciences and Applications

International Symposium on Managing Land and Water for Climate-Smart Agriculture



The Director General at the opening of the International Symposium on Managing Land and Water for Climate-Smart Agriculture, July 2022.

The International Symposium on Managing Land and Water for Climate-Smart Agriculture, jointly organized by the Agency and FAO, was held in hybrid format in Vienna in July 2022. The symposium facilitated the exchange of scientific information among soil, water and environment experts and aimed to increase understanding, collaboration, networking and capabilities in order to enhance food security, improve the conservation of natural resources and mitigate the negative impacts of climate change. The symposium also identified knowledge gaps, research needs and new opportunities to develop climate-smart agricultural practices.

Second International Conference on Applications of Radiation Science and Technology

The Second International Conference on Applications of Radiation Science and Technology (ICARST-2022) was held in hybrid format in Vienna in August 2022 to showcase key developments in radiation science and technology applications, including the production of advanced high-performance materials; green technologies to rehabilitate the environment; new trends in food irradiation; studies on the stability and compatibility of irradiated products in the human body; and novel approaches to managing radiotracers and other related nuclear techniques. It also served as a platform for industry and academia to foster new initiatives in this field.



Opening of ICARST-2022, August 2022.

International Conference on Integrated Medical Imaging in Cardiovascular Diseases

The Agency held the International Conference on Integrated Medical Imaging in Cardiovascular Diseases (IMIC-2022) to review the status of evidence-based recommendations on the use of various imaging modalities, including single photon emission computed tomography, positron emission tomography, echocardiography, computed tomography and magnetic resonance imaging, in the management of cardiovascular diseases. The event brought together top scientists and practitioners, who showcased the latest developments in cardiac imaging.

ReNuAL2



Groundbreaking ceremony for the new laboratories building in Seibersdorf, 5 October 2022.

Key milestones were reached under the final phase of the Renovation of the Nuclear Applications Laboratories (ReNuAL) initiative, known as ReNuAL2. In October 2022, ground was broken for the construction of a new building to house the Nuclear Science and Instrumentation Laboratory, the Terrestrial Environmental Radiochemistry Laboratory and the Plant Breeding and Genetics Laboratory. Major construction is expected to be completed by the end of 2024. Under ReNuAL2, the project team mobilized more than €22 million of extrabudgetary contributions from 29 Member States and non-traditional donors. Resource mobilization efforts are currently focused on raising €3.4 million required by early 2023 for new greenhouses.

Artificial intelligence for nuclear science, technology and applications

The Agency publication *Artificial Intelligence for Accelerating Nuclear Applications, Science and Technology* provides a review of current AI activities in the nuclear field, highlights the Agency's role in their implementation, outlines challenges and identifies priorities for future AI activities. In 2022, the Agency continued working with the High-Level Committee on Programmes' Inter-Agency Working Group on Artificial Intelligence on the adoption of principles for the ethical use of AI in the UN system. It also continued its partnership with the "AI for Good" platform and contributed to the 2022 report *United Nations Activities on Artificial Intelligence (AI)*, which featured new Agency AI initiatives in the areas of radiotherapy, the marine environment, radioactive contamination in agriculture, climate change impact assessment and fusion science. All these activities were integrated in "AI for Atoms", a new Agency knowledge-sharing platform for partnership on AI applications in the nuclear field.

Food and Agriculture

Memorandum of Understanding between the Agency and FAO

In October 2022, the Agency and FAO signed a memorandum of understanding (MOU) to leverage innovative research and development activities using the comparative advantage presented by nuclear and related technologies to transform agrifood systems. The MOU expands the scope of cooperation to the marine environment, physical and chemical sciences and human health and supports a stronger strategic partnership through joint resource mobilization and the implementation of programmatic and advocacy activities.



FAO Director-General, Qu Dongyu, and IAEA Director General, Rafael Mariano Grossi, sign an MOU to strengthen cooperation between FAO and the Agency, October 2022.

Seeds in space

Given the growing interest in understanding how the space environment could produce mutations in plant genomes and modify plant physiology, the Agency and FAO, through the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, initiated a feasibility study to determine whether the harsh environment of outer space would trigger mutations in plant seeds that would allow them to boost their tolerance to increasingly difficult growth environments created by climate change. Seeds were sent to space in November 2022, to be returned to Earth after 3–4 months.

Antimicrobial resistance

Agricultural systems are increasingly polluted by antimicrobial substances, including antibiotics, which are used to prevent and treat infections. In 2022, the Agency developed techniques to monitor the pathway of sulfamethoxazole, an antibiotic commonly used in veterinary medicine, in soil carbon turnover processes. Results have shown a strong reduction in the mineralization of organic matter and accelerated priming, leading to losses in soil carbon. In addition, the Agency developed soil and water sampling and analytical protocols, harmonized techniques for diagnostics and monitoring of synthetic labelled antibiotics in field-applied manure, and published a technical paper in cooperation with FAO entitled *Antimicrobial movement from agricultural areas to the environment: The missing link. A role for nuclear techniques*.

Irradiated vaccines



Agency research scientist using an X-ray machine to irradiate larger organisms at lower doses.

To effectively control zoonotic diseases, better vaccines — and better access to those vaccines — are required. The Agency has conducted research on the use of irradiation to develop new vaccine formulations. This novel approach aims to inhibit the replication capacity of pathogens while maintaining their metabolic activities, and to reduce antigen alterations using radioprotectors. Under the ZODIAC project, the Veterinary Diagnostic Laboratory Network has developed techniques to produce irradiated vaccines for priority animal and zoonotic diseases.

Food safety and authenticity

Food safety is compromised by foodborne contaminants, diseases and events that disrupt normal food production and control systems, such as extreme weather, the COVID-19 pandemic or food fraud. In 2022, the Agency helped Member States protect consumers and industry from the impacts of food fraud by developing nuclear analytical and fingerprinting methodologies to facilitate the rapid and cost-effective testing of commodities in the field. These techniques can detect contaminants, provide information on the geographical origin of products and help verify claims of organic fruit and spice production.



Sample preparation to verify the geographical origin and detect the adulteration of honey by measuring the ratio of stable isotopes of hydrogen ($\delta^2\text{H}$) in honey saccharides.

Human Health

Launch of a global database on breast milk intake

In 2022, the Agency launched its database on human milk intake, which provides the most comprehensive picture to date on breast milk intake around the globe. The database constitutes a growing collection of studies that use the deuterium oxide dose-to-mother nuclear technique to determine how much breast milk is consumed by breastfed infants. By combining data from individual studies, the database generates new value and helps to answer globally relevant questions on breast milk intake, exclusive breastfeeding, and infant feeding patterns more generally.

Release of Audit Methodology for Medical Physics Clinical Training Programme

Clinically qualified medical physicists contribute directly to ensuring the safety, quality and effectiveness of patient diagnosis and treatment, and structured and supervised clinical training programmes equip medical physicists with the competencies needed in the clinical environment. To develop and provide national training programmes, the Agency published the *Audit Methodology for Medical Physics Clinical Training Programmes* (IAEA-TCS-74), which provides guidance on how to establish and sustain such programmes.

New services at the Agency's Dosimetry Laboratory

The Agency contributes actively to the harmonization of dosimetry worldwide. In 2022, electron beam audit, photon calibration and high dose rate brachytherapy source calibration services were launched to enhance Member States' capacity to implement radiation imaging and treatment modalities safely and effectively, using optimized dosimetry and medical physics practices. In addition, the Agency's Dosimetry Laboratory commissioned a gamma beam irradiator, which is providing reference data that increases the accuracy of radiation protection level dosimetry for Agency staff.

Water Resources

Addressing the water crisis

In 2022, the Agency actively promoted the value of nuclear and isotopic techniques in global water-related activities, including preparatory meetings for the 2023 UN Water Conference, the World Water Forum, the Second Dushanbe Water Action Decade Conference, World Water Week, COP27 and the UN-Water Summit on Groundwater. It also strengthened its relationships with other international organizations, including the World Bank Group, the World Meteorological Organization and the United Nations Educational, Scientific and Cultural Organization, with which the Agency is currently embarking on a capacity-building initiative to address global water resource monitoring and assessment.

Launch of new isoscape model

The Global Network of Isotopes in Precipitation (GNIP) is being increasingly used by Member States to track changes in precipitation and as a baseline for assessing groundwater resources. Building on GNIP data, the Agency published a revised and updated Regionalized Cluster-Based Water Isotope Prediction Model of isoscapes for naturally occurring tritium in precipitation. The resulting maps depict the spatial distribution of present-day tritium in precipitation and aid understanding of the connection between the atmosphere, surface water and groundwater systems. In addition, the Agency's Tritium Intercomparison (TRIC) exercise in 2022 yielded a record number of 93 submissions.

Marine Environment

Using radionuclides to assess the potential of blue carbon as a nature-based solution to climate change worldwide

Blue carbon, which refers to carbon sequestered in vegetated marine and coastal ecosystems with the aim of reducing atmospheric carbon dioxide, is a key focus for the IAEA Marine Environment Laboratories. The Agency implements several joint projects with international research institutions in 30 countries, using radionuclides to assess the rates of carbon sequestration in vegetated marine and coastal areas as well as to evaluate the capacity of these ecosystems as long-term carbon storage solutions.

Emergency response support to Peru to assess the impact of a major oil spill on the marine environment

In January 2022, rogue waves hit an unloading oil tanker at La Pampilla refinery in Peru. Approximately 10 000 barrels of crude oil leaked into the sea. At the request of the Government of Peru, the Agency rapidly mobilized its experts to support the country. Through coordinated efforts with the national environmental authorities and a UN mission team, technical advice was provided, a long-term monitoring strategy was devised and work was initiated on the collection and preservation of oil and environmental samples for follow-up analysis.

Plastic-derived contaminants and their impact on the marine environment

Plastic-derived chemical contaminants are an emerging threat to ocean health, in particular sensitive marine ecosystems. The Agency develops analytical methods that target chemicals linked to plastics, using stable isotopes and mass spectrometric techniques to accurately measure toxic contaminants in the marine environment at ultra-trace levels. In 2022, these methods were used in collaboration with the Scientific Centre of Monaco and provided valuable insights into the combined effects of exposure to chemicals linked to plastic debris and ocean warming, highlighting the potential threat of plastic pollution to sensitive ecosystems.



Agency research scientist conducts laboratory experiment on tropical coral nubbins.

Radiochemistry and Radiation Technology

Accreditation as reference material producer

In 2022, the Agency's Marine Environmental Studies Laboratory and Terrestrial Environmental Radiochemistry Laboratory obtained accreditation as producers of reference materials for gamma-emitting radionuclides in marine and terrestrial environmental matrices. To date, four materials have obtained certified reference material status within the scope of the accreditation.

Launch of new IAEA/WHO guideline

Mindful of the rapid expansion of molecular imaging and targeted radiopharmaceutical therapy, the Agency and WHO launched a new guideline on good manufacturing practices for investigational radiopharmaceutical products. The guideline is in line with trends in good manufacturing practices specific to investigational radiopharmaceuticals used in clinical trials and is harmonized with other related international guidelines.

Quality assurance for analysis of environmental samples

As a developer and custodian of reference materials for stable isotope scales worldwide, the Agency organized its first ever training course on enhancing the quality of data for isotopic analysis in Member State laboratories to present the best approaches for calibrating relevant instruments and calculating data for stable isotope analysis of environmental and food samples.

NUCLEAR SAFETY AND SECURITY

Nuclear and Radiation Safety

Safety standards and their application

The Agency issued 17 Safety Guides after their endorsement by the Commission on Safety Standards. The Agency launched an e-learning course on the safety standards, in Arabic, Chinese, English, French, Russian and Spanish.

The Agency conducted 62 safety- and security-related peer review and advisory service missions to support 46 Member States in the application of safety standards and nuclear security guidance publications.

International conferences

The Agency organized the International Conference on Occupational Radiation Protection: Strengthening Radiation Protection of Workers – Twenty Years of Progress and the Way Forward in Geneva, Switzerland, in September 2022. The conference identified emerging issues in occupational radiation protection and discussed implementation of safety standards concerning occupational radiation protection; commitment to safety culture; and exchange of operating experience. A 'call for action' document was drafted as an outcome of the conference.

The Agency held the International Conference on Topical Issues in Nuclear Installation Safety: Strengthening Safety of Evolutionary and Innovative Reactor Designs in Vienna in October 2022, where recommendations were issued in the areas of robust safety demonstration; harmonization



International Conference on Occupational Radiation Protection: Strengthening Radiation Protection of Workers – Twenty Years of Progress and the Way Forward, held in Geneva, Switzerland, September 2022.

and standardization; international collaboration; experimental data and tools; and integrated use of deterministic and probabilistic considerations for evolutionary and innovative reactors.

The Agency held the International Conference on the Safety and Security of Radioactive Sources: Accomplishments and Future Endeavours in Vienna in June 2022. The conference discussed experiences and anticipated future developments related to establishing and maintaining a high level of safety and security of radioactive sources throughout their life cycle.

Advanced Liquid Processing System treated water

The Agency made substantial progress in 2022 in its review of safety-related aspects of the handling of Advanced Liquid Processing System (ALPS) treated water at Fukushima Daiichi NPP. The ALPS task force conducted three technical review missions and the Agency published three reports throughout the year. Additionally, the task force conducted seven meetings, including a meeting that focused on the Agency's laboratory capabilities and the initiation of the Agency's independent sampling and analysis work associated with the planned water discharges. The Agency facilitated four sampling campaigns for ALPS treated water and one sampling campaign for environmental samples (seawater, seaweed, etc.), with analysis of these samples scheduled to begin in 2023.



Agency expert processing ALPS treated water samples taken at Fukushima Daiichi NPP for further analysis by Agency and third-party laboratories. (Photograph courtesy of TEPCO)

Safety of nuclear power plants, research reactors and fuel cycle facilities

In March, the Agency conducted its 50th Safety Aspects of Long Term Operation mission, at Koeberg NPP in South Africa.

The Agency held the Fifth International Conference on Nuclear Power Plant Life Management in Vienna in November–December 2022. The conference provided an international forum for presentations of key elements of plant life management programmes and safety aspects of LTO, such as: ageing management strategies; preparation and implementation of LTO projects, including material testing, prediction models and risk informed models; supply chain; knowledge management; and regulatory approaches to LTO activities. This diverse event brought together participants from all countries operating NPPs and several international organizations and featured the active engagement of regulators, operators and technical support and research organizations.

Safe and secure deployment of advanced reactors, including SMRs

The Agency conducted the first mission related to the siting of SMRs, examining the site selection process for an SMR in Romania, in August 2022. Feedback from the mission was utilized to develop a Site and External Events Design review module tailored to SMR-type reactors, with particular emphasis on the application of a graded approach to siting and design.

Assisting countries embarking on a new nuclear power programme

The Agency held a meeting of the Regulatory Cooperation Forum (RCF) Steering Committee in Vienna in June 2022 to review the status of regulatory infrastructure development in countries receiving support from the RCF and to foster the exchange of experience. In addition, regular RCF task team meetings were held to monitor and evaluate the implementation of the RCF Strategic Plan and related activities.

Incident and emergency preparedness and response



The Director General delivers his opening remarks at the Eleventh Meeting of the Representatives of Competent Authorities identified under the Early Notification Convention and the Assistance Convention held at Agency Headquarters in Vienna, June 2022.

In June 2022, the Agency held the Eleventh Meeting of the Representatives of Competent Authorities identified under the Early Notification Convention and the Assistance Convention to share information on national emergency preparedness and response (EPR) arrangements and related challenges.

The Agency maintained continuous communication with the Ukrainian nuclear regulatory authority, the State Nuclear Regulatory Inspectorate of Ukraine, from 24 February 2022 and conducted daily assessments of the situation at Zaporizhzhya NPP (ZNPP) from 2 September 2022 and assessments of the situation at other NPPs and nuclear facilities, based on the information received from the IAEA Support and Assistance Mission to Zaporizhzhya NPP and other monitoring activities and missions undertaken.

Radioactive waste management, environmental assessments and decommissioning of nuclear facilities

The Agency developed guidance on the conduct of Integrated Regulatory Review Service (IRRS) and Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) missions in a back-to-back manner. This guidance was used for the first time in Slovenia, where an IRRS mission held in April 2022 was followed by an ARTEMIS mission in May 2022.

The Agency held a Technical Meeting on Methods for Radiological and Environmental Impact Assessment (MEREIA) in November 2022 and a series of webinars on MEREIA focusing specifically on development of young professionals.

Radiation protection

The Agency, in association with the Radiation Protection Symposium North-West Europe, organized the Tenth International Symposium on Naturally Occurring Radioactive Material in Utrecht, Netherlands, in May 2022, to provide a forum for the industrial, technical and scientific communities and regulatory bodies involved in the management of naturally occurring radioactive material (NORM) and to disseminate scientific information, research and knowledge with a focus on the use of residues from industrial operations and processes involving NORM.

In 2022, the Agency made available technical guidance jointly sponsored by FAO and WHO on how to manage exposures due to radionuclides in food in non-emergency situations.

Capacity building in nuclear, radiation, transport and waste safety and emergency preparedness and response

The Agency conducted 168 capacity-building activities on nuclear, radiation, transport and waste safety and EPR, including training courses, fellowships, workshops, webinars and the launch of e-learning packages.

The Agency, in cooperation with Tokai University, Japan, held the first virtual International School on Nuclear and Radiological Leadership for Safety. Three more Schools were organized in Egypt, Mexico and Pakistan during 2022.

In July 2022, on the occasion of the 25th anniversary of the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO), celebrated in Madrid, the Portuguese Environment Agency joined FORO, becoming its 11th member.

Safety conventions

The Agency facilitated the Fourth Extraordinary Meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) in Vienna in May 2022, and the Seventh Review Meeting of the Joint Convention in Vienna in June–July 2022.

The Agency continued preparations for the Joint Eighth and Ninth Review Meeting of the Contracting Parties to the Convention on Nuclear Safety, to be held in March 2023.

Codes of conduct

In 2022, the number of States having notified the Agency of their intention to act in accordance with the Code of Conduct on the Safety and Security of Radioactive Sources grew to 145. The number of States having notified the Agency of their intention to act in accordance with the Guidance on the Import and Export of Radioactive Sources increased to 129, and the number of States having notified the Agency of their commitment to implement the Guidance on the Management of Disused Radioactive Sources rose to 52 in 2022.

The Agency continued to assist Member States in the application of the Code of Conduct on the Safety of Research Reactors. The Agency also provided assistance through peer reviews and advisory services and capacity-building activities on areas of the Code identified from Member States' self-assessments as needing improvement.



Opening of the Seventh Review Meeting of the Contracting Parties to the Joint Convention, June 2022.

The Agency's Radiation Safety and Nuclear Security Regulator

The Agency's Radiation Safety and Nuclear Security Regulator approved the design of the new Flexible Modular Laboratory 2 at Seibersdorf, a modification to the Neutron Science Facility, clearance of material from the Nuclear Material Laboratory, and the radiation protection programmes for several Agency Departments. The operation authorization for the Dosimetry Laboratory was modified to permit the use of a new irradiator. Inspections were conducted at the Nuclear Science and Instrumentation Laboratory and the Nuclear Security Detection and Monitoring Equipment Laboratory.

Civil liability for nuclear damage

The Agency acted as the Secretariat of the Second Meeting of the Contracting Parties and Signatories to the Convention on Supplementary Compensation for Nuclear Damage (CSC), which was held in Vienna in May–June 2022.

The International Expert Group on Nuclear Liability (INLEX) held its 22nd regular meeting in September. The Group discussed, *inter alia*, liability issues concerning insurance of radioactive sources, right of recourse of nuclear fusion facilities operators, small modular reactors, nuclear powered ships, and supplementary compensation obligations for parties to both the Brussels Supplementary Convention and the CSC. The Group also adopted a statement on the “Benefits of Joining the Global Nuclear Liability Regime”. The meeting was followed by a half-day Workshop for Diplomats on Civil Liability for Nuclear Damage.

During the 66th regular session of the General Conference, the Agency hosted a special side event to celebrate the 25th anniversary of the CSC and the 1997 Vienna Convention on Civil Liability for Nuclear Damage. In the context of the Agency's Legislative Assistance Programme, support was provided to Member States in the development of national legislation, including legislation related to civil liability for nuclear damage. In addition, the Secretariat also conducted several joint legislative assistance–INLEX missions to address the importance of establishing a

global regime, including two sub-regional workshops on nuclear law for Asia and the Pacific and a bilateral mission to Saudi Arabia.

Interfaces between safety and security

In 2022, the Regulatory Infrastructure Development Projects assisted participating countries in the Latin America and the Caribbean and Africa regions to enhance their regulatory framework for radiation safety and security of radioactive material in the areas of policy and strategy, regulations, establishment of an integrated management system, national inventory and registry, and physical protection of radioactive sources.

The Agency issued *Regulatory Oversight of the Interfaces Between Nuclear Safety and Nuclear Security in Nuclear Power Plants* (Technical Reports Series No. 1003) as a preprint document.

In 2022, the Agency hosted regular meetings of the International Nuclear Safety Advisory Group (INSAG) to discuss current and emerging safety issues and identify needs for new INSAG publications. The Agency's Advisory Group on Nuclear Security and INSAG worked on a report entitled *A Systems View of Nuclear Security and Nuclear Safety – Identifying Interfaces and Building Synergies*.

Nuclear Security

Conference of the Parties to the Amendment to the Convention on the Physical Protection of Nuclear Material

The Agency organized the Conference of the Parties to the Amendment to the Convention on the Physical Protection of Nuclear Material, pursuant to Article 16.1 of the Convention as amended, in Vienna in March–April 2022. The conference reviewed the implementation of the Convention as amended and its adequacy as concerns the preamble, the whole of the operative part and the annexes in the light of the then prevailing situation.

Capacity building and outreach in nuclear security

In 2022, the Agency provided assistance in drafting nuclear security regulations to 53 Member States. It also conducted 140 training events for more than 4000 participants from 154 States and continued to deliver its e-learning activities, with over 2500 users from 140 States completing e-learning modules during the year. Two new e-learning modules were developed and two e-learning modules were translated from English and made available in Arabic, Chinese, French, Russian and Spanish during the reporting period. In total, there are 21 e-learning modules, 19 of which are available in Arabic, Chinese, English, French, Russian and Spanish.

Supporting Member States' needs

Targeted assistance is provided to States, upon request, to address needs identified within the Integrated Nuclear Security Support Plan (INSSP) framework and in line with Member State priorities. In 2022, the total number of States with approved INSSPs remained at 92. As of 31 December 2022, there were 16 INSSPs awaiting Member State acceptance and 5 INSSPs were at the initial drafting stage.

The Agency's programme to support States' major public events provided assistance throughout the year ranging from large sporting events to major international conferences and international cultural and religious occasions.

The Agency continued to construct the Nuclear Security Training and Demonstration Centre at its Seibersdorf laboratories. This specialized facility is scheduled to be operational at the end of 2023 and will provide support to States through state-of-the-art technical infrastructure and equipment.



INSSP finalization mission to Bolivia, July 2022.

NUCLEAR VERIFICATION^{1,2}

Over the course of 2022, the impact of the COVID-19 pandemic on safeguards implementation diminished markedly. The Agency carried out 3000 verification activities (3000 in 2021) and spent 14 100 days in the field conducting those activities (14 600 in 2021). This ensured that the Agency was able to draw soundly based conclusions for all States in which safeguards were implemented by the Agency for 2022.

Implementation of safeguards in 2022

At the end of every year, the Agency draws a safeguards conclusion for each State for which safeguards are applied. This conclusion is based on an evaluation of all safeguards relevant information available to the Agency in exercising its rights and fulfilling its safeguards obligations for that year.³

¹ The designations employed and the presentation of material in this section, including the numbers cited, do not imply the expression of any opinion whatsoever on the part of the Agency or its Member States concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

² The referenced number of States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons is based on the number of instruments of ratification, accession or succession that have been deposited.

³ For States with a comprehensive safeguards agreement (CSA) in force with an operative small quantities protocol (SQP) based on the original standard text, the Agency's ability to draw a credible and soundly-based annual safeguards conclusion is significantly affected. This is due, inter alia, to the fact that the original standard text of the SQP holds in abeyance the requirement for these States to provide to the Agency an initial report on all nuclear material as well as the Agency's right to perform verification activities in these States. In light of such limitations, and given the significant lapse of time since the decision of the Board of Governors in 2005 authorizing the Director General to conclude with each State with an SQP an exchange of letters giving effect to the revised standardized text and the modified criteria, the Agency may no longer be able to draw a safeguards conclusion for such States unless the States concerned respond positively to the repeated calls by the Director General to amend or rescind such SQPs.

In 2022, safeguards were applied for 188 States^{4,5} with safeguards agreements in force with the Agency. Of the 134 States that had both a comprehensive safeguards agreement (CSA) and an additional protocol (AP) in force, the Agency drew the broader conclusion that *all* nuclear material remained in peaceful activities for 74 States⁶; for the remaining 60 States, as the necessary evaluation regarding the absence of undeclared nuclear material and activities for each of these States remained ongoing, the Agency concluded only that *declared* nuclear material remained in peaceful activities. Similarly, for the 46 States with a CSA but with no AP in force, the Agency concluded only that *declared* nuclear material remained in peaceful activities.

Safeguards were also implemented with regard to nuclear material in selected facilities in the five nuclear-weapon States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) under their respective voluntary offer agreements. For these five States, the Agency concluded that nuclear material in the selected facilities to which safeguards had been applied remained in peaceful activities or had been withdrawn from safeguards as provided for in the agreements. For three States not party to the NPT, the Agency implemented safeguards pursuant to item-specific safeguards agreements based on INFCIRC/66/Rev.2. For these States, the Agency concluded that nuclear material, facilities or other items to which safeguards had been applied remained in peaceful activities.

As of 31 December 2022, five States Parties to the NPT had yet to bring CSAs into force pursuant to Article III of the Treaty. For these States Parties, the Agency could not draw any safeguards conclusions.

Conclusion of safeguards agreements and APs, and amendment and rescission of small quantities protocols

The Agency continued to facilitate the conclusion of safeguards agreements and APs, and the amendment or rescission of small quantities protocols (SQPs). The status of safeguards agreements and APs as of 31 December 2022 is shown in Table A6 in the Annex to this report. During 2022, a CSA with an SQP and an AP entered into force for Cabo Verde and Guinea-Bissau. A CSA with an SQP entered into force for the State of Palestine⁷. An AP was signed for Sierra Leone. SQPs were amended for the Lao People's Democratic Republic, Namibia, Suriname and Tuvalu. An SQP was rescinded for Lithuania. At the end of 2022, 99 States with CSAs in force had operative SQPs, of which 77 SQPs were based on the revised standard text, and 11 States had rescinded their SQPs.

Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015)

Between 16 January 2016 and 23 February 2021, the Agency, in light of UN Security Council resolution 2231 (2015), verified and monitored the Islamic Republic of Iran's (Iran's) implementation of its nuclear-related commitments under the Joint Comprehensive Plan of Action (JCPOA). From 8 May 2019 onwards, however, Iran reduced the implementation of those commitments on a step-by-step basis and, from 23 February 2021 onwards, stopped the implementation of those commitments, including the AP. This seriously affected the Agency's verification and monitoring in relation to the JCPOA, which was exacerbated in June 2022 by Iran's decision to remove all of the Agency's equipment previously installed in Iran for surveillance and monitoring activities in relation to the

⁴ These States do not include the Democratic People's Republic of Korea (DPRK), where the Agency did not implement safeguards and, therefore, could not draw any conclusion.

⁵ And Taiwan, China.

⁶ And Taiwan, China.

⁷ The designation employed does not imply the expression of any opinion whatsoever concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

JCPOA. During 2022, the Director General submitted to the Board of Governors, and in parallel to the UN Security Council, 4 quarterly reports and 15 reports providing updates on developments between the issuance of the quarterly reports, entitled *Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015)*.

Islamic Republic of Iran

During 2022, despite the Agency's continued efforts to engage Iran in order to resolve outstanding safeguards issues related to the presence of uranium particles of anthropogenic origin at locations in Iran not declared to the Agency, limited progress was made. Unless and until Iran clarifies these issues, the Agency will not be able to provide assurance about the exclusively peaceful nature of Iran's nuclear programme. The Director General submitted four reports to the Board of Governors entitled *NPT Safeguards Agreement with the Islamic Republic of Iran*. The Board of Governors adopted by a vote two resolutions entitled *NPT Safeguards Agreement with the Islamic Republic of Iran*.

Syrian Arab Republic

The Director General continued to urge the Syrian Arab Republic to cooperate fully with the Agency in connection with all unresolved issues. In August 2022, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic*.

Democratic People's Republic of Korea

In September 2022, the Director General submitted a report to the Board of Governors and the General Conference entitled *Application of Safeguards in the Democratic People's Republic of Korea*. In 2022, no verification activities were implemented in the field, but the Agency continued to monitor developments in the nuclear programme of the Democratic People's Republic of Korea (DPRK) and to evaluate all safeguards relevant information available to it. The Agency did not have access to the Yongbyon site or to other locations in the DPRK. The continuation of the DPRK's nuclear programme, a clear violation of relevant UN Security Council resolutions, is deeply regrettable.

State-level safeguards implementation

The Agency continued to enhance the consistency and effectiveness of safeguards implementation through a project aimed at improving the development and implementation of State-level approaches (SLAs) using a structured approach. Performance targets were embedded in a new dedicated IT application in 2022 to support acquisition path analysis and the development of SLAs. This application simplified the process and facilitated the updating of SLAs for 16 States with the broader conclusion during the year. These SLAs will be implemented in 2023.

Naval nuclear propulsion

The use of nuclear material subject to safeguards under a CSA by a State in a nuclear activity such as naval nuclear propulsion is foreseen by the CSA. Australia and Brazil have informed the Agency of their plans related to the use of nuclear material — subject to safeguards under their respective CSA — for naval nuclear propulsion. The use of nuclear material in such an activity requires arrangements under their respective safeguards agreements and the development of appropriate Agency safeguards approaches. Hence, during 2022, the Secretariat engaged in consultations with the States concerned to consider the possible implications on the application of Agency safeguards.

Cooperation with State and regional authorities

In 2022, the Agency conducted over 50 training events for personnel responsible for overseeing and implementing State systems of accounting for and control of nuclear material (SSACs) and regional systems of accounting for and control of nuclear material. These events were a combination of in-person and virtual training courses, as well as scientific visits. In total, more than 450 experts from 70 States were trained on safeguards-related topics. During the year, 11 Member States contributed in-kind support to the implementation of 18 activities as part of the IAEA Comprehensive Capacity-Building Initiative for SSACs and SRAs, including scientific visits, expert visits, SSAC webinars, and the development of safeguards procedures and national training plans.

Safeguards equipment and tools

In 2022, the active universal asymmetric seal was authorized for use. It will start to be deployed in 2023 to replace the electronic optical sealing system, providing the Agency with an optimized life cycle cost. The laser curtain for containment, which uses lasers to detect possible intrusion in a safeguarded area in a nuclear facility, was used for the first time in 2022. A new high-resolution cadmium zinc telluride detector was validated by Agency technical experts. Its integration into various non-destructive assay systems will support the standardization of parts and reduce the need for specific training for inspectors.

Safeguards analytical services

As of December 2022, the Agency's Network of Analytical Laboratories (NWAL) consisted of the Agency's Safeguards Analytical Laboratories and 25 other qualified laboratories in various Member States. During the year, six additional laboratories for sample analysis and reference material provision were in the process of qualification. In 2022, the Agency collected 604 nuclear material samples, 516 environmental samples and 5 heavy water samples that were analysed by the Agency's laboratories in Seibersdorf and through the NWAL.

Developing the safeguards workforce

In 2022, the Agency conducted 45 distinct safeguards staff training courses (as some were held more than once, a total of 92 offerings were provided overall, of which 26 were held outside Vienna), helping to provide safeguards inspectors, analysts and support staff with the necessary core and functional competencies. The Safeguards Traineeship Programme for young graduates and junior professionals commenced in February 2022, involving nine participants (including five women) from Algeria, Cameroon, Costa Rica, Guyana, Nigeria, Panama, Tajikistan, the United Republic of Tanzania and Yemen.

Partnerships

The Agency forged new partnerships in support of Agency safeguards during the course of the year. In 2022, the United Arab Emirates declared its intention to establish a new Member State Support Programme and provided a significant financial contribution to the Department of Safeguards for initial activities. To further broaden the support base for Agency safeguards, the Agency also signed Practical Arrangements with the Open Nuclear Network and the Henry L. Stimson Center.

Safeguards Symposium

In 2022, the Agency organized its 14th Symposium on International Safeguards with the theme 'Reflecting on the Past and Anticipating the Future'. The programme featured 70 different sessions,



The Director General signs the AP for Sierra Leone and receives a copy of its SQP amendment letter at a special event on the safeguards legal framework, October 2022.

over 150 presentations, 24 exhibitors and 3 experiential rooms devoted to different futures. Some 700 registered participants — of whom 36% were women — from 124 States and 15 organizations attended the event. The Symposium's programme, video recordings, papers, e-posters and more are available on its website.

MANAGEMENT OF TECHNICAL COOPERATION FOR DEVELOPMENT

The Technical Cooperation Programme in 2022

In 2022, the Agency provided assistance to 149 countries and territories through the TC programme, including key support for activities related to ZODIAC, NUTEC Plastics and Rays of Hope, in the form of training, expert advice and equipment procurement.

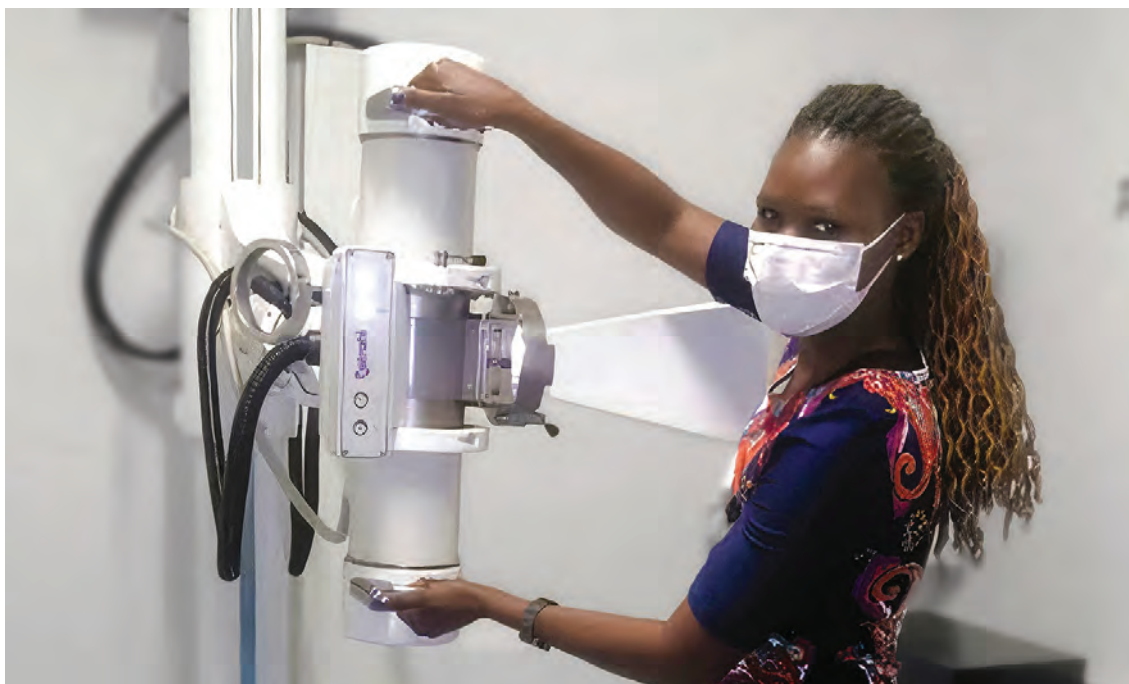
Member States interested in small modular reactors were supported through an interregional project involving 46 countries and 12 participating donors. In 2022, activities included a training course on establishing a national position for a new nuclear power programme, held in St Petersburg, Russian Federation.

In 2022, food and agriculture accounted for the highest proportion of actuals (disbursements) delivered through the programme, at 26.7%. This was followed by health and nutrition at 21.6% and by safety and security at 16.7%. By the end of the year, financial implementation of the Technical Cooperation Fund (TCF) stood at 84.4%.

Nineteen Country Programme Frameworks (CPFs) — for Belarus, Botswana, Côte d'Ivoire, the Dominican Republic, Estonia, Fiji, Guatemala, Jordan, Malaysia, Mongolia, Montenegro, Nepal, Papua New Guinea, the Philippines, Qatar, Rwanda, Saint Lucia, Viet Nam and Zimbabwe — were signed in 2022, bringing the total number of valid CPFs to 112 by the end of the year.

Overview of Regional Activities

Africa



A new orthovoltage radiotherapy machine installed at Windhoek Central Hospital treated skin cancer patients for the first time in 2022. (Photograph courtesy of Dr AB May Cancer Care Centre)

In 2022, the Agency provided technical cooperation to 46 Member States in Africa, including 26 least developed countries (LDCs). Approximately 80% of this assistance was delivered in the areas of food and agriculture, human health and nutrition, radiation safety and human resource development. This is in line with the region's priority areas, as outlined in the CPFs of individual Member States and the African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) Regional Strategic Cooperative Framework for 2019–2023. Important assistance in the form of training and laboratory equipment was provided under ZODIAC for the early monitoring of zoonotic diseases.

Twenty-five Member States in the region requested participation in Rays of Hope. Bilateral meetings were held with the Ministers of Health of 15 Member States to identify needs and assess the financial resources required to assist them in establishing or expanding their countries' radiotherapy services.

In May, an orthovoltage radiotherapy machine for treating skin cancer, purchased with government cost-sharing contributions, treated its first patients in Windhoek. In July, a new brachytherapy unit began providing treatment to cervical cancer patients in Madagascar.

Djibouti opened its Regional Research Observatory on the Environment and Climate, established with Agency assistance to study the impact of climate change.

The first sterile insect technique release trial in South Africa, targeting malaria mosquitoes, was carried out in northern KwaZulu-Natal from May to December, with 30 000 sterile males released each week. Preliminary results indicate a 60–70% decline in the fecundity of the wild mosquito population.

In March, a PhD conference on water resources management, the first to be held within the framework of a TC project, took place in Vienna. Fifteen sandwich PhD fellows and one postdoctoral fellow presented their work.

Ministers and permanent secretaries from seven African Member States interested in establishing research reactors met in August to learn about the Agency's Milestones approach and requirements for the establishment of such facilities.

The Congo received Agency assistance in February to remove two disused cobalt-60 sealed radiotherapy sources from the country.

Asia and the Pacific



The Director General at the opening of the RCA exhibition at the 66th regular session of the General Conference, September 2022.

Thirty-nine Member States and territories in Asia and the Pacific receive technical cooperation, of which seven are LDCs and seven are small island developing States (SIDS). In 2022, approximately 60% of technical cooperation in the region addressed food and agriculture, health and nutrition, industrial applications and radiation safety, with the remainder focusing on nuclear energy, the environment and nuclear knowledge management, in line with the priorities set out in Country and Regional Programme Frameworks.

Four pilot countries in Asia made progress in developing irradiation technology for use in plastic recycling under NUTEC Plastics and are now prioritizing the establishment of industrial partnerships. National stakeholder meetings were held in Indonesia and Malaysia to engage government representatives and potential industrial partners.

A two-week virtual lecture series on SDGs in the South Pacific, aimed at university teaching staff and postgraduate research students from faculties covering science and related fields, was launched in partnership with the Australian Nuclear Science and Technology Organisation and the University of the South Pacific. The lectures were attended by some 300 participants, both online and in person.

Twenty-five universities and institutions attended the first annual meeting of the International Nuclear Science and Technology Academy, which focused on the expansion of nuclear science and technology education at the tertiary level.

Europe



Agency staff visit Dashoguz oncology hospital in Turkmenistan and assess radiation medicine capacity.

In 2022, the TC programme provided assistance to 33 Member States in Europe and Central Asia. A focus was placed on enhancing nuclear and radiation safety, the diagnosis of non-communicable diseases, cancer treatment and radiation medicine. During the 66th regular session of the General Conference, Member States endorsed a new regional profile for Europe and Central Asia (2022–2027).

Turkmenistan's first national TC programme began in 2022. Activities focused on cancer diagnosis and treatment, radiation safety and regulatory infrastructure, and radioactive waste management.

The Board of Governors approved an off-cycle TC project to help Ukraine strengthen radiation therapy and medical imaging. The project will provide equipment and strengthen human resource capabilities to ensure increased access to, and effective delivery of, cancer diagnosis, management and treatment, and will be implemented and delivered through existing Agency mechanisms, under the Rays of Hope initiative. The project aims to strengthen existing services to meet increasing demand, in particular at some medical institutions that have become key locations for cancer patients coming from different parts of the country.

Latin America and the Caribbean

In 2022, the Agency provided technical assistance to 31 Member States in Latin America and the Caribbean, focusing on human health, food and agriculture, radiation safety, and water and the environment.

In February, 12 scientists from Latin America received training at the Agency's Seibersdorf laboratories in crop mutation breeding for resistance to Fusarium wilt, which affects critical banana plantations in the region. Sixteen national reference laboratories received equipment and training to improve their early detection capacities.

The Research Network of Marine-Coastal Stressors in Latin America and the Caribbean established harmonized strategies for the sampling and analysis of microplastics to ensure the collection of comparable data. The goal is to establish a regional database on the quantity of microplastics in marine and coastal environments.



Andrew Holness, Prime Minister of Jamaica, at the inauguration of Jamaica's first public nuclear medicine centre, June 2022.

The regional chapter of Women in Nuclear (WiN) for Latin America and the Caribbean continued to support equal female participation in nuclear science and technology. In September, it launched a guide on gender mainstreaming in the nuclear sector in the region entitled 'Somos Potencia' (We Are the Power).



The Director General at the opening of the WiN booth at the 66th regular session of the General Conference, September 2022.

Emergency Response

The TC programme is flexible and agile, and can respond quickly to the urgent needs of Member States. In 2022, following historic flooding in Pakistan, the Agency and FAO consulted closely with Pakistan's Government and national agriculture and veterinarian institutes to develop an emergency support package to assist the country in applying nuclear science to better understand the impact of the flood on soils and crops, as well as the potential spread of animal and zoonotic diseases.

An expert mission to Cyprus in May under a project to develop a rapid response strategy to prevent the establishment of the Asian tiger mosquito discovered the presence of the *Aedes aegypti* mosquito, which is the primary vector for diseases such as dengue, Zika and chikungunya and poses a potential threat to the country's healthcare system and its important tourism industry. In response to this finding and following a request from the Member State, the Agency developed an emergency response plan. The Asian tiger mosquito was subsequently found on the island later in the year and the ongoing project was adjusted to help Cyprus address this emergency.

Following a large fire at Cuba's Matanzas supertanker base in August, the Agency procured environmental and air quality monitoring equipment to support local efforts to measure the effect of the fire and develop mitigation strategies. Furthermore, to aid the country's recovery efforts in the wake of Hurricane Ian, the Agency procured mobile X-ray equipment for four hospitals and equipment to determine environmental contaminants and water quality.

Following an oil spill off the coast of Callao, Peru in January, the Agency rapidly responded to assess the environmental situation and organized the necessary assistance upon the request of the country.

A computed tomography scanner was delivered to Saint Vincent and the Grenadines to replace the only such scanner in the country, damaged during the eruption of the La Soufrière volcano.

Mexico received Agency support following a fruit fly outbreak in Colima in 2021. An emergency action plan based on integrated pest management, including the application of the sterile insect technique, was implemented in 2021 and 2022 to control the outbreak (see related case study).

Programme of Action for Cancer Therapy (PACT)

Through the WHO-IAEA Joint Programme on Cancer Control, the Agency supported Member States by assessing their cancer control capacities, providing expert advisory support for the development of national cancer control programmes (NCCPs) and strategic documents, and mobilizing resources.

Support for Member States under Rays of Hope is coordinated across the Agency and has been initiated in seven African countries: Benin, Chad, the Democratic Republic of the Congo, Kenya, Malawi, the Niger and Senegal. Regional anchor centres will provide regional training and expertise. The pool of both traditional and non-traditional partners has already expanded and efforts are under way to match partners to Member States in need. The Agency has established partnerships with international financial institutions such as the Islamic Development Bank, and helps Member States develop bankable documents to apply for concessional loans. Through such triangular cooperation and the Rays of Hope initiative, more financial resources will be invested from international financial institutions to support the use of radiation medicine to treat cancer in developing countries.

ImPACT Review missions were conducted in Colombia, the Lao People's Democratic Republic, the Syrian Arab Republic and Uzbekistan, with in-country follow-up missions carried out in the Syrian Arab Republic and Uzbekistan and virtual follow-ups carried out for Costa Rica and El Salvador. Reviews were also initiated in Cambodia, El Salvador, Fiji, Jordan and the Sudan. The Agency provided technical advice for NCCP elaboration to ten countries — Benin, Botswana, Burundi, Kenya, Paraguay, Senegal, Sierra Leone, the Sudan, Zambia and Zimbabwe — and conducted in-country workshops in nine of these countries. Burundi, the Central African Republic, the Democratic



The *imPACT* Review team visits the Farah Children's Cancer Association in Lattakia, Syrian Arab Republic, October 2022.

Republic of the Congo, Togo, the United Republic of Tanzania and Zambia were assisted in drawing up bankable documents. The *Methodology for Integrated Missions of the Programme of Action for Cancer Therapy (imPACT Reviews)* (IAEA Services Series No. 46) was published, along with a peer reviewed article on its evolution.

Technical Cooperation and the Global Development Context

In February, the Agency participated in the fifth session of the United Nations Environment Assembly and a special session of the United Nations Environment Assembly (UNEP@50), highlighting the contribution of nuclear and nuclear-related technologies to addressing plastic pollution, zoonotic diseases, water and groundwater management, ocean acidification, agriculture and coastal agriculture, ecosystems restoration and energy transition.

In May, the Agency participated in person at the 75th World Health Assembly. The Director General reaffirmed the Agency's continued close cooperation with WHO on cancer, nutrition and zoonotic diseases.

In July, the Agency participated in the United Nations High-level Political Forum on Sustainable Development, presenting its contributions to the achievement of SDGs such as quality education, life below water and life on land. It highlighted the contribution of nuclear science and technology to sustainable development and presented the support it provided to SIDS. At a side event on desertification and land degradation, the Agency presented the role of nuclear techniques in soil and water management and in supporting recovery. It also participated in a side event hosted by Namibia and South Africa on gender in science, technology and innovation.

In August, Agency representatives participated in the 72nd Session of the WHO Regional Committee for Africa, in Lomé, meeting more than 20 Ministers of Health. It also took part in the WHO Regional Committee for Europe, held in Israel, and explored regional cooperation on cancer.

In September, the Agency attended the United Nations Global South–South Development Expo to raise awareness of the contribution of nuclear technology to sustainable development in the context of South–South and triangular cooperation, and to identify new partnership and resource

mobilization opportunities. It supported a side event on harnessing the power of the atom, and two exhibition booths.

In October, the Agency participated in the Asian Development Bank's Innovation Fair, where it showcased the socioeconomic impact of nuclear technology in agriculture, health and industry.

Also in October, the Agency attended the World Cancer Congress 2022, where a focus was placed on the need to forge new, and expand traditional, partnerships in the global fight against cancer.

At the invitation of the Indonesian G-20 President, the Agency participated in the G-20 Research and Innovation Initiative Gathering and Research and Innovation Ministers' Meeting, where it underscored the importance of nuclear science and technology in relation to health, plastic pollution, energy and food security.

Legislative Assistance

Country-specific bilateral legislative assistance was provided to seven Member States through written comments and advice on drafting national nuclear legislation and six dedicated bilateral review meetings to provide specific advice on draft and enacted nuclear legislation. Three regional and sub-regional workshops were held for Member States in Asia and the Pacific, Latin America and the Caribbean and the Middle East. In addition, a further 18 legislative assistance activities were conducted, including 10 awareness-raising meetings and 8 national workshops on nuclear law.

The Agency organized the tenth session of the Nuclear Law Institute (NLI) in Vienna, Austria. The NLI is an interregional training event designed to give participants a solid understanding of all aspects of nuclear law, with a particular focus on legislative drafting. In addition, five webinars were held in 2022 as part of the Agency's interactive webinar series on topical issues in nuclear law.

The Agency also delivered short introductory courses on nuclear law at Khalifa University of Science and Technology in the United Arab Emirates and the University of Buenos Aires in Argentina as part of the university partnership initiative launched at the First International Conference on Nuclear Law: The Global Debate.

Technical Cooperation Programme Management

Quality assurance activities, reporting and monitoring

In 2022, the Agency focused on knowledge management, organizational learning and training of TC programme stakeholders, with the aim of enhancing the efficiency, effectiveness and relevance of the support provided to Member States.

Training on the use of the logical framework approach in project design was provided upon request to national TC project counterparts during the design phase of the 2024–2025 TC programme. Online tutorials on the TC project document template, the logical framework approach and the TC project work plan and budget were posted on the Programme Cycle Management Framework IT platform.

Project Progress Assessment Reports for the 2021 reporting period were received for 844 TC projects — a submission rate of 83%.

One hundred and fifty-one recommendations from the Office of Internal Oversight Services have been addressed since 2019. All recommendations owned by TC and issued prior to 2021 have been closed.

Financial resources

The TC programme is funded by contributions to the TCF, extrabudgetary contributions, government cost-sharing and contributions in kind. New resources reached €129.6 million in 2022, with approximately €93.7 million for the TCF (including assessed programme costs arrears, National Participation Costs (NPCs) and miscellaneous income), €35.6 million in extrabudgetary resources and about €0.3 million in in-kind contributions. The rate of attainment for the TCF stood at 97.5% on payments and 98.7% on pledges at the end of 2022. Payment of NPCs totalled €4.0 million.

Actuals

In 2022, approximately €108.7 million was disbursed to 149 countries or territories, of which 35 were LDCs.

MANAGEMENT ISSUES

Managing for results

The Agency continued its efforts to strengthen its results based management throughout the programme cycle. To that end, the Agency formally added a section to its administrative framework outlining the results based approach, thereby strengthening its effective internalization throughout the Agency. This includes the integration of knowledge management coordination into the Agency's results based management framework, implemented at the Department level through the development of Departmental knowledge management action plans. The Agency's risk management system was revised to further strengthen the links between risk management, results based management and internal controls.

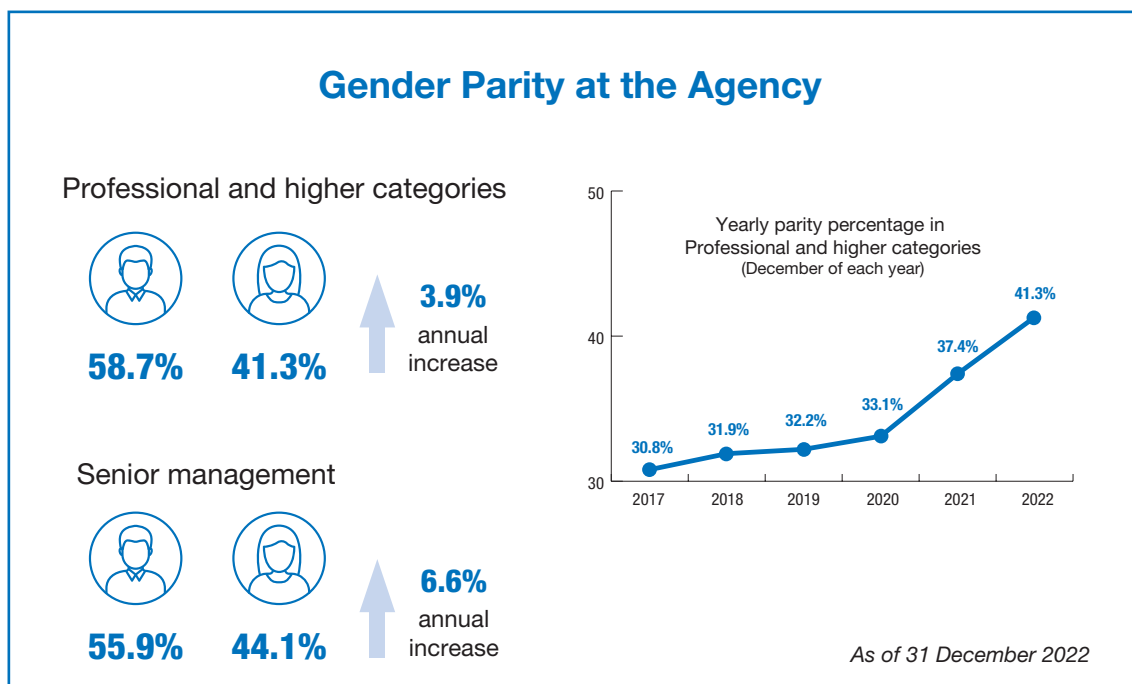
The Agency actively supported the update of UN system-wide guidance on results based management contained in the UN Development Group's *Results-based Management Handbook*, serving as informal guidance to Agency managers as well.

The Agency updated the Programme and Budget IT system with improved functionalities such as better assessment of actual achievements against planned targets during the reporting phase. In parallel, continuous capacity-building activities, particularly during the planning phase and as part of the induction programme for new managers, were developed and implemented.

Gender equality and respect for diversity

Further to the goal set by the Director General, the Agency continued to strive to achieve gender parity in all levels of the Professional and higher categories by 2025. At the end of 2022, the percentage of women in the Professional and higher categories was 41.3%, the highest to date, and that of women in senior management positions (D level or higher) had reached 44.1%. These figures represent an increase of 3.9% and 6.6%, respectively, compared with the figures from December 2021. In 2022, the Secretariat continued to implement its Gender Equality Policy and its internal Gender Action Plan, which were updated in 2021 to include tasks for the 2021–2022 biennium.

In terms of programmatic gender mainstreaming, the focus continued to be on further mainstreaming a gender perspective into programme planning and implementation, reporting on gender-related programmatic results, and strengthening staff capacity for gender mainstreaming in programmes and activities. This included efforts to enhance the participation of women as training participants, fellows, scientific visitors, project counterparts, researchers, experts and panellists. With regard to planning for the 2024–2025 biennium, conducting a gender analysis was a mandatory requirement during project design. Similarly, every TC project design includes a section on cross-cutting issues,



including gender, where efforts to evaluate any different impacts on men and women are assessed and described. The Agency also assisted ARCAL in preparing and launching a practical guide on gender-related issues in nuclear in order to strengthen the capacities of national nuclear institutes by presenting potential strategies to promote gender mainstreaming at all levels.

In 2022, the Secretariat continued providing mandatory training in line with its Respect for Diversity and Anti-Discrimination Policy to promote a respectful workplace and discourage improper behaviour, and participated in training modules, jointly organized and delivered with other Vienna-based UN organizations, reaching over 700 staff members of the participating organizations.

The Secretariat also enhanced training for new and current managers to support them with leadership skills to manage their staff and processes in a diverse workforce.

Partnerships and resource mobilization

Leveraging the Agency's approved projects distributed across the Departments, the Director General's initiatives are being implemented to step up the Agency's impact in addressing global challenges, including Rays of Hope, ZODIAC, NUTEC Plastics, NHSI, the IAEA Platform on Small Modular Reactors and their Applications, the Marie Skłodowska-Curie Fellowship Programme and the Lise Meitner Programme. They will continue to be implemented through enhanced in-house coordination and by mobilizing additional resources outside the Agency's traditional framework to bridge the gap between demand and resources. Similarly, coordination, cooperation and collaboration with other organizations in the UN system, other international organizations, governments and non-traditional partners — including development and regional banks, the private sector and foundations — will be further strengthened.

In 2022, the Agency received a total of €158 million in extrabudgetary contributions. At the same time, nearly 40 Practical Arrangements and 10 new memoranda of understanding were signed by the Agency.

Internally, the Director General adopted decisions for enhanced internal coordination, a more cohesive approach and increased accountability to deliver results with regard to mobilizing extrabudgetary resources. These decisions were implemented within existing resources and

organizational arrangements, focusing on three areas: a strengthened partnerships and resource mobilization (PRM) function in the Department of Technical Cooperation, the designation of dedicated Departmental PRM coordinators, and the revision and strengthening of the Partnerships and Resource Mobilization Coordination Committee's composition and function.

Information security and technology

The Agency remained vigilant to ongoing cyberthreats as part of its regular IT operations and strengthened its information and IT security through a number of actions, including implementing a new information security management system, preparing for the ISO/IEC 27001 certification of the system managed by the Agency, increasing anti-malware and security defence mechanisms, and improving monitoring capabilities. In addition, the operational needs of the Agency in the context of the COVID-19 pandemic continued to be met, including supporting hybrid meetings, maintaining scalable remote access capabilities for staff, and adapting IT operating models as required.

Multilingualism

The documents submitted to the Policy-Making Organs, and all Safety Requirements and editions of the IAEA Bulletin, were issued in Arabic, Chinese, English, French, Russian and Spanish. In addition, the translation of 59 publications from English into one or more other languages resulted in 98 issuances of publications in languages other than English. These included the translation of several publications in the IAEA Safety Standards Series, IAEA Nuclear Security Series, IAEA Nuclear Energy Series, and IAEA Technical Documents series, and of the *Nuclear Law: The Global Debate* book, into Arabic, Chinese, French, Russian and Spanish.

In 2022, the Agency continued offering regionally targeted (or 'localized') news on its web site (iaea.org) to better serve its audience in Arabic, Chinese, French, Russian and Spanish. By December 2022, the combined traffic in the languages other than English had increased by 23% compared to December 2021, accounting for 18% of the overall web traffic of iaea.org. This increase in traffic was also due to search engine optimization measures and to the Agency's regular reporting on the nuclear safety and security situation in Ukraine.

The Agency continued to regularly publish content on its Facebook accounts in Arabic, French, Russian and Spanish, and on its Weibo account in Chinese. Furthermore, the number of followers on the Agency's social media accounts in languages other than English grew by 11% during 2022. Other outreach activities included the production of 9 videos, 25 press releases and 34 interviews with the Director General, Deputy Directors General and Agency experts in languages other than English.