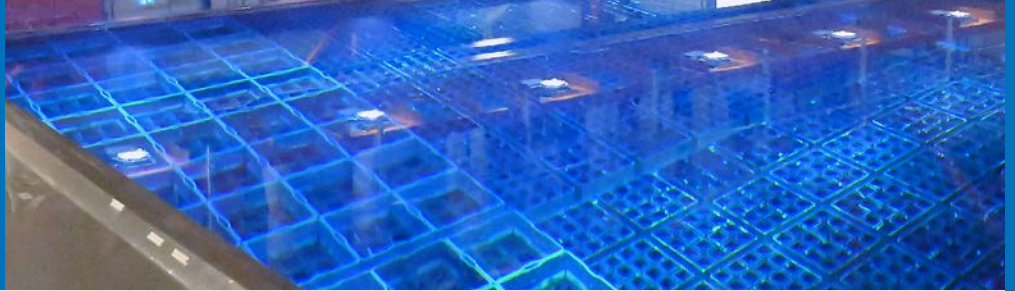


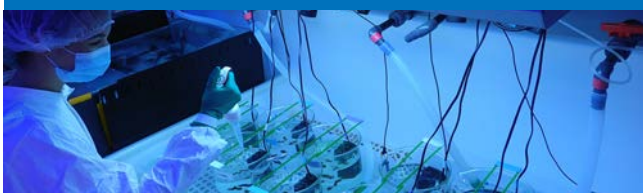


IAEA

International Atomic Energy Agency



ANNUAL REPORT



2023

Atoms for Peace and Development



FOREWORD

**by IAEA Director General
Rafael Mariano Grossi**

In 2023, as we marked the 70th anniversary of US President Dwight D. Eisenhower's famous 'Atoms for Peace' speech, the International Atomic Energy Agency remained as relevant as ever through its indispensable work in safety, security and safeguards and in expanding access to the lifesaving and life-affirming uses of nuclear science and technology across the globe.

In October, I launched Atoms4Food together with the Director-General of the Food and Agriculture Organization of the United Nations. The initiative looks at the needs of individual Member States and harnesses our experience in using nuclear techniques and technologies to enhance food security and nutrition. At the same time, we continued to implement existing key initiatives such as Rays of Hope, ZODIAC and NUTEC Plastics.

Our efforts to refurbish the unique and critically important facilities and laboratories at Seibersdorf achieved a milestone when, in November, we were able to announce the completion of all major fundraising for ReNuAL2. Just a few weeks before, we had been in Seibersdorf for the opening of the Agency's new Nuclear Security Training and Demonstration Centre, which will assist Member States in tackling nuclear terrorism and crime.

An important part of our work in 2023 was to ensure transparency around the discharge of ALPS-treated water from Fukushima Daiichi NPP. In July, I presented to Prime Minister Fumio Kishida of Japan an Agency report that found the discharge approach to be consistent with international safety standards. The results of the Agency's independent sampling and analysis of the water indicate tritium levels well below Japan's operational limits.

Another key priority was to support Ukraine's nuclear safety and security as the war stretched into its second year. Some 86 Agency missions comprising 187 staff travelled to Ukraine and over €7.5 million worth of equipment was delivered. The Agency maintained an uninterrupted presence at all five nuclear sites in Ukraine and, in May, I presented to the UN Security Council the five principles for protecting nuclear safety and security at Zaporizhzhya NPP.

I am confident that we will look back at 2023 as a milestone in the transition to net zero. At COP28, leaders for the first time backed investment in nuclear as a low-carbon energy source. Key to making this happen is that governments establish the appropriate conditions.

Small modular reactors (SMRs) will play an important role, including in developing countries, but only once they move from development to deployment. In 2023, our Nuclear Harmonization and Standardization Initiative (NHSI), which supports the timely and safe deployment of SMRs, made concrete progress in highlighting approaches to getting this done.

The nuclear sector still has some way to go in terms of gender equality and I am determined that the Agency will be part of the solution. By the end of 2023, the IAEA Marie Skłodowska-Curie Fellowship Programme had 560 fellows and we had launched the Lise Meitner Programme, offering early- and mid-career women in the nuclear sector new opportunities for career advancement. We also progressed towards gender equality in the Secretariat. Gender balance was achieved in senior management while in the Professional and higher categories, 44% of positions were held by women.

In closing, let me touch on the future, where fusion energy no longer seems the far-flung prospect it once was. At the 29th IAEA Fusion Energy Conference, I launched the World Fusion Energy Group, which will bring together key stakeholders on the next leg of the journey from experimentation to demonstration to deployment.

As this report shows, the Agency is maximizing its impact efficiently and sustainably, proving an invaluable asset to its 178 Member States seven decades after it was first envisioned.



Rafael Mariano Grossi
IAEA DIRECTOR GENERAL

NOTES

- ▶ The *IAEA Annual Report 2023* aims to summarize only the significant activities of the Agency during the year in question. The main part of the report, starting on page 36, generally follows the programme structure as given in *The Agency's Programme and Budget 2022–2023* (GC(65)/2). The objectives included in the main part of the report are taken from that document and are to be interpreted consistently with the Agency's Statute and decisions of the Policy-Making Organs.
- ▶ The introductory chapter, 'In Focus 2023', covers specific Agency activities — which in some instances are cross-cutting in nature — with a focus on notable developments during the year. More detailed information can be found in the latest editions of the Agency's *Nuclear Safety Review*, *Nuclear Security Review*, *Nuclear Technology Review*, *Technical Cooperation Report* and *Safeguards Statement and Background to the Safeguards Statement*.
- ▶ Tables annexed to this report are available, in electronic form only, on iaea.org, along with the *Annual Report*.
- ▶ The designations employed and the presentation of material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.
- ▶ The mention of names of specific companies or products (whether or not indicated as registered) does not imply any intention to infringe proprietary rights, nor should it be construed as an endorsement or recommendation on the part of the Agency.
- ▶ The term 'non-nuclear-weapon State' is used as in the Final Document of the 1968 Conference of Non-Nuclear-Weapon States (United Nations document *A/7277*) and in the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The term 'nuclear-weapon State' is as used in the NPT.
- ▶ All the views expressed by Member States are reflected in full in the summary records of the June Board of Governors meetings. On 3 June 2024, the Board of Governors approved the *Annual Report for 2023* for transmission to the General Conference.

IAEA ANNUAL REPORT 2023

**Article VI.J of the Agency’s Statute requires the Board of Governors to submit
“an annual report to the General Conference concerning the affairs of
the Agency and any projects approved by the Agency”.**

This report covers the period 1 January to 31 December 2023.

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ANNEX

Scan the QR code
to access the Annex to this report.



MEMBER STATES OF THE INTERNATIONAL ATOMIC ENERGY AGENCY

(as of 31 December 2023)

AFGHANISTAN	DOMINICAN REPUBLIC	MADAGASCAR	SLOVAKIA
ALBANIA	ECUADOR	MALAWI	SLOVENIA
ALGERIA	EGYPT	MALAYSIA	SOUTH AFRICA
ANGOLA	EL SALVADOR	MALI	SPAIN
ANTIGUA AND BARBUDA	ERITREA	MALTA	SRI LANKA
ARGENTINA	ESTONIA	MARSHALL ISLANDS	SUDAN
ARMENIA	ESWATINI	MAURITANIA	SWEDEN
AUSTRALIA	ETHIOPIA	MAURITIUS	SWITZERLAND
AUSTRIA	FIJI	MEXICO	SYRIAN ARAB REPUBLIC
AZERBAIJAN	FINLAND	MONACO	TAJIKISTAN
BAHAMAS	FRANCE	MONGOLIA	THAILAND
BAHRAIN	GABON	MONTENEGRO	TOGO
BANGLADESH	GAMBIA, THE	MOROCCO	TONGA
BARBADOS	GEORGIA	MOZAMBIQUE	TRINIDAD AND TOBAGO
BELARUS	GERMANY	MYANMAR	TUNISIA
BELGIUM	GHANA	NAMIBIA	TÜRKİYE
BELIZE	GREECE	NEPAL	TURKMENISTAN
BENIN	GRENADA	NETHERLANDS, KINGDOM OF THE	UGANDA
BOLIVIA, PLURINATIONAL STATE OF	GUATEMALA	NEW ZEALAND	UKRAINE
BOSNIA AND HERZEGOVINA	GUINEA	NICARAGUA	UNITED ARAB EMIRATES
BOTSWANA	GUYANA	NIGER	UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
BRAZIL	HAITI	NIGERIA	UNITED REPUBLIC OF TANZANIA
BRUNEI DARUSSALAM	HOLY SEE	NORTH MACEDONIA	UNITED STATES OF AMERICA
BULGARIA	HONDURAS	NORWAY	URUGUAY
BURKINA FASO	HUNGARY	OMAN	UZBEKISTAN
BURUNDI	ICELAND	PAKISTAN	VANUATU
CABO VERDE	INDIA	PALAU	VENEZUELA, BOLIVARIAN REPUBLIC OF
CAMBODIA	INDONESIA	PANAMA	
CAMEROON	IRAN, ISLAMIC REPUBLIC OF	PAPUA NEW GUINEA	
CANADA	IRAQ	PARAGUAY	
CENTRAL AFRICAN REPUBLIC	IRELAND	PERU	
CHAD	ISRAEL	PHILIPPINES	
CHILE	ITALY	POLAND	
CHINA	JAMAICA	PORTUGAL	
COLOMBIA	JAPAN	QATAR	
COMOROS	JORDAN	REPUBLIC OF MOLDOVA	
CONGO	KAZAKHSTAN	ROMANIA	
COSTA RICA	KENYA	RUSSIAN FEDERATION	
CÔTE D'IVOIRE	KOREA, REPUBLIC OF	RWANDA	
CROATIA	KUWAIT	SAINT KITTS AND NEVIS	
CUBA	KYRGYZSTAN	SAINT LUCIA	
CYPRUS	LAO PEOPLE'S DEMOCRATIC REPUBLIC	SAINT VINCENT AND THE GRENADINES	
CZECH REPUBLIC	LATVIA	SAMOA	
DEMOCRATIC REPUBLIC OF THE CONGO	LEBANON	SAN MARINO	
DENMARK	LESOTHO	SAUDI ARABIA	
DJIBOUTI	LIBERIA	SENEGAL	
DOMINICA	LIBYA	SERBIA	
	LIECHTENSTEIN	SEYCHELLES	
	LITHUANIA	SIERRA LEONE	
	LUXEMBOURG	SINGAPORE	

The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are located in Vienna.

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THE AGENCY AT A GLANCE



2555
professional
and general
service staff

**€136.62
million**
extrabudgetary
expenditures
in 2023



**€421.41
million**
total Regular
Budget for 2023*



* At the United Nations average rate of exchange of US \$0.925 to €1.00. The total Regular Budget was €425.79 million at the US \$1.00 to €1.00 rate.



1
Headquarters

- Vienna



2
Liaison offices

- New York
- Geneva



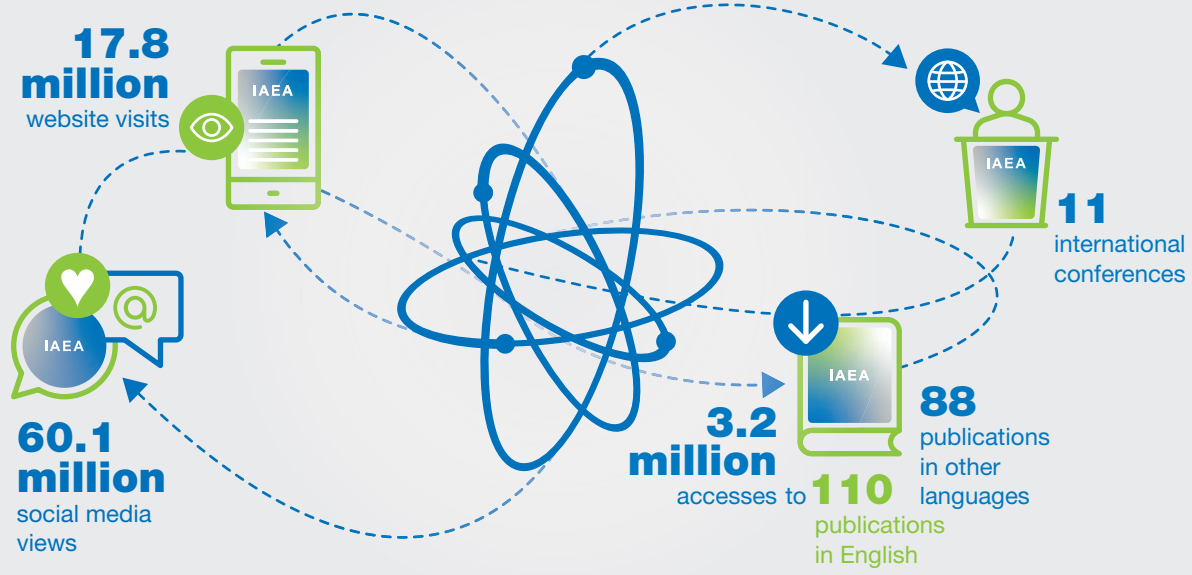
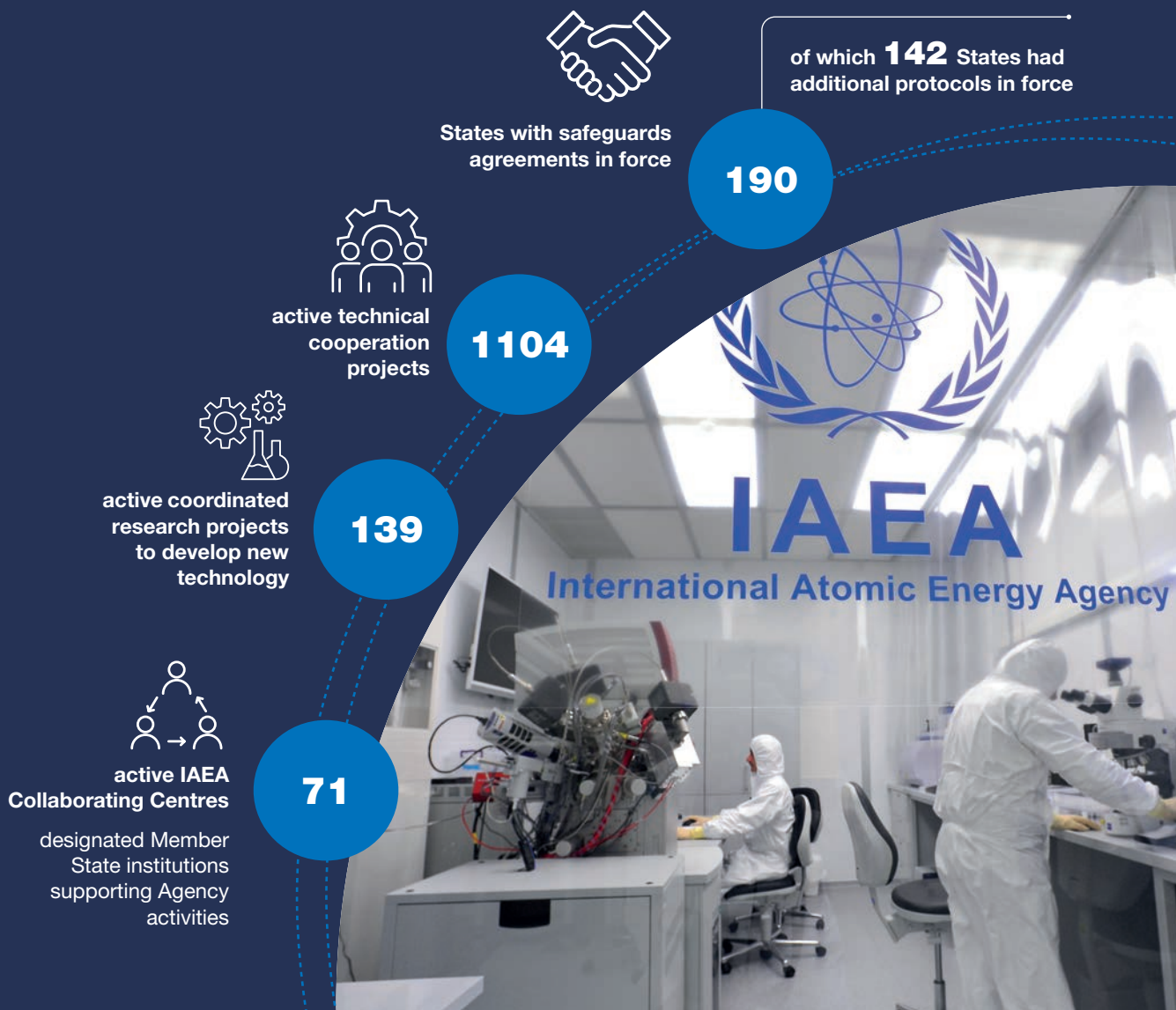
15
international
laboratories

- Vienna
- Seibersdorf
- Monaco



2
safeguards
regional offices

- Tokyo
- Toronto



THE BOARD OF GOVERNORS

The Board of Governors oversees the ongoing operations of the Agency. It comprises 35 Member States and generally meets five times a year, or more frequently if required for specific situations.

In the area of nuclear technologies, in the course of 2023 the Board considered the *Nuclear Technology Review 2023*.

In the area of safety and security, the Board discussed the *Nuclear Safety Review 2023* and the *Nuclear Security Review 2023*.

In March 2023, the Board appointed the Director General for a further four-year term of office, from 3 December 2023 to 2 December 2027.

As regards verification, the Board considered the *Safeguards Implementation Report for 2022*. The Board considered the Director General's reports on verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015). The Board also considered the Director General's reports on naval nuclear propulsion: Australia and naval nuclear propulsion: Brazil, respectively. The Board kept under its consideration the implementation of the Treaty on the Non-Proliferation of Nuclear

Weapons (NPT) Safeguards Agreement in the Syrian Arab Republic and the application of safeguards in the Democratic People's Republic of Korea and considered the Director General's respective reports thereon. The Board also kept under its consideration the issue of the NPT Safeguards Agreement with the Islamic Republic of Iran and considered the Director General's reports thereon.

The Board considered the Director General's reports on nuclear safety, security and safeguards in Ukraine.

The Board discussed the *Technical Cooperation Report for 2022* and approved funding for the Agency's technical cooperation programme for 2024.

The Board considered IAEA safeguards in relation to AUKUS; and the restoration of sovereign equality in the Agency.

In June 2023, the Board approved the recommendations contained in the proposal to the Board of Governors by the co-chairs of the Working Group on the Regular Budget and the Technical Cooperation Fund Targets for 2024–2025.





COMPOSITION OF THE BOARD OF GOVERNORS 2023-2024

35

Board members



CHAIR
HE Mr Holger
Federico
MARTINSEN
(Governor from Argentina)



VICE-CHAIRS
HE Ms Emilia
KRALEVA
(Governor from Bulgaria)



HE Mr Peter
POTMAN
(Governor from the Kingdom of
the Netherlands)

- Algeria
- Argentina
- Armenia
- Australia
- Bangladesh
- Brazil
- Bulgaria
- Burkina Faso
- Canada
- China
- Costa Rica
- Denmark
- Ecuador
- Finland
- France
- Germany
- India
- Indonesia
- Japan
- Kenya
- Korea, Republic of
- Namibia
- Netherlands,
Kingdom of the
- Paraguay
- Qatar
- Russian Federation
- Saudi Arabia
- Singapore
- South Africa
- Spain
- Türkiye
- Ukraine
- United Kingdom of
Great Britain and
Northern Ireland
- United States of
America
- Uruguay

THE GENERAL CONFERENCE

The General Conference comprises all Member States of the Agency and usually meets once a year, in regular session.

In January 2023, the General Conference convened a special session, at the request of the Board of Governors, for the purpose of approving *The Agency's Draft Budget Update for 2023 (Revised)*, in accordance with Article XIV.A of the Statute. The draft budget update was duly approved.

In its regular session in September 2023, the General Conference approved the appointment of the Director General from 3 December 2023 to 2 December 2027, and adopted resolutions on the Agency's financial statements for 2022; on the Agency's budget for 2024; on nuclear and radiation safety; on nuclear security; on strengthening the Agency's technical cooperation activities; on strengthening the Agency's activities related to nuclear science, technology and applications, comprising non-power nuclear applications,

nuclear power applications and nuclear knowledge management; on strengthening the effectiveness and improving the efficiency of Agency safeguards; on the implementation of the NPT Safeguards Agreement between the Agency and the Democratic People's Republic of Korea; on the application of IAEA safeguards in the Middle East; on the status of Palestine in the IAEA; on restoration of the sovereign equality of Member States in the IAEA; on nuclear safety, security and safeguards in Ukraine; and on staffing of the Secretariat and women in the Secretariat. The Conference also adopted decisions on the progress made towards the entry into force of the amendment to Article XIV.A of the Statute, approved in 1999, and on the progress made towards the entry into force of the amendment to Article VI of the Statute, approved in 1999.

702

participants



SCIENTIFIC FORUM:
Nuclear Innovations for Net Zero



35

speakers



142



general debate
statements
delivered

2835

participants
registered



2589
Member State
representatives

89
from international
organizations

153
from NGOs



PRESIDENT

**PRESIDENT
OF THE GENERAL CONFERENCE**

HE Ms Vilawan
Mangklatanakul

Ambassador and Resident
Representative of Thailand



111
side events



14 285
livestream participants



3274
downloads of the GC67
mobile app

ABBREVIATIONS

AEOI	Atomic Energy Organization of Iran	FINAS	Fuel Incident Notification and Analysis System
ALMERA	Analytical Laboratories for the Measurement of Environmental Radioactivity	HFIPS	Hefei Institutes of Physical Science
ALPS	Advanced Liquid Processing System	HOPS	Hub for On-line Nuclear Power Plant Part-Task Simulators
AP	additional protocol	ICTP	Abdus Salam International Centre for Theoretical Physics
ARTEMIS	Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation	imPACT	integrated missions of PACT
CNDC	China Nuclear Data Center	INIR	Integrated Nuclear Infrastructure Review
CNPP	country nuclear power profile	INIR-RR	Integrated Nuclear Infrastructure Review for Research Reactors
COMPASS	IAEA Comprehensive Capacity-Building Initiative for SSACs and SRAs	INIS	International Nuclear Information System
ConvEx	Convention Exercise	INL	Idaho National Laboratory
COP	Conference of the Parties to the United Nations Framework Convention on Climate Change	INSARR	Integrated Safety Assessment of Research Reactors
CPF	country programme framework	INSServ	International Nuclear Security Advisory Service
CRP	coordinated research project	IPPAS	International Physical Protection Advisory Service
CSA	comprehensive safeguards agreement	IRMIS	International Radiation Monitoring Information System
DIRATA	Database on Discharges of Radionuclides to the Atmosphere and Aquatic Environment	IRRS	Integrated Regulatory Review Service
DSRS-TeC	Disused Sealed Radioactive Sources Technical Centre peer review	IRRUR	Integrated Research Reactor Utilization Review
EPR	emergency preparedness and response	IRS	Incident Reporting System
EPREV	Emergency Preparedness Review	IRSRR	Incident Reporting System for Research Reactors
Euratom	European Atomic Energy Community	ISCA	Independent Safety Culture Assessment
FAO	Food and Agriculture Organization of the United Nations	ISOP	International Network on Innovation to Support Operating Nuclear Power Plants
		ITU	International Telecommunication Union

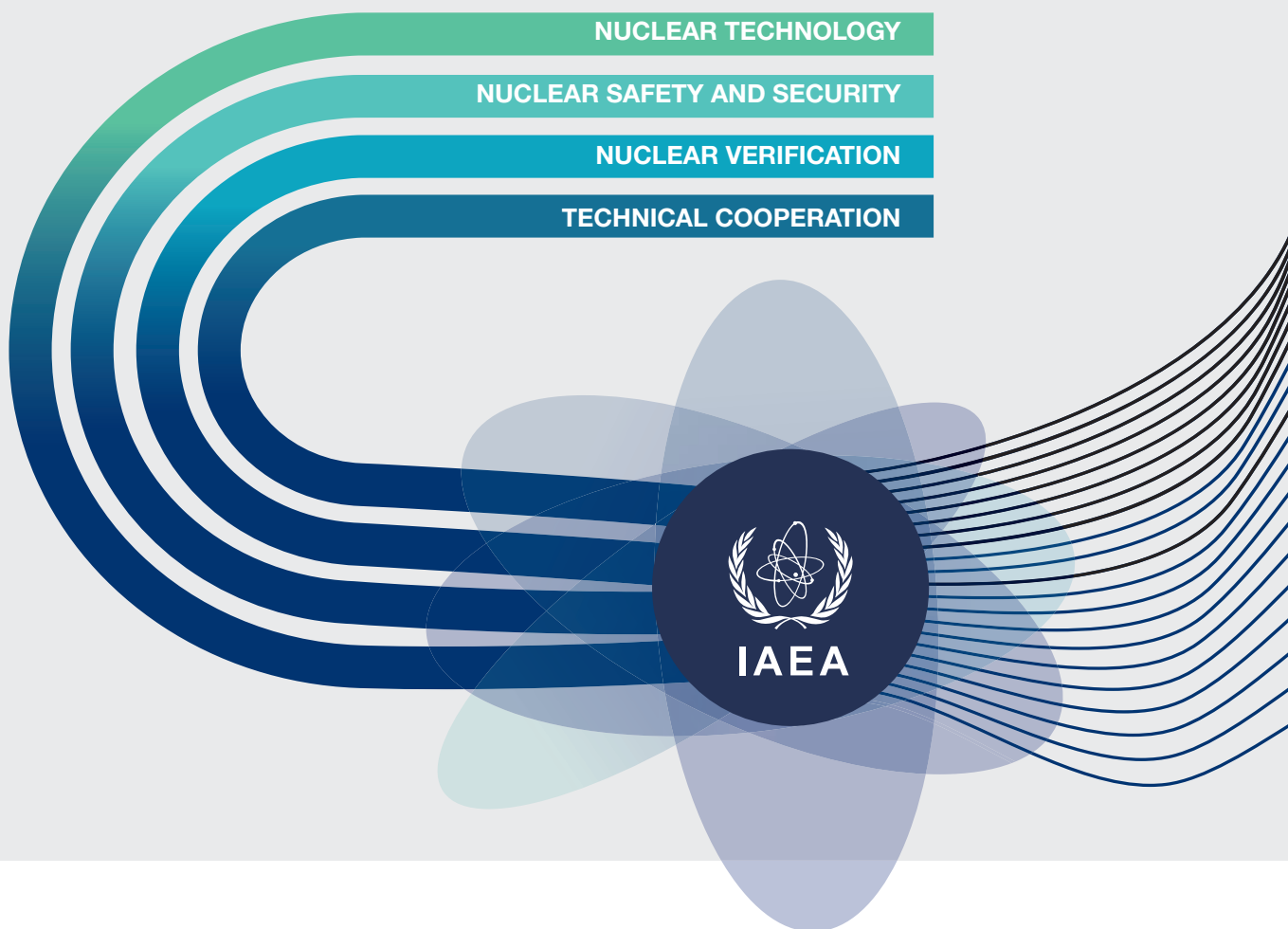
LEU	low enriched uranium	RISS	Advisory Mission on Regulatory Infrastructure for Radiation Safety and Nuclear Security
MIT	Massachusetts Institute of Technology	SALTO	Safety Aspects of Long Term Operation
NHSI	Nuclear Harmonization and Standardization Initiative	SANIS	Simulation and Experimental Analyses Network Information System
NPP	nuclear power plant	SEED	Site and External Events Design
NPT	Treaty on the Non-Proliferation of Nuclear Weapons	SMR	small modular reactor
NUTEC Plastics	NUclear TEChnology for Controlling Plastic Pollution	SPECT-CT	single photon emission computed tomography–computed tomography
OECD/NEA	Nuclear Energy Agency of the Organisation for Economic Co-operation and Development	SQP	small quantities protocol
OMARR	Operation and Maintenance Assessment for Research Reactors	TCF	Technical Cooperation Fund
ORPAS	Occupational Radiation Protection Appraisal Service	TSR	Technical Safety Review
OSART	Operational Safety Review Team	UNESCO	United Nations Educational, Scientific and Cultural Organization
PACT	Programme of Action for Cancer Therapy	UNEP	United Nations Environment Programme
PRIS	Power Reactor Information System	WHO	World Health Organization
PROSPER	Peer Review of Operational Safety Performance Experience	ZODIAC	Zoonotic Disease Integrated Action
QUAADRIL	Quality Assurance Audit for Diagnostic Radiology Improvement and Learning		
QUANUM	Quality Assurance in Nuclear Medicine		
QUATRO	Quality Assurance Team for Radiation Oncology		
RANET	Response and Assistance Network		

IN FOCUS 2023

ATOMS FOR PEACE AND DEVELOPMENT

In 2023, 70 years after the 'Atoms for Peace' speech inspired its creation, the Agency continued to address the needs of Member States in tackling global challenges using nuclear techniques, while maintaining vigilant oversight of nuclear material and facilities in 190 States in accordance with their safeguards agreements with the Agency. In doing so, the Agency continued its work to highlight nuclear energy, including at COP28; implement new food security programmes; improve access to nuclear technology and applications for health, agriculture and environmental protection; conduct safeguards in a war zone; and promote nuclear safety and security around the world — including by helping to prevent a nuclear accident at nuclear facilities in Ukraine.

'In Focus 2023' provides an overview of some of these key programmatic activities that were implemented with enhanced interdepartmental coordination and in close cooperation with Member States and other interested partners, with a view to making greater impact in addressing global issues. It also includes a section entitled 'Managing for results', which summarizes efforts to optimize the use of resources and leverage technology to enable efficient and effective programme delivery.





Rays of Hope

ZODIAC

NUTEC Plastics

Atoms4Food

Seibersdorf Facilities and Laboratories

Nuclear Power Around the World

IAEA Platform on Small Modular Reactors
and their Applications

Nuclear Harmonization
and Standardization Initiative

Fusion Energy

Atoms4NetZero

COP28

Nuclear Safety, Security and Safeguards
in Ukraine

Fukushima ALPS-Treated Water Discharge

COMPASS

Artificial Intelligence

Together for More Women in Nuclear
Managing for Results

Rays of Hope

The Rays of Hope initiative aims to support Member State efforts to increase access to safe and secure radiotherapy and diagnostic imaging services, thereby reducing cancer deaths worldwide. The global cancer burden is expected to grow to 30 million new cases and 16.3 million deaths annually by 2040, with the disease placing its heaviest burden on low and middle income countries.

As of the end of 2023, the procurement and delivery of equipment such as linear accelerators, SPECT-CT machines, a cyclotron, brachytherapy equipment, quality assurance/control equipment and X-ray equipment was under way to support the cancer care capabilities of Benin, Kenya, Malawi and Senegal, while also ensuring the safe and secure use of radioactive sources for medical purposes. In addition, fellows from Rays of Hope 'first wave' African countries were undergoing training as medical physicists, nuclear medicine technologists, radiation oncologists, nuclear medicine physicians, radiation therapists, radiopharmacists and oncology nurses.

The first Rays of Hope anchor centres were established as capacity building and knowledge hubs for their respective regions. These centres will play a pivotal role in ensuring that the progress achieved in the global fight against cancer can be sustained and scaled up for a future of equitable cancer care for all. The Agency is supporting the centres by expanding their capacities to conduct critical work more effectively.

The private sector emerged as a crucial partner, with Elekta, GE HealthCare and Siemens Healthineers signing Practical Arrangements with the Agency to improve access to cancer care in underserved countries. An in-kind contribution from GE HealthCare in the form of clinical training for nuclear medicine and radiology practitioners in low and middle income countries will support much-needed capacity building.

Anchor centres strengthen the capacities of neighbouring countries; create opportunities for regional, subregional and interregional advancement; and support innovation. The first five Rays of Hope anchor centres are:

- Bab El Oued Teaching Hospital and Pierre and Marie Curie Centre, Algeria;
- King Hussein Cancer Center, Jordan;
- National Oncology Institute, Morocco;
- Nuclear Medicine, Oncology and Radiotherapy Institute, Pakistan; and
- Ege University Faculty of Medicine, Türkiye.



◀ **The Director General visiting the Advanced Centre for Treatment, Research and Education in Cancer (ACTREC) based at the Tata Memorial Centre in Mumbai, India, October 2023.**

ZODIAC

The Zoonotic Disease Integrated Action (ZODIAC) initiative aims to enhance the preparedness and response capabilities of Member States with regard to zoonotic diseases. By the end of 2023, 128 Member States had designated ZODIAC national laboratories (ZNLs) and 150 had designated ZODIAC national coordinators (ZNCs).

In total, 39 ZNLs have been furnished, with Agency support, with state-of-the-art equipment for serology and molecular diagnostics. Similar equipment is being procured for an additional nine ZNLs. To build and strengthen the capacity of these laboratories, three in-person training courses on the generic verification of standard operating procedures for serology and molecular diagnostics in ZNLs were held in 2023 in Argentina, Bulgaria and the Republic of Korea with the participation of some 70 regional representatives. Moreover, four virtual and two in-person regional workshops were organized to assess the bio-risk management status of ZNLs — the majority of which are officially designated veterinary laboratories — and to identify priority procedures to be developed as standard operating procedures under ZODIAC.

Further training was provided to 25 African Member States through two in-person courses on verification and calibration of biosafety cabinets, and verification and calibration equipment and consumables were procured for 20 African Member States. During a virtual interregional workshop on lessons learned on preparedness and control of avian influenza, experts from reference laboratories shared their expertise and experience with participants from over 60 countries.

In addition, two fellowships on bioinformatics for data treatment and interpretation for whole-genome sequencing were completed by fellows from Senegal and Tunisia. Thirteen additional fellowships on the use of whole-genome sequencing platforms and bioinformatics for data treatment and interpretation are in the pipeline. The Agency's close collaboration with WHO and FAO has been pivotal for various training courses.

Under a coordinated research project on enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases in Asia and the Pacific, the first research coordination meeting established a detailed work plan with key actions.



Having the capacity to detect early zoonotic diseases is critical for health and the economy in Bulgaria, as in many countries. ZODIAC has made significant strides since it was launched. With almost 130 ZODIAC national laboratories and the training of their staff, it is one of the largest networks of veterinary laboratories ready to work and cooperate for the prevention of zoonotic diseases.

Prof. Emiliya Ivanova

ZODIAC national coordinator for Bulgaria and Director of Bulgaria's National Diagnostic and Research Veterinary Medical Institute

Participants in a regional training course on verification of standard operating procedures for new serological and molecular techniques, Republic of Korea, February 2023.



NUTEC Plastics

Plastic pollution is one of today's most pressing global environmental challenges and a direct threat to sustainable development. According to global projections, by 2025 the ocean will contain 1 tonne of plastic for every 3 tonnes of fish and by 2050, there may be more plastic in the ocean than fish.

The NUclear TEChnology for Controlling Plastic Pollution (NUTEC Plastics) upstream component aims to reduce plastic pollution by using ionizing radiation to promote sustainable biobased plastics and improve recyclability. In 2023, national stakeholder meetings were held in the Philippines and Thailand to evaluate technology readiness levels and plan for future collaboration with industry partners. Progress has been made in numerous pilot countries, with Indonesia, Malaysia and the Philippines aiming to build technical-scale prototypes in early 2024. NUTEC upstream activities also included the initiation of a coordinated research project (CRP) aimed at bolstering Member State capabilities in applying radiation technologies to modify natural and biodegradable polymers, in order to reduce reliance on fossil fuel-based single use plastics and increase biomass availability for energy purposes.

NUTEC's downstream component aims to advance the assessment and monitoring of marine plastics using isotopic tracing techniques. Continuous efforts to harmonize marine microplastics monitoring protocols and build capacity have facilitated the development of the global NUTEC Plastics network of marine monitoring laboratories. In 2023, a CRP was launched to develop and improve techniques for assessing concentrations and polymer composition of marine microplastics — an essential element of comparing variations in polymer samples. In addition, work was completed on the construction of a dedicated plastics laboratory at the IAEA Marine Environment Laboratories in Monaco, which has significantly increased the Agency's capacity to conduct analyses and provide training to Member States.

Highlights in 2023:

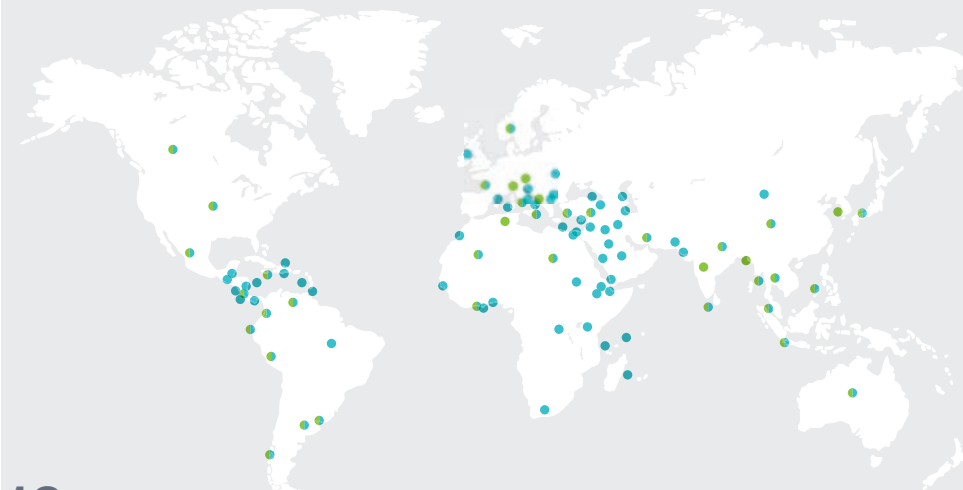
- The number of Member States participating in the upstream and downstream components increased to 38 and 77, respectively.
- The Agency developed a portal to capture and curate information and achievements.
- Awareness was raised about the Agency's role in addressing plastic pollution through side events at the 67th regular session of the Agency's General Conference, the first session of the Preparatory Committee for the 2026 NPT Review Conference, Monaco Ocean Week and meetings of the Intergovernmental Negotiating Committee on Plastic Pollution.



NUTEC Plastics

Global NUTEC Plastics involvement (90 countries and territories)

- downstream involvement
- upstream involvement





▲
FAO Director-General, Qu Dongyu, and IAEA Director General, Rafael Mariano Grossi, at FAO Headquarters in Rome, October 2023.

Atoms4Food

In October 2023, at the World Food Forum in Rome, the Agency and FAO launched a joint initiative, Atoms4Food. This initiative aims to address Member State needs regarding food, diet quality, nutrition security and food safety, and to support their efforts in transforming agrifood systems to achieve the SDGs.

Building on almost 60 years of Agency–FAO strategic partnership through the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Atoms4Food seeks to provide Member States with groundbreaking solutions, tailored to their specific needs and circumstances, by harnessing the advantages of nuclear techniques and other advanced technologies to enhance crop and livestock productivity, ensure sustainable natural resources management, reduce food losses and waste, ensure food safety, improve diet quality and nutrition and adapt to the challenges of climate change.

A multidisciplinary approach and multistakeholder cooperation will be fostered, in conjunction with a resource mobilization mechanism to enable the scaling up of existing programmes and initiatives.

Seven essential services are available under Atoms4Food:

- **Assessment Mission** to map food and nutrition security needs and develop tailored comprehensive technical packages to help Member States address challenges in transforming their agrifood systems.
- **Crop Variety Improvement Service** to build mutation breeding pipelines using nuclear and advanced technologies for enhanced resilience to climate change, pests and pathogens and better nutrition.
- **Soil and Water Management and Crop Nutrition Service** to gather information on soil fertility, major crops and their average yields, availability of fertilizer and water irrigation systems.
- **Animal Production and Health Service** to support rapid disease diagnosis, provide safer, broadly protective irradiated vaccines and enhance animal production through improved reproductive performance and animal nutrition.
- **Insect Pest Control Service** to tackle insect pests that affect agricultural production, using the nuclear-based sterile insect technique along with other control methods as part of an area-wide integrated pest management approach.
- **Food Safety and Control Service** to enhance the surveillance of contaminants/residues associated with foodborne diseases, fight food fraud, promote food irradiation and facilitate market access.
- **Public Health Nutrition Service** to use stable isotope techniques to assess the nutritional value of foods, diet quality and associated nutrition outcomes.

Seibersdorf Facilities and Laboratories

In Seibersdorf, Austria, the Agency runs eight nuclear applications laboratories focusing on food and agriculture, human health, environmental monitoring and assessment, and nuclear instrumentation and accelerator applications, along with two safeguards analytical laboratories. In 2014, work commenced to comprehensively renovate the nuclear applications laboratories, established in 1962, and in 2023, a new training centre for nuclear security was integrated into the Seibersdorf complex.

ReNuAL2

The final phase of the Renovation of the Nuclear Applications Laboratories (ReNuAL) initiative, known as ReNuAL2, involves the construction of a new laboratories building to house the three laboratories not yet modernized during ReNuAL's earlier phase; the replacement of ageing greenhouses; and the refurbishment of the Dosimetry Laboratory.

In 2023, significant progress was achieved under ReNuAL2. Work started on the construction of the new laboratories building and the refurbishment of the Dosimetry Laboratory. All major fundraising was also completed, leading to the signing of a contract with a specialized company to replace the ageing greenhouses.

Once completed, the ReNuAL initiative, at an overall cost of around €94 million, will deliver high-quality modern facilities for all eight of the Agency's nuclear applications laboratories in Seibersdorf. This will greatly expand the Agency's capacities to help Member States address challenges in food and agriculture, human health and environmental management.

Nuclear Security Training and Demonstration Centre

In October 2023, the Agency opened its Nuclear Security Training and Demonstration Centre (NSTDC) at the new Multipurpose Building in Seibersdorf. As the first international facility of its kind, the centre supports growing efforts to tackle global nuclear terrorism.

ReNuAL 2



EARLY 2023
Construction of new laboratories building begins.

OCTOBER 2023
Shell of laboratories building completed and contract for new greenhouses signed, with all three primary components of ReNuAL2 fully funded and under contract.

NOVEMBER 2023
Director General announces completion of all major fundraising for ReNuAL2.

BY END OF 2023
€29 million in extrabudgetary contributions provided to ReNuAL2 by 37 Member States.

The NSTDC was inaugurated on 3 October 2023.

More than €18 million in extrabudgetary funding from 15 donors, as well as in-kind contributions, were received to build and operate the Multipurpose Building.

In the first 3 months of operation, 14 events were conducted and 346 participants were trained.



NSTDC

Nuclear Power Around the World

For a third successive year, the Agency revised upwards its annual projections for the potential growth of nuclear power in the coming decades.

In its new outlook for global nuclear capacity for electricity generation, the Agency increased its low case projection to 458 GW(e) by 2050, representing a significant increase of 55 GW(e) compared to the 2022 projection. Likewise, the high case projection increased to 890 GW(e) by 2050, up from 873 GW(e) in 2022 and representing a 175 GW increase compared to 2020. For these projections to be realized, there would need to be large scale implementation of long term operation across the existing fleet and more than 600 GW(e) of new build in the coming three decades.

By the end of 2023, some 50 Member States had expressed interest in nuclear power as a potentially beneficial option and approximately 30 were in various phases of the Milestones approach. The Agency continued its assistance to newcomer countries in 2023, conducting a Phase 1 Integrated Nuclear Infrastructure Review (INIR) mission to Estonia in October, which focused on the development of infrastructure required to support the deployment of SMRs in the country, and an INIR Phase 1 follow-up mission to Kazakhstan in March.

The Agency launched the International Network on Innovation to Support Operating Nuclear Power Plants, under the auspices of which a working group on artificial intelligence has been piloted since mid-2022. By the end of 2023, the working group comprised more than 60 active members from utilities, research organizations, academia and regulators.

To ensure consistent and coordinated support and outreach activities for stakeholder engagement, the Agency prepared a two-year roadmap of events, with the first event — a workshop on reimagining nuclear energy — held in April 2023. The workshop discussed the creation of a new image for nuclear energy.



Kenya acknowledges the positive contribution of nuclear power in climate change mitigation and energy security. We are pleased to inform that we have made significant progress in the introduction of nuclear power in our energy mix. We anticipate to actualize our nuclear power programme by 2034, and we will continue to partner with the Agency in developing nuclear related infrastructure.

Justus Wabuyabo

Chief Executive Officer of Kenya's Nuclear Power and Energy Agency



10%
electricity generated by nuclear power globally



371.5
GW(e) global operating nuclear power capacity in 2023



413
operating nuclear power reactors in 31 countries



5
GW(e) new capacity connected to grid in 2023



61.1
GW(e) under construction with 59 reactors in 17 countries

IAEA Platform on Small Modular Reactors and their Applications

The IAEA Platform on Small Modular Reactors and their Applications (SMR Platform) has been serving as a focal point for the Agency's activities in this field and providing coordinated support and expertise from across the Agency since 2021.

The SMR Platform reviews all requests for Agency support submitted by Member States and other stakeholders in the area of small modular reactors (SMRs) and their applications, identifying the best approaches and mechanisms to address them in a consistent and coordinated manner. It also provides a framework for relevant Agency experts to collaborate and share information on their activities.

In 2023, the Platform addressed requests from the Plurinational State of Bolivia, Brazil, Cote D'Ivoire, India, Poland, the Bolivarian Republic of Venezuela and the World Association of Nuclear Operators. Among other things, an expert mission was carried out to Jordan to review pre-feasibility study reports on SMR deployment for desalination and 16 technical cooperation project activities were conducted, including an interregional event on technology development and applications of SMRs in Sanya, China.

In November 2023, the International Symposium on the Deployment of Floating Nuclear Power Plants – Benefits and Challenges was organized, which enhanced knowledge and understanding in relation to floating NPP designs, relevant legal, safety and security aspects and licensing approaches.

The Platform developed a high-level action plan to implement its Medium Term Strategy (2022–2029) for providing systematic and comprehensive support to Member States on SMRs and their applications. The action plan will help Member States to become knowledgeable customers and make an informed decision about whether to embark on or expand SMR-based nuclear power programmes.



The IAEA support for Jordan's nuclear programme, particularly the SMR project, is highly valued and plays a pivotal role in enhancing our capabilities and advancing our endeavours. We eagerly anticipate continued collaboration with the IAEA across all aspects of the peaceful uses of nuclear energy.

Khalid Khasawneh

Commissioner for Nuclear Power Reactors at the Jordan Atomic Energy Commission



The Director General at the opening of the International Symposium on the Deployment of Floating Nuclear Power Plants – Benefits and Challenges, November 2023.



SMR Platform

Nuclear Harmonization and Standardization Initiative

The Nuclear Harmonization and Standardization Initiative (NHSI) is aimed at facilitating the effective global deployment of safe and secure advanced nuclear reactors by advancing towards the harmonization of regulatory approaches and standardization of industrial approaches. A NHSI Special Task Force has been established under the SMR Platform to ensure coordination with other Agency activities in the area of SMRs.

In June 2023, participants gathered for the second NHSI Plenary, providing feedback on the work carried out and highlighting areas for enhancement. Member States were also provided with an update during a side event at the 67th regular session of the General Conference.

NHSI comprises two separate but complementary tracks. The NHSI Industry Track has four Topical Groups on: harmonization of high-level user requirements; common approaches on codes and standards; experimental testing and validation for design and safety analysis computer codes; and accelerating the implementation of infrastructure for SMRs. In 2023, 17 working meetings were held, engaging more than 45 entities that contributed over 80 individuals from 15 Member States and international organizations. One publication on the use of commercial grade products in NPP safety systems was issued.

The NHSI Regulatory Track has three Working Groups on: building a framework for sharing information; multinational pre-licensing regulatory design review process; and process for leveraging other regulatory reviews and working together during ongoing regulatory reviews. In 2023, 12 working meetings were held with regulatory bodies from 28 Member States, and the work of the groups is progressing as planned. International organizations and industry representatives are participating as observers, except for in the first Working Group, where membership has been extended to industry representatives and government policymakers.



In the Nordics, we've already proven that such standardization is possible and now we are expanding these simplified procedures. Using high-quality standard equipment offers benefits such as faster delivery times, more affordable price level and proven quality, without compromising safety in any way.

Petra Lundström

Executive Vice President, Nuclear Generation at Fortum, and NHSI Industry Track participant



The efforts of the NHSI Regulatory Track will help increase international regulatory cooperation related to reviews of new and advanced reactor designs and pave the way to harmonization of regulatory approaches. Through enhanced cooperation, information sharing and leveraging of regulatory reviews, NHSI has the potential to benefit both regulatory bodies and the nuclear industry, leading to enhanced safety of reactor designs and a possible reduction in regulatory and industry costs.

Sean Belyea

Senior Project Officer at the Canadian Nuclear Safety Commission, Chair of the NHSI Regulatory Track Working Group 3

Fusion Energy

Fusion is developing fast and gaining momentum as a climate solution. It has the potential to generate four times more energy per kilogram of fuel than nuclear fission, and nearly four million times more energy than burning oil or coal, without emitting greenhouse gases or generating high activity or long lived nuclear waste.

In October 2023, the 29th IAEA Fusion Energy Conference, organized by the Agency and hosted by the United Kingdom, attracted some 2000 participants from more than 80 countries and from many different fusion initiatives, both public and private. For an entire week, fusion scientists, engineers, policy makers, regulators and entrepreneurs gathered to review recent developments and chart the way to a future with fusion energy. The diverse range of topics covered in the scientific sessions included magnetic confinement, inertial fusion, materials science, machine designs and plasma physics. In addition, socioeconomic issues relevant to fusion, including energy justice, social licensing, public engagement and public-private partnerships, were discussed.

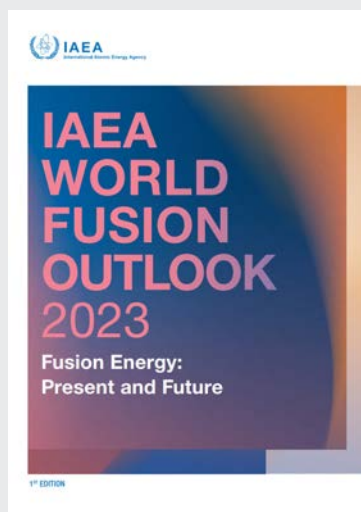
During the conference, the Director General introduced the first IAEA World Fusion Outlook, a global reference for authoritative information on the latest developments in fusion energy, and announced the inaugural meeting of the World Fusion Energy Group in 2024. This group will bring together not just fusion scientists and engineers from laboratories and experimental centres, but also a set of diverse stakeholders including policymakers, financiers, regulators and private companies, in a dialogue that will drive fusion development forward.

Additionally, fusion experts will work with the Agency to outline key elements such as fusion-related definitions, characteristics and criteria to help develop a common understanding among stakeholders, which will be essential for global deployment.



Fusion energy is making progress. There have been momentous achievements in the field. Meanwhile, more than US\$6 billion has gone into the private sector. We are at a crucial moment in the development of the field and there are new stakeholders who want to be – and need to be – part of the dialogue. The IAEA will convene the inaugural World Fusion Energy Group in 2024.

Rafael Mariano Grossi
IAEA Director General



IAEA
WORLD
FUSION
OUTLOOK
2023



15 919
views online



2nd
most downloaded
publication of 2023

Atoms4NetZero

The Agency's Atoms4NetZero initiative, launched by the Director General at COP27 in 2022, aims to provide policymakers and decision makers with net zero energy scenario modelling that takes into account the full potential of nuclear power to contribute to net zero emissions through low carbon electricity, heat and hydrogen.

Scenarios incorporate the constraints countries face as they seek to build energy systems to meet their net zero objectives, and are used by policymakers to determine how best to plan future investments in low carbon technologies and the grid.

Atoms4NetZero also helps to assess the potential contribution of advanced nuclear reactors, including small modular reactors, to long term national energy strategies. This includes the use of nuclear energy to decarbonize hard-to-abate sectors such as energy-intensive industry and transport, which generate almost 60% of all greenhouse gas emissions. The initiative will help to develop credible scenarios using Agency analytical tools such as the Model for Energy Supply Strategy Alternatives and their General Environmental Impacts (MESSAGE), the FRAMework for Modelling of Energy Systems (FRAMES) and others.

Beyond modelling, Atoms4NetZero encompasses a number of other activities to assist countries in their transition to clean energy, including advisory services to support long term energy strategy development, workshops and training for capacity building, and outreach and stakeholder engagement.

The Second International Conference on Climate Change and the Role of Nuclear Power 2023: Atoms4NetZero took place in Vienna in October 2023. Participants discussed the role of nuclear power in the global clean energy transition, and in providing security of supply, helping to decarbonize hard-to-abate sectors and contributing to energy system resilience. Participants stressed that nuclear energy plays a pivotal role in addressing climate change but must overcome a number of challenges in order to achieve the doubling or more of current capacity that, according to several authoritative studies, is needed to achieve net zero emissions by 2050.



Nuclear power is the only technology that can produce at scale the three low carbon energy vectors needed to reach net zero: electricity, heat and hydrogen.

HE Hamad Alkaabi

Ambassador of the United Arab Emirates and President of the Second International Conference on Climate Change and the Role of Nuclear Power: Atoms4NetZero

The Second International Conference on Climate Change and the Role of Nuclear Power 2023: Atoms4NetZero



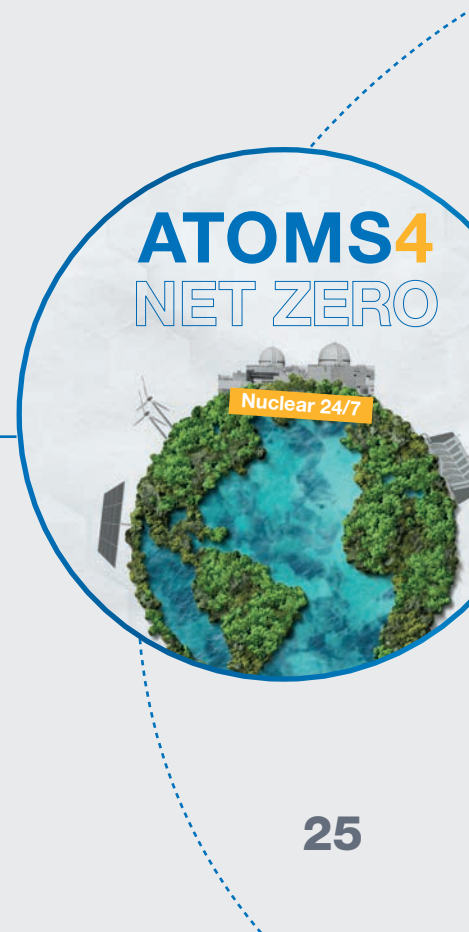
550
participants



81
countries



26
organizations



COP28

Led by the Director General, the Agency played a key role at the 28th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP28) in Dubai, United Arab Emirates.

Highlighting the solutions that nuclear science and technology can provide in addressing climate adaptation, mitigation and monitoring, the Agency and its partners hosted 30 events at the Atoms4Climate pavilion, focusing on nuclear applications for energy, food, water and the oceans. COP28 concluded with the historic inclusion of nuclear energy in the Global Stocktake. 'Nuclear' was mentioned explicitly as one of the low emission technologies needed to achieve deep and rapid reductions in greenhouse gas emissions.

In addition, the Agency organized or participated in some 30 events at other pavilions, attracting Heads of State, ministers, leaders of international organizations, scientists, experts, women's organizations and youth groups. Reflecting the progress made in relation to nuclear energy since COP27, where the Agency had hosted the first-ever nuclear-themed pavilion, COP28 featured four such pavilions in the Blue Zone and two in the Green Zone, with more than 100 nuclear-related events held over the two-week period. All of this underscored the momentum building behind the world's second largest source of clean electricity.

Notable announcements included:

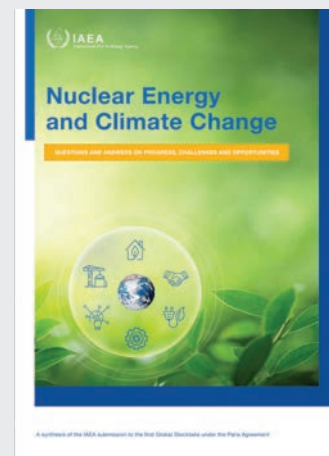
- The IAEA Statement on Nuclear Power, emphasizing its pivotal role in climate action;
- A declaration by more than 20 countries supporting a tripling of global nuclear generation capacity by 2050;
- Plans to hold the first-ever Nuclear Energy Summit in March 2024, announced by Prime Minister Alexander De Croo of Belgium, President Emmanuel Macron of France and the Agency's Director General;
- The launch of a new technical cooperation project that optimizes the Agency's climate adaptation work on food and water availability; and
- The launch of a joint project with the Kuwait Institute for Scientific Research to promote ocean health.



Belgian Prime Minister Alexander De Croo and the Director General at COP28, at the Net Zero Nuclear event 'Tripling Nuclear Energy by 2050', December 2023.



[Learn more](#)



Nuclear Safety, Security and Safeguards in Ukraine

In 2023, the Agency continued monitoring the nuclear safety and security situation in Ukraine and reporting regularly on it publicly, and continued delivering technical support and assistance to Ukraine – both in-person technical assistance and delivery of equipment.

The Agency maintained an uninterrupted presence of its staff at nuclear sites in Ukraine (Zaporizhzhya, Khmelnytsky, Rivne and South Ukraine NPPs and the Chernobyl NPP site) and continued to use the Seven Pillars developed in 2022 to tailor an independent and impartial assessment of the nuclear safety and security situation in Ukraine. These efforts were aimed at helping to prevent a nuclear accident and ensure continued nuclear safety and security amid the armed conflict.

In addition, at the UN Security Council meeting on 30 May 2023, the Director General established five concrete principles for protecting nuclear safety and security at Zaporizhzhya NPP (see figure below).

The Agency expanded the scope of its programme for assistance to encompass medical assistance for operating personnel at NPPs and assistance to the Kherson Oblast.

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

Highlights in 2023:

- Five public reports;
- Over 60 online updates;
- Deployment of 86 missions comprising 187 staff to Ukraine, including a permanent presence at all five nuclear sites;
- Over €7.5 million worth of equipment delivered;
- Medical needs assessment for operating staff at NPPs and initiation of a mental health programme; and
- Fact-finding mission to assist Ukraine in relation to the safety and security of radioactive sources.

- 1 There should be no attack of any kind from or against the plant, in particular targeting the reactors, spent fuel storage, other critical infrastructure, or personnel.
- 2 The plant should not be used as storage or a base for heavy weapons (i.e. multiple rocket launchers, artillery systems and munitions, and tanks) or military personnel that could be used for an attack from the plant.
- 3 Off-site power to the plant should not be put at risk. To that effect, all efforts should be made to ensure that off-site power remains available and secure at all times.
- 4 All structures, systems and components essential to the safe and secure operation of the ZNPP should be protected from attacks or acts of sabotage.
- 5 No action should be taken that undermines these principles.



Director General statement to UN Security Council



Nuclear Safety, Security and Safeguards in Ukraine



The Director General at the UN Security Council meeting on 30 May 2023.



The Director General visiting Zaporizhzhya NPP, March 2023.

Fukushima ALPS-Treated Water Discharge

In 2021, the Government of Japan requested the Agency to conduct a detailed review of the safety-related aspects of the discharge of advanced liquid processing system (ALPS) treated water with reference to the Agency's safety standards.

The Director General committed the Agency to being involved before, during and after the discharge, and in compliance with its statutory mandate and functions. To implement the review in a fully transparent manner, the Director General established a Task Force, including independent and internationally recognized experts from around the world.

In July 2023, the Agency published its Comprehensive Report on the Safety Review of the ALPS-Treated Water at the Fukushima Daiichi Nuclear Power Station. The report concluded that the approach to discharging ALPS-treated water into the sea was consistent with Agency safety standards and that the discharge, as currently planned and assessed, would have a negligible radiological impact on people and the environment. In his foreword to the report, the Director General emphasized that the release of the treated water stored at Fukushima Daiichi Power Station is a national decision by the Government of Japan and that this report is neither a recommendation nor an endorsement of that policy, while hoping that all who have an interest in this decision will welcome the IAEA's independent and transparent review.

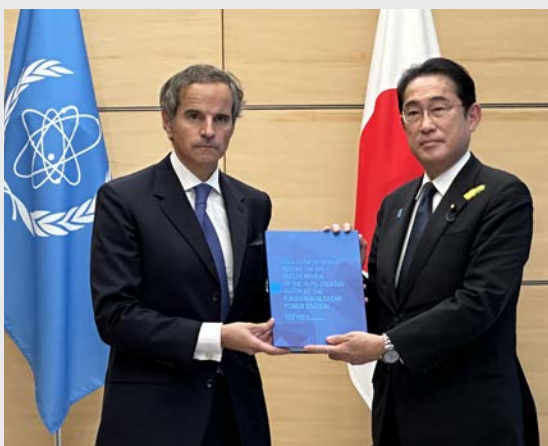
Also in July 2023, the Director General visited Japan, the Republic of Korea, the Cook Islands, which chaired the Pacific Islands Forum, and New Zealand, to engage with governments and communities, address local concerns and brief leaders on the Agency's findings.

In August 2023, the discharge operation began. The Agency and third-party laboratories in Member States are undertaking activities to corroborate Japan's programmes for source and environmental monitoring. In 2023, three batches amounting to 23 400 cubic metres of water were discharged into the sea.

In October 2023, the Task Force conducted its first review mission following the start of the discharge, and concluded that the operation is progressing as planned and continues to be consistent with the Agency safety standards.

Highlights in 2023:

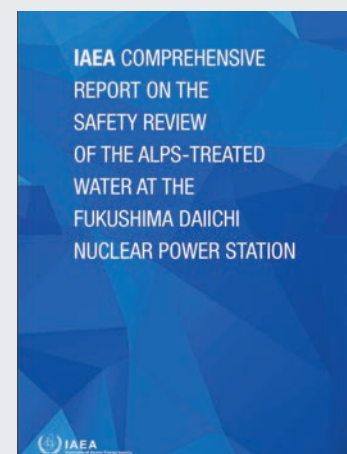
- ◉ Establishment of a Memorandum of Cooperation between the Agency and Japan to provide a framework for the Agency's activities;
- ◉ Monitoring and assessment to directly observe the technical safety aspects of the systems and activities;
- ◉ Review of Japan's approach to assessing the radiological environmental impact of the discharge;
- ◉ Agency presence in Japan, with a local office of technical experts conducting observations, performing sampling and analysis, and gathering information and data;
- ◉ Agency review missions continuing on a periodic basis;
- ◉ Corroboration of source and environmental monitoring, including interlaboratory comparisons.



The Director General handing over the Agency's Comprehensive Report to Fumio Kishida, Prime Minister of Japan, July 2023.



[Learn more](#)



COMPASS

The IAEA Comprehensive Capacity-Building Initiative for SSACs and SRAs (COMPASS), building on other safeguards-related support that the Agency provides, assists States in their efforts to strengthen and sustain the effectiveness of their State system of accounting for and control of nuclear material (SSAC) and their State or regional authority responsible for safeguards implementation (SRA).

In March 2023, the Agency concluded the pilot phase of COMPASS, with capacity-building activities implemented in seven participating States on the basis of their specific needs. COMPASS has provided multifaceted assistance, including in the areas of outreach to national stakeholders; legal and regulatory frameworks; training; information technology; procurement; and expertise. Partners from several Member States supported the implementation of the pilot phase financially and/or in kind.

Implementation proceeded in accordance with seven agreed work plans that provided a framework of cooperation with each pilot State, including a defined timeline for activities and their expected outcomes. During the pilot phase, a total of 96 activities were conducted by the Agency, including many in cooperation with the implementing partners mentioned above.

COMPASS assistance greatly benefitted the pilot States by strengthening their SSAC and SRA, particularly in relation to their legal and regulatory frameworks, enhancing outreach and staff capacity building, and improving their technical capabilities. COMPASS also benefitted the Agency by providing a mechanism through which it was able to enhance its collaboration with the pilot States. In addition, joint implementation of assistance activities with partners allowed the Agency to leverage the experience and expertise of these States, encouraging peer-to-peer support coordinated by the Agency.

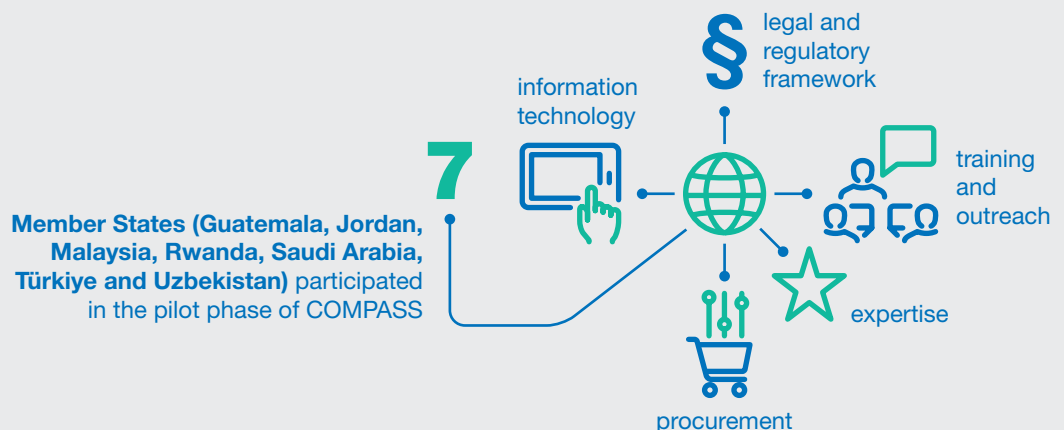
Building on the experience gained from the pilot phase and lessons learned, the Agency is integrating COMPASS into the suite of safeguards assistance it provides to States.



The COMPASS initiative has been a game changer for Malaysia. It really helped us to identify the gaps in safeguards implementation. In two years, COMPASS helped us review safeguards regulations, develop technical guidelines and license conditions, and also enhance the training within the national safeguards authority.

Nurul Hafiza binti Mohamed Aliasrudin

Assistant Director of the Nuclear Installation Division at Malaysia's Department of Atomic Energy



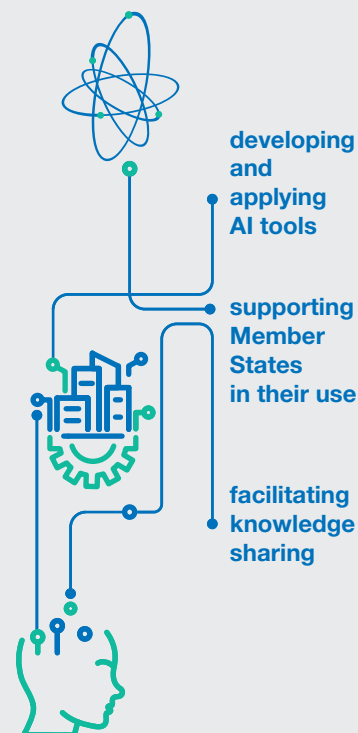
Artificial Intelligence

The development and use of artificial intelligence (AI) is rapidly evolving and growing in all spheres of life – nuclear science and technology are no exception. The Agency has continued participating in the high-level dialogue within the UN system on the use of AI, and has signed Practical Arrangements with the International Telecommunication Union (ITU) to enhance cooperation in the use of the ‘AI for Good’ platform.

The Agency’s focus on AI is in the following areas:

- Developing and applying AI tools to support routine business activities, to improve the efficiency and effectiveness of services and of its programmatic work;
- Developing and applying AI tools in its activities related to the peaceful uses of nuclear material and technology and supporting Member States in their use; and
- Keeping abreast of AI development and use in the nuclear field and facilitating knowledge sharing.

While AI can bring great applied benefits, it can also present challenges due to the associated risks and ethical concerns. The Agency has an interest in the appropriate integration of AI tools in its activities related to the fields of nuclear safety, security and safeguards.



The Agency’s AI-related activities in 2023 are summarized below:

- A contest for start-up companies launched by the Agency, the ITU, FAO and UNESCO on jumpstarting AI-powered solutions for food and climate-smart agriculture and water resources management. Following the announcement of the winners at COP28, the Agency started working with these start-ups to identify ways to utilize the analytical capabilities of AI to provide insights into its large data sets collected using various nuclear technologies.
- Publication of *Artificial Intelligence in Medical Physics*, which contextualizes the roles and responsibilities of clinically qualified medical physicists in applying AI in radiation medicine;
- Designation of two Collaborating Centres on AI: the Massachusetts Institute of Technology Plasma Science and Fusion Center, focusing on fusion science applications, and Purdue University, focusing on nuclear power applications;
- A new coordinated research project bringing together academia and industry to assess the role of generative AI in relation to public safety during an emergency response;
- Research and development of machine learning to improve the efficiency of Agency safeguards inspector and analyst review of surveillance footage;
- A special side event during the 67th regular session of the General Conference featuring presentations on the adoption of AI in radiation medicine and the nuclear power sector and the Agency’s expected role in this regard;
- Launch of a collaborative platform and network on the use of AI in nuclear power industries; and
- Application of AI tools across the Agency, including in relation to cyber security, machine translation, speech-to-text conversion, data extraction, and mapping the IT landscape.

Together for More Women in Nuclear

The Agency works to address the under-representation of women in the nuclear field through the **IAEA Marie Skłodowska-Curie Fellowship Programme (MSCFP)** and the **Lise Meitner Programme (LMP)**. By enabling more women to enter and pursue careers in the nuclear field, these programmes help to build the future nuclear workforce.

Established in 2020, the MSCFP provides scholarships for relevant master's degrees and opportunities to complete internships, participate in technical events and join the MSCFP Student and Alumni LinkedIn Group. By the end of 2023, there were 560 MSCFP fellows, of whom 173 had completed their master's studies. Of these graduates, 93 progressed to internships facilitated by the Agency while others pursued doctoral studies or employment.

Launched in 2023, the LMP provides women working in the nuclear sector in the early and middle stages of their careers with career development opportunities through a visiting professional programme. Participants gain valuable technical experience in different facilities, focused on their area of expertise, and enhance their leadership and other soft skills. The first two LMP cohorts were hosted in 2023 by North Carolina State University and Oak Ridge and Idaho National Laboratories in the United States of America and were focused on NPP operation. Other countries have also expressed interest in hosting the programme.

As of December 2023, the MSCFP had received pledges amounting to €11.4 million and in-kind contributions for 73 students. Donors include Member States, the European Union, private sector partners and academic institutions.

LMP is funded by extrabudgetary financial and in-kind contributions. The funding requirement per visit is between €150 000 and €200 000. The first two visits were funded by the United States of America.



The Lise Meitner Programme surpassed all my expectations. It was truly a transformational experience both on a professional and personal level.

Maria Emilia Sabbatini

2023 Lise Meitner Programme visiting professional from Argentina



The Director General meeting Marie Skłodowska-Curie Scholarship fellows from Pakistan, February 2023.



Gender at the IAEA

Managing for Results

The Agency follows a results based approach in all areas of its work, optimizing the use of resources and leveraging technology to enable efficient and effective programme delivery.

To further strengthen results based management (RBM), the Agency consistently integrated cross-cutting issues such as the SDGs, gender equality, knowledge management and risk management throughout all phases of the RBM cycle. These topics are, to varying degrees, relevant to all aspects of the Agency's activities. In addition, the Agency strengthened its collaboration with the wider UN system and other international actors, including through the UN Strategic Planning Network (UNSPN) and the OECD Development Assistance Committee Results Community. The aim was to contribute to and continuously learn from best practices in applying RBM for better results. To this end, the Agency hosted the 2023 UNSPN meeting for the Vienna International Centre based organizations and actively participated in the exchange of good practices. Furthermore, it developed pilot knowledge tests and participant follow-up surveys for better and more timely measurement of capacity-building results. It also continued to strengthen its RBM capacity-building activities, including through the development of e-learning materials as part of the induction programme for new managers.

Promoting workforce development and a respectful workplace, including gender equality

In 2023, the Agency continued supporting staff in strengthening their professional competencies, with a focus on leadership and managerial skills. More than 100 managers participated in a new Leadership Development Programme that was initiated in 2023, and almost 100 staff members took part in the Agency's mentoring programme.

The Agency strengthened efforts to promote a respectful workplace, launching an online resource hub of relevant policies and a wide variety of learning materials and holding 31 training sessions with more than 1000 participants, including specially tailored training for senior managers, to raise awareness and build capacity to respond effectively to workplace issues.

In addition, several initiatives in support of the physical and mental well-being of staff were launched. They encompassed preventative care, vaccination campaigns, awareness-raising and training courses.



As we strive to deliver excellent services to Member States, we are committed to making efficient use of the resources entrusted to us, continuously optimizing our management practices and developing new partnerships that amplify the impact of our work.

Margaret Doane

Deputy Director General
and Head of the Department
of Management

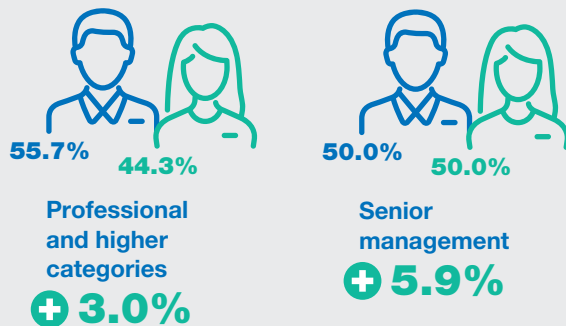
The Agency's work is underpinned by an organizational culture based on integrity, professionalism and respect for diversity. In 2023, the Ethics function delivered a range of training sessions aimed at ensuring that staff and others understand and demonstrate the Agency's core values and standards of conduct, including respect for diversity and gender equality.

Further progress was made in 2023 towards achieving the goal set by the Director General in 2020 to reach gender parity in the Professional and higher categories by 2025. By the end of 2023, the percentage of women in the Professional and higher categories was 44.3%, and in senior management positions (D level or higher) it had reached 50% — a significant milestone.

Building on the Agency-wide gender mainstreaming approach, a practical guide aiming to facilitate the integration of gender considerations in the development of Country Programme Frameworks (CPFs) was prepared. The guide aims to promote equality in outcomes for women and men as participants in and beneficiaries of the technical cooperation (TC) programme. In the area of capacity building, a roster of gender mainstreaming trainers was made available to support internal training in each Department and the Technical Cooperation Orientation Workshop now includes a dedicated session entitled 'Gender Aspects and Policy Embedded in the TC Programme'.

Providing an enabling working environment remained an area of focus. An enhanced parental leave policy was introduced and a new nursing room, supplying suitable facilities for lactation, was made available in the Vienna International Centre. In addition, in line with its commitment to gender equality and anti-discrimination, the Agency joined the UN initiative UNiTE to End Violence against Women, to address gender-based violence.

Gender Parity at the Agency

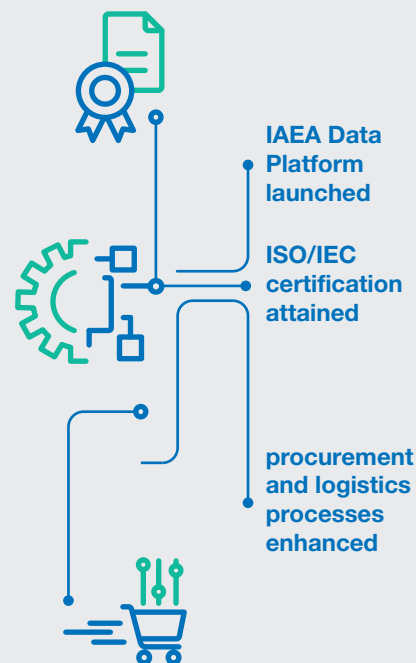


Percentage of women in the Professional and higher categories

Responsive programme delivery through process optimization and innovation

Leveraging technology, the Agency streamlined administrative processes, increased efficiency and optimized the delivery of programmes:

- IAEA Data Platform launched to centralize access to publicly shared datasets;
- ISO/IEC 27001 certification attained for the Agency's information security management system;
- ISO 14001:2015 certification attained by the Publishing Section for its environmental management system for sustainable publishing;
- Emergency procurement and logistics task force created to manage critical responses, including for Libya, Morocco, the Syrian Arab Republic, Türkiye and Ukraine;
- Procurement processes streamlined and long term strategic supplier agreements established to enable fast delivery of equipment to end users.



Partnership and resource mobilization

In 2023, the Agency continued providing support to Member States, including through major initiatives focusing on key areas of the applications of nuclear science and technology. Notably, the Director General placed additional emphasis on areas such as cancer care and women in nuclear, through the Rays of Hope initiative, the IAEA Marie Skłodowska-Curie Fellowship Programme and the Lise Meitner Programme, and on support to Ukraine.

The Agency continued to leverage CPFs for establishing partnership and results matrices to support Member States in the process of identifying potential partners for the implementation of projects aimed at achieving national development priorities. This approach also applied to the Agency's support for efforts under regional cooperative agreements to establish partnerships and mobilize resources for related TC projects. Such arrangements will help ensure sustainability and will encourage ownership of and commitment to TC activities under the regional agreements' portfolios.

In 2023, there was a large increase in the number of partnerships established, highlighting growing interest in the Agency. As a result of the synergies between participating partners and their common objective to create measurable impact, the Agency reached significant milestones in 2023.



€188 million
extrabudgetary
contributions
received in 2023

6 new memoranda
of understanding
and **37**
new practical
arrangements
signed in 2023

Outreach and communication

The Agency provided objective, accurate and timely information about its work and nuclear developments and remained the leading publisher in the nuclear field. In 2023, the Agency continued promoting multilingualism, as the availability of information and communication materials in multiple languages enhances the Agency's reach.



Publications

The Agency issued **110** publications in English and **88** in other languages.

For the first time, the IAEA Bulletin was published simultaneously in six languages.

There were **3.2 million** publication views online.



Social media

Social media content attracted **60.1 million** views and followers grew by more than 10% for English and 25% for other languages compared to 2022.

Outreach to global audiences increased via social media, offering regionally targeted multilingual news and impact stories.



Website

There were **14.8 million** visits to the IAEA.org English website, with an average of **1.2 million** views per month.

Visits to IAEA.org multilingual websites, launched in 2018, surpassed **3 million**, up 39% compared to 2022.



Multimedia content

Over **230** videos, press releases, press conferences and livestreamed events, and **62** Director General interviews, resulted in over **38 000** mentions in the media across all six languages, representing a 23% increase compared to the last three years.

NUCLEAR TECHNOLOGY

**Nuclear Power,
Fuel Cycle
and Nuclear Science**



“

We must tackle climate change, but we must also ensure access for all to clean, secure, affordable and modern forms of energy. For sustainable development and prosperity, we need an abundance of clean and reliable energy. Nuclear power is clearly part of the solution.

Mikhail Chudakov

Deputy Director General
and Head of the Department of Nuclear Energy

Nuclear Power, Fuel Cycle and Nuclear Science

active Collaborating Centres
within the Department of
Nuclear Energy

19

peer review
missions

23

active coordinated
research projects
(CRPs)

22

online training and
education courses
hosted on CLP4NET

1850

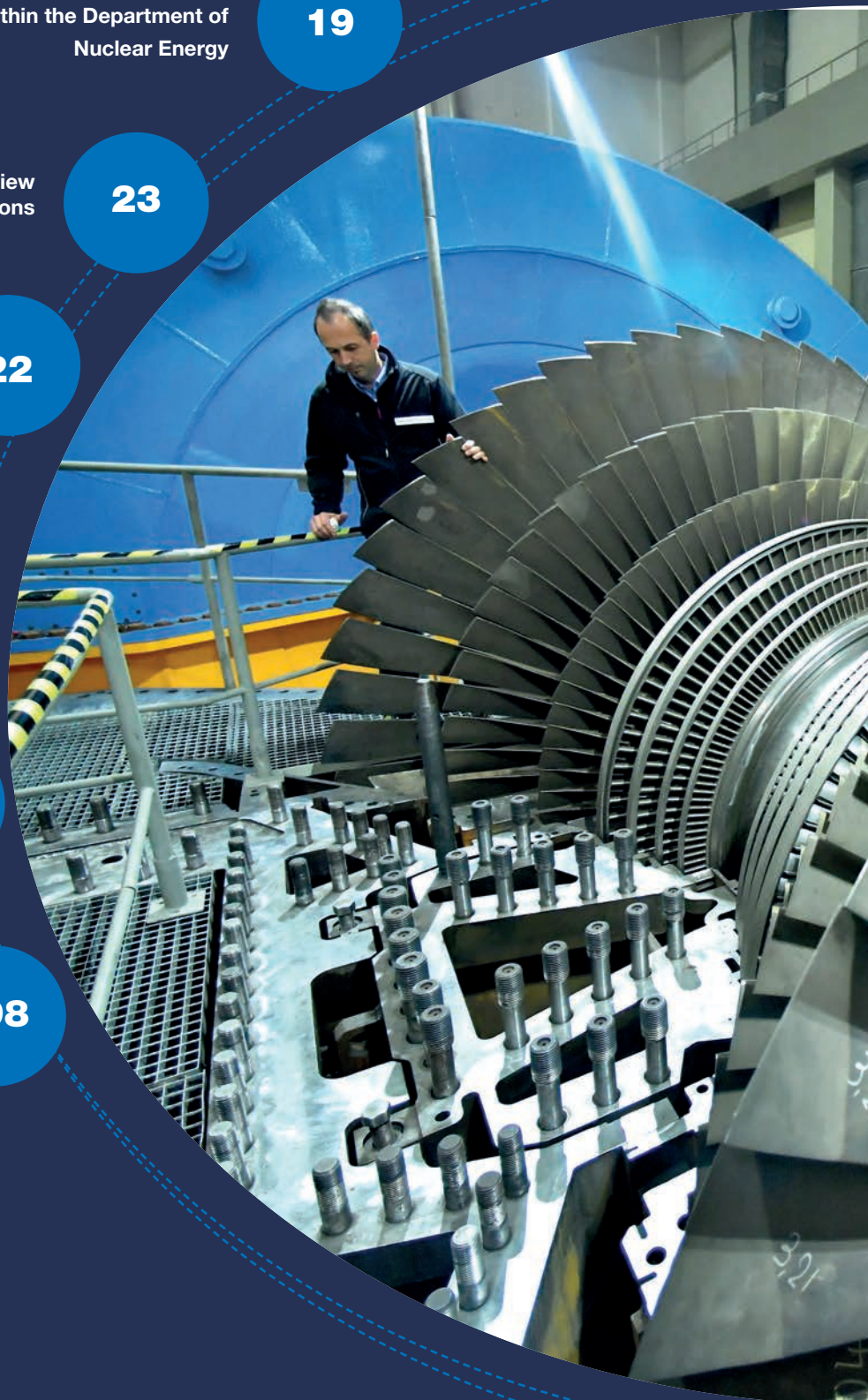
Participants
in IAEA schools

298

207 Nuclear Energy
Management School

68 Nuclear Knowledge
Management School

23 Regional Research
Reactor School



7

IAEA-designated International Centres based on Research Reactors in 7 countries

11

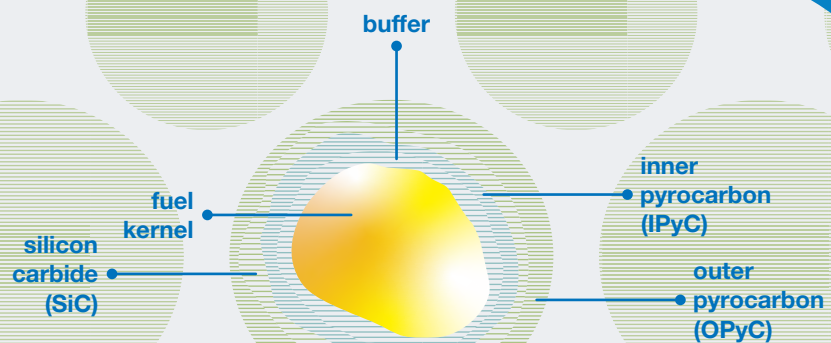
research reactors under construction in 10 countries

24

databases

25

modelling tools and simulators



TRISO fuel particle

Tri-structural isotropic, or 'TRISO' particle fuel, an inherently safe technology that offers excellent retention of fission products, has been identified as one of the fuel options for SMRs.

In 2023, the Agency opened a call for proposals to start a CRP entitled 'Fuel Modelling Exercises for Coated Particle Fuel for Advanced Reactors Including Small and Modular Reactors'.



NUCLEAR POWER

OBJECTIVE

To support Member States with existing nuclear power plants (NPPs) to enhance operating performance and safe, secure, efficient and reliable long term operation, with a harmonized approach to human, technological and organizational aspects.

To support Member States embarking on new nuclear power programmes in planning and building their national nuclear infrastructures through coordinated assessment and assistance activities.

To support Member States in modelling, analysing and assessing future nuclear energy systems for sustainable development of nuclear energy and to provide them with collaborative frameworks and support for technology development and deployment of advanced nuclear reactors, non-electric applications, and integrated energy systems.



SNETP, together with the European Commission services and other stakeholders, is today actively involved in the new European Industrial Alliance on SMRs that aims at supporting the development, demonstration and deployment of SMRs and AMRs in Europe by early 2030. The close links we have built over the years with the IAEA teams, are an asset to support the revival of the nuclear sector, as it is strongly needed to reach our common goal to provide safe, efficient and competitive low carbon energy sources.

Bernard Salha

President of the Sustainable Nuclear Energy Technology Platform (SNETP)



2

INIR missions

Phase 1, Estonia
Phase 1 follow-up, Kazakhstan



17 000

new PRIS database users
540 000 hits



2

new platforms

CNPP
HOPS



2

new networks

ISOP
SANIS

KEY OUTPUTS

Launching Nuclear Power Programmes

With global energy demand on the rise, nuclear power — a low-carbon energy source for sustainable development — continues to play an important role in the energy mix of many countries. Global nuclear capacity is expected to grow, resulting in an increased demand for Agency services to support nuclear infrastructure development. In 2023, there were 27 Member States considering, planning or

implementing a new nuclear power programme. The Agency continued to provide support to them in building awareness of the commitments required for the decision making process and in developing the required infrastructure in line with the Milestones Approach. Nine Integrated Work Plan meetings were held to identify priority areas for Agency support for embarking countries.

Operating Nuclear Power Plants and Expanding Nuclear Power Programmes

Interest in the long term operation of NPPs is growing, with a view to helping expand the role of nuclear power in the clean energy transition. A technical meeting in Gyeongju-si, Republic of Korea, allowed participants to share good practices and lessons learned from long term NPP operation, review a draft publication provisionally entitled *Good Practices and Lessons Learned from the Long Term Operation of Nuclear Power Plants* and conduct the first

Steering Committee Meeting of the International Network on Life Management of Nuclear Power Plants.

The country nuclear power profile (CNPP) application process and website were overhauled in 2023, allowing for more comprehensive integration with the Power Reactor Information System (PRIS) database.

Human Resource Development and Management and Stakeholder Engagement Support

The Agency supports Member States that are operating, expanding or developing new nuclear power programmes in acquiring and maintaining competent staff for all nuclear organizations — including government agencies and owner/operators — and in engaging with stakeholders. The Nuclear Energy Capacity Building Hub, launched in 2023,

offers Member States an online repository of tools and resources to support human resource development, training and qualification, knowledge management, stakeholder engagement, industrial involvement and innovation management.

Nuclear Reactor Technology Development

Nuclear power technology is evolving, with a focus on the development of advanced energy systems and the broadening of their applications. A technical meeting on compatibility between coolants and materials for fusion facilities and advanced fission reactors allowed participants to discuss related state-of-the-art technology. The experience accumulated through the maturing of fission power technology could be employed to accelerate the industrialization and commercialization of fusion power. Of special interest is experience in material R&D for Generation IV reactors, whose temperature and radiation damage characteristics are similar to those of anticipated fusion power facilities. In this regard, the Agency organized extensive consultations on a study relating to synergies between fusion technology developments and advanced nuclear fission technologies.

As part of the Agency's Open-source Nuclear Codes for Reactor Analysis initiative, a joint training workshop by the Abdus Salam International Centre for Theoretical Physics (ICTP) and the Agency on open-source nuclear codes for reactor analysis was conducted in Trieste, Italy, providing training on reactor neutronics, thermal hydraulics, and system analysis at various scales.

Technology development for advanced water cooled reactors

Water cooled reactors (WCRs) account for more than 95% of the world's operating commercial NPPs and contribute

significantly to meeting global energy needs. Many of the lessons learned from the past 50 years of WCR operation continue to be applied to the design and operation of existing and advanced WCRs.

The Agency publication *Terms for Describing Advanced Nuclear Power Plants* provides Member States with up-to-date terms for describing advanced NPPs, draws distinctions between design phases and clarifies terms commonly used when describing advanced NPPs. Meanwhile, the revised *Nuclear Reactor Technology Assessment for Near Term Deployment* explains how reactor technology assessment enables decision making for nuclear power planning and implementation.

Small and medium sized or modular reactors, including high temperature reactors

Global interest in small and medium sized or modular reactors has been increasing due to their ability to meet the need for flexible power generation for a wider range of users and applications and replace ageing fossil fuel-fired power plants.

In 2023, the Agency launched a new coordinated research project to identify and enhance understanding of families of enabling technologies with the potential to either reduce small modular reactor (SMR) construction costs and schedules or better suit users' needs, thus facilitating and favouring the early deployment of such reactors.



The Director General visiting Huaneng's Shidao Bay high temperature gas cooled, pebble bed module (HTR-PM) demonstration project, China, May 2023.



During the 67th regular session of the General Conference, a side event on reactor technology assessment informed participants about how to perform SMR assessments using the Agency's Reactor Technology Assessment methodology and Advanced Reactor Information System database, which are integral parts of SMR Platform activities.

A technical meeting on the harmonization and use of industrial codes and standards for SMRs advanced harmonization efforts for near deployment reactors, in such areas as engineering standards, non-nuclear codes and serially produced components.

Lastly, the publication *Suitability Evaluation of Commercial Grade Products for Use in Nuclear Power Plant Safety Systems* provides information on approaches to such evaluation.

Fast reactors

The Agency redesignated the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland as a Collaborating Centre on modelling and simulation capabilities in the field of advanced reactors. One of the outputs of this cooperation was a workshop on open-source nuclear codes for reactor analysis, jointly organized with EPFL and ICTP, which offered a comprehensive overview of cutting-edge computational techniques for nuclear reactor analysis.

Non-electric Applications of Nuclear Power

The proven use of nuclear energy for non-electric applications, including district heating, desalination and direct provision of heat for various industrial processes, is one of the drivers of interest in nuclear energy to help decarbonize energy applications.

Within the framework of the SMR Platform, the Agency conducted an expert mission to Jordan to review a pre-feasibility study on SMR deployment for desalination. A number of factors were considered, including safety and security, siting, licensing and stakeholder engagement. Following the mission, the Agency delivered its final report and suggestions to the Jordan Atomic Energy Commission.

An interregional training course on specific design considerations of nuclear cogeneration projects using SMRs and microreactors, held in Moscow, trained participants on the fundamentals of cogeneration using such reactors. Meanwhile, a technical meeting allowed participants to exchange information on the most recent developments in high temperature hydrogen production projects worldwide and to discuss the potential for coupling these technologies with various types of nuclear plant.

Enhancing Global Nuclear Energy Sustainability through Innovations

National strategic and long term nuclear energy planning requires tools that increase awareness of the options available for sustainable nuclear energy development. The Agency's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) supports its members in sustainable energy planning.

At the 32nd Meeting of the INPRO Steering Committee, INPRO members discussed new collaborative projects (fossil-to-nuclear and Framework for Modelling of Energy Systems model development), finalized the INPRO Subprogramme Plan 2024–2025, discussed updates to the INPRO Strategic Plan 2024–2029, and discussed the potential launch of a new INPRO advisory service on strategic planning for sustainable nuclear energy development. The publication *Comparative*

Evaluation of Nuclear Energy System Options presents case studies of different approaches on this topic.

At a technical meeting on the INPRO collaborative project 'Legal and Institutional Issues of Prospective Deployment of Fusion Facilities', experts identified the need to develop a regulatory framework for fusion power plants that will support long term sustainability.

During the Joint ICTP–IAEA INPRO School on Strategic Planning for Sustainable Nuclear Energy Development, held in Italy, participants learned basic concepts, methodology and tools for modelling, analysis and sustainability assessment of nuclear energy systems.



NUCLEAR FUEL CYCLE AND WASTE MANAGEMENT

OBJECTIVE

To support Member States in establishing effective, safe, secure and sustainable frameworks and solutions for the fuel cycle, radioactive waste management, decommissioning and life cycle management of related facilities, including research reactors, for nuclear programmes and nuclear applications.

To support Member States in strengthening their capabilities and human resources in the domains of fuel cycle, radioactive waste management, decommissioning and environmental remediation, and research reactors.

To be a platform to facilitate and strengthen international cooperation, coordination and information sharing among Member States.



The Agency has provided important fora of technical information exchange on the front- and the back-ends of the nuclear fuel cycle in 2023 and is encouraged to pursue its efforts to support Member States' interest in nuclear power, especially after the declaration made at COP28 by several countries to triple their nuclear energy capacities by 2050.

Mr Zheng Mingguang

Chief Engineer for Nuclear Energy at China's State Power Investment Corporation, Chair of the Agency's Standing Advisory Group on Nuclear Energy



5

peer review missions conducted

1 DSRS-TeC
1 INIR-RR
3 OMARR



2

Collaborating Centre agreements signed

KINGS
Sogin



209

nuclear reactors permanently retired from service, of which 22 fully decommissioned



519

research reactors decommissioned or undergoing decommissioning in 37 countries



56 000

tonnes of uranium (preliminary data) produced globally

KEY OUTPUTS

Uranium Resources and Processing

Uranium is the primary fuel for nuclear reactors and must be managed properly, in a safe and sustainable manner. Participants in a training workshop on mineral exploration

planning and management for uranium and thorium projects, held in 2023 in Espoo, Finland, acquired practical knowledge on techniques used for exploration.

Assurance of Supply

The IAEA Low Enriched Uranium (LEU) Bank in Kazakhstan, which provides an assurance of supply mechanism of last resort, continued safe operations at the Ulba Metallurgical Plant, with the first campaign of recertification of LEU-filled

30B cylinders carried out in June 2023. An LEU reserve in Angarsk, established following an agreement of February 2011 between the Government of the Russian Federation and the Agency, remained operational.

Nuclear Fuel Development

Nuclear fuel must be adequately designed and manufactured to enable the reliable and safe operation of NPPs. In 2023, participants in a technical meeting on advances in nuclear fuel fabrication technologies for power reactors exchanged

the most up-to-date information on fuel developments to meet the needs of new reactors, including small modular reactors (SMRs).

Management of Spent Fuel from Nuclear Power Reactors

Managing the spent fuel arising from NPPs until its disposal is an important step in the nuclear fuel cycle, constituting the so-called 'back end'. Participants in an international workshop on the chemistry of fuel cycles for molten salt

reactor technologies, jointly organized in 2023 with the OECD/NEA, identified gaps, opportunities and needs relating to the deployment of molten salt reactors.

Radioactive Waste Management

A number of disposal options have been developed for final management of radioactive waste, including deep borehole disposal. To explore further options and solutions for radioactive waste management, new coordinated research projects (CRPs) were launched in 2023 on enhancing global knowledge about deep borehole disposal for intermediate and high level nuclear waste and on geopolymers as an immobilization matrix for radioactive waste.

Participants in a technical meeting on the high temperature processing of radioactive waste reiterated the importance of establishing waste acceptance criteria and defining the endpoint or disposal option, before a treatment process is selected. In addition, the publication *Policies and Strategies for Radioactive Waste Management* was translated into French.

Management of disused sealed radioactive sources

Radioactive sources are used worldwide in medicine, industry and research. Once they fall out of use, the safety and security risks increase if the sources are improperly managed.

The publication *Management of Depleted Uranium Used as Shielding in Disused Radiation Devices* presents relevant information on technical issues and factors, as well as specific Member State experience leading to the identification of potential options for the management of depleted uranium shields.

At the inaugural meeting of the Disused Sealed Radioactive Sources Network, held three years after its inception, participants exchanged information on the national status of disused sealed radioactive source (DSRS) management and discussed further needs and support in this area, and expressed strong interest in silo storage and disposal of DSRS.

Member States received training and assistance in managing DSRS, including technological and engineering support as part of the pilot borehole disposal project in Malaysia. Thirty-six Category 1 and 2 disused sources were removed from Bosnia and Herzegovina, Chile, Croatia, Ecuador, Nicaragua and Slovenia.

Decommissioning and Environmental Remediation

Decommissioning

Decommissioning is a normal part of a nuclear facility's life cycle and needs to be considered in its design. It includes activities such as planning and the physical and radiological characterization of the facility, including the associated land.

In 2023, the Agency conducted a series of technical meetings that allowed participants to share knowledge on the decommissioning of various nuclear facilities. A meeting held in Cadarache, France, in collaboration with the French Alternative Energies and Atomic Energy Commission and ITER, facilitated the collection, sharing and analysis of good practices and experiences in decommissioning and related waste management considerations for fusion facilities.

To ensure good decommissioning knowledge management, the Agency jointly developed *A Taxonomy for the Decommissioning of Nuclear Facilities* with the European Commission and the OECD/NEA.

The Biennial Forum of the International Decommissioning Network reviewed the Agency's decommissioning activities over the previous two years, paying specific attention to capacity building, human resources development and knowledge management.

A new Collaborating Centre on decommissioning was established with KEPKO International Nuclear Graduate School (KINGS) in the Republic of Korea. In addition, a new CRP on R&D to advance decommissioning of legacy reactors was launched.

Environmental remediation

The report *Determination of Environmental Remediation End States* provides guidance to assist Member States in decision making for environmental remediation of radioactively contaminated sites.

In 2023, the Agency expanded the work scope of Sogin, an existing Collaborating Centre in Italy, to include programmatic activities in environmental remediation.

Research Reactors

The Agency assists Member States with the planning, operation, utilization and fuel cycle of research reactors, which are used for research, testing, radioisotope production, education and training. It also provides assistance in the areas of capacity building and infrastructure development.

New research reactor projects, infrastructure development and capacity building

Two Regional Research Reactor Schools, conducted in Argentina and Morocco, and the 18th EERRI Research Reactor Training Course, held in Austria, the Czech Republic and Slovenia, trained young professionals in a broad range of topics related to the safe operation and effective use of research reactors.

In addition, the Agency designated the National Centre for Nuclear Energy, Sciences and Technology in Morocco as an International Centre based on Research Reactor, providing nuclear education and training opportunities to students and young professionals from African countries.

Research reactor fuel cycle

In 2023, the Agency published *Post-irradiation Examination Techniques for Research Reactor Fuels*, which gives Member States an introduction to such techniques in support of LEU fuel development for high-power research reactors.

A technical meeting on proliferation resistance for research reactors allowed participants to share information and experience in incorporating intrinsic features in the design of new research reactors to minimize the potential of their use for nuclear proliferation.

Furthermore, a training workshop held in Lemont, United States of America, provided participants with practical information and guidance on establishing coupling schemes between neutronics and thermal-hydraulics codes to improve the design, operation, utilization and safety of research reactors.

Research reactor operation and maintenance

Operation and Maintenance Assessment for Research Reactors (OMARR) missions in the Islamic Republic of Iran and Thailand, and Agency missions in support of in-service inspections of research reactors in the Democratic Republic of the Congo, Indonesia and the Islamic Republic of Iran, helped these Member States to improve the operational availability and reliability of their research reactors.

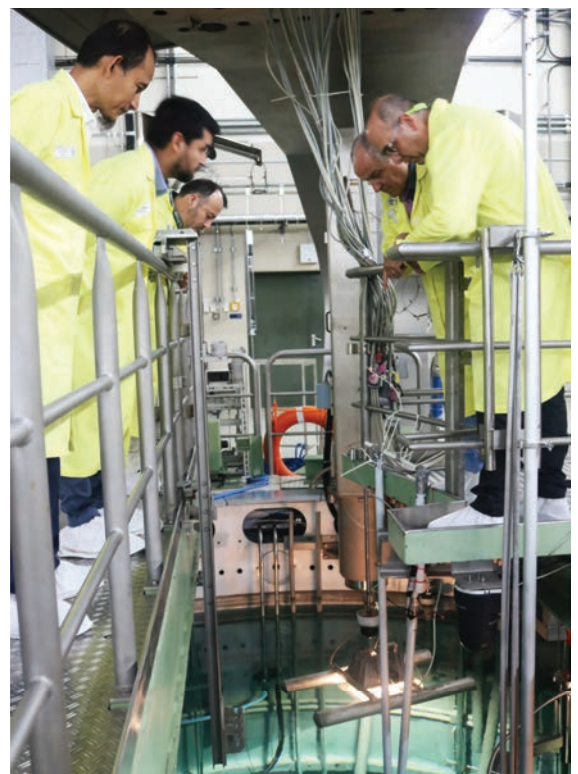
Technical meetings on digital instrumentation and control systems and integrated management systems for research reactors, and a webinar on decommissioning considerations in the design and operation of research reactors, allowed participants to share experience in managing different life cycle stages of facilities and support Members States' continuous safe operation of their research reactors.



Agency mission in support of an in-service inspection of RSG-GAS research reactor in Indonesia, June 2023. (Photograph courtesy of Indonesia's National Research and Innovation Agency (BRIN))



The Director General visiting the Underground Research Laboratory of the French National Radioactive Waste Management Agency (Andra) to discuss the future construction of Cigéo, France's planned deep geological repository for high-level and intermediate nuclear radiological waste, November 2023. (Photograph courtesy of Andra)





CAPACITY BUILDING AND NUCLEAR KNOWLEDGE FOR SUSTAINABLE ENERGY DEVELOPMENT

OBJECTIVE

To support Member States in strengthening their capacities for formulating robust energy strategies, plans and programmes, and to improve their understanding of nuclear energy's contribution to facilitating the clean energy transition, combating climate change and achieving the Sustainable Development Goals (SDGs).

To support Member States in strengthening their capacities for establishing, managing and using their nuclear knowledge base and to foster international networking.

To acquire, preserve and provide Member States with access to information in the area of nuclear science and technology and to facilitate sustainable information sharing among Member States.



The IAEA remains an important partner for the Korea Atomic Energy Research Institute in the field of knowledge management, including human resources development. It enables us to acquire a broad overview of knowledge preservation activities in the nuclear sector at the global level.

Youngmi Nam

Principal Researcher at the Korea Atomic Energy Research Institute



6

Knowledge Management Assist Visits to Armenia, Egypt, Georgia, India Switzerland and Tunisia



6

Nuclear Energy Management Schools

3

Nuclear Knowledge Management Schools



4

International Nuclear Management Academy visits

KEY OUTPUTS

Energy Modelling, Data and Capacity Building

Energy planning remains at the heart of efforts to resolve the current energy and climate crises and ensure that countries' planned transition pathways meet the SDGs in the near-to-medium term, and the objectives of the Paris Agreement in the longer term. An increasing number of countries are assessing the option of using nuclear power, and integrating that option in energy planning allows these countries to decide on whether to embark on a nuclear programme. The Agency can provide technology-neutral advice on a country's energy planning, which might consist of different technology options, including nuclear energy, renewables, etc. Some of the energy planning training events organized in

2023 were focused specifically on small modular reactors or on supporting initiatives such as Atoms4NetZero, which aim to help Member States assess nuclear power as a means to decarbonize electricity, heat and hydrogen production. The Agency continued to assist Member States in energy planning to address sustainable development and climate change mitigation, and increasingly net zero transitions. At 51 capacity-building 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.



Students working on a group project during the Joint ICTP-IAEA Nuclear Knowledge Management School in Trieste, Italy, October 2023.



Energy, Economic and Environmental (3E) Analysis

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 could open up sustainable financing options that are already accessible to other low-carbon technologies. In 2023, the Agency organized several workshops on nuclear financing and on the macroeconomic impacts of investments in the nuclear sector, as well as high-level panel sessions and events at the Second International Conference on Climate Change and the Role of Nuclear Power: Atoms4NetZero and at COP28, on financing nuclear investments and engaging with financial institutions. In particular, participants discussed the development of taxonomies that include nuclear power as part of sustainable activities, the use of climate models to inform financial institutions on the potential contribution of nuclear power to mitigate climate change, and the need for

multilateral development banks to include nuclear power in their climate finance policies.

At COP28, the Agency released three booklets: *Nuclear Energy and Climate Change: Questions and Answers on Progress, Challenges and Opportunities*, part of the Agency's contribution to the first Global Stocktake; *Nuclear Energy in Mitigation Pathways to Net Zero*, which analyses the role of nuclear and gaps in the Intergovernmental Panel on Climate Change Sixth Assessment Report; and *Nuclear Energy in Climate Resilient Power Systems*, which examines the potential of nuclear power to support decarbonized, climate-resilient energy systems. These booklets provided background to several events organized by the Agency or its partners during COP28.



▶ The Director General with the President of Armenia, Vahagn Khachaturyan (left), and Kazakhstan's Minister of Energy, Almassadam Satkaliyev (right), at the Agency event 'Net Zero Needs Nuclear Power', COP28, December 2023.

▶ The Net Zero Nuclear event 'Tripling Nuclear Energy by 2050', COP28, December 2023.



Nuclear Knowledge Management

Building, collecting, transferring, sharing, preserving, maintaining and utilizing knowledge is essential to developing and retaining the necessary technical expertise and competences required for nuclear power programmes and other nuclear technology. In this regard, the Agency helps Member States maintain and preserve nuclear knowledge.

Four International Nuclear Management Academy missions were implemented in 2023, at Sofia University in Bulgaria, KEPCO International Nuclear Graduate School (KINGS) in the Republic of Korea, the University of Idaho in the United States of America and Ontario Tech University in Canada, and three new members joined the Academy — KINGS, the University of Idaho and the University of West Bohemia, Czech Republic.

Two technical working groups, on nuclear knowledge management and human resource development, were merged to provide a more efficient, cost-effective service, with the first meeting of the new Technical Working Group on Managing Human Resources and Knowledge in the Field of Nuclear Energy held in 2023.

Furthermore, a technical meeting on the International Nuclear Management Academy provided a forum for university representatives to present the status of their existing or planned nuclear technology management programmes and share good practices and experiences.

The publication *A Nuclear Knowledge Management Course for University Master's Level Programmes* provides guidance to Member States, in particular universities, on establishing a master's level course in nuclear knowledge management.

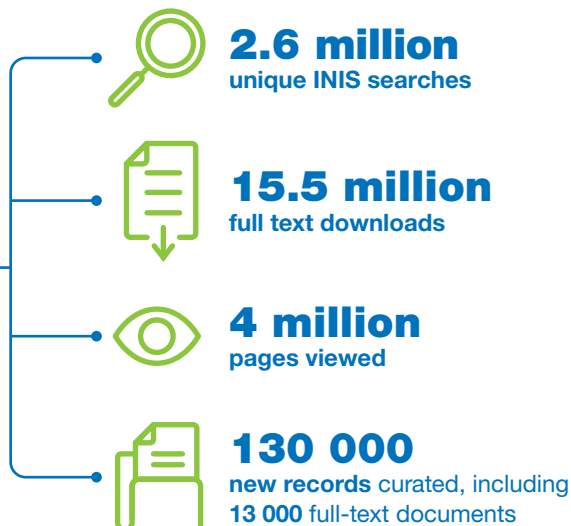
Nuclear Information

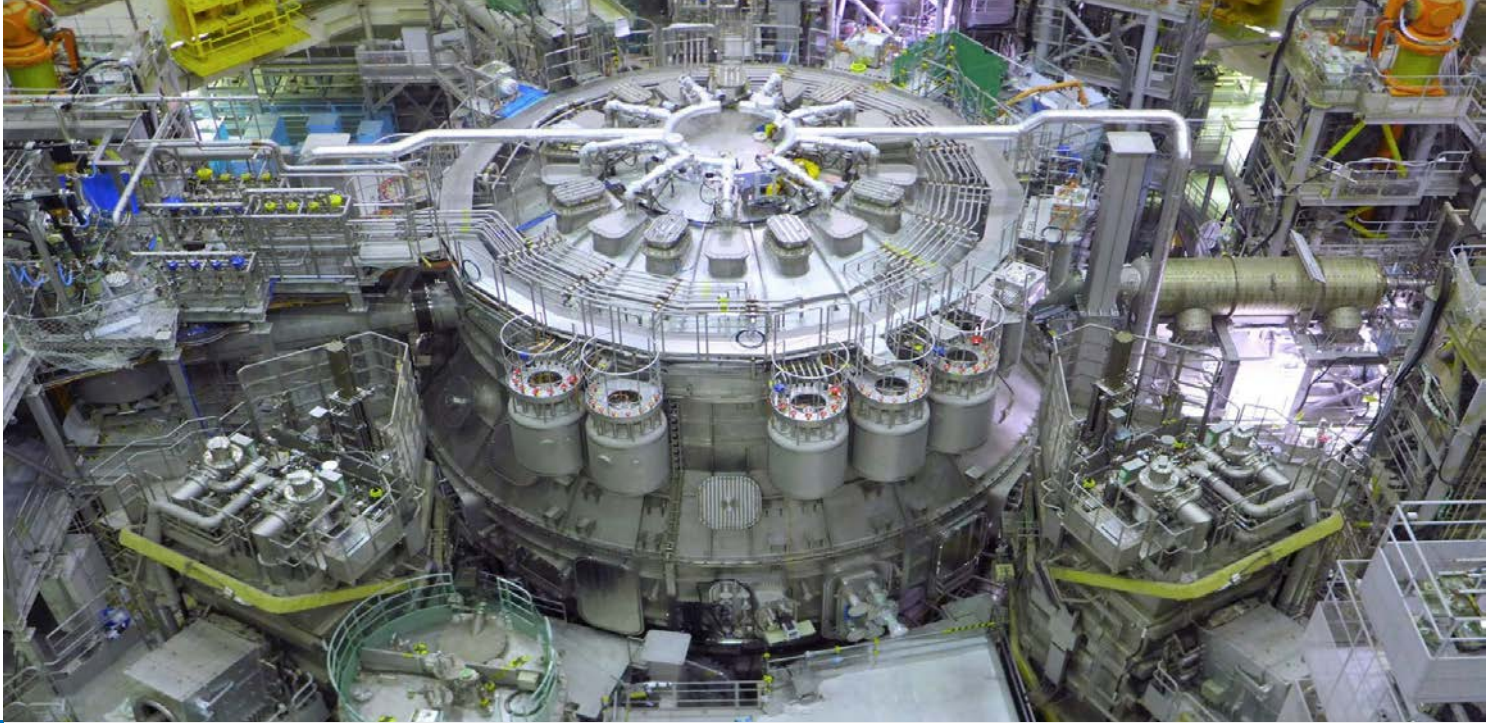
The IAEA Library, renamed the IAEA Lise Meitner Library in March 2023, continued to meet the information needs of Member States by working with members of the International Nuclear Library Network.



Agency staff and Monica Frisch, grand-niece of Lise Meitner, at the renaming of the IAEA Library, March 2023.

1.7 million
users accessed
the INIS repository
globally





NUCLEAR SCIENCE

OBJECTIVE

To support Member States in strengthening their capabilities in the development and application of nuclear science as a tool for their technological and socioeconomic development.

To support Member States in enhancing sustainable operation and effective utilization of particle accelerators and neutron sources, as well as effective utilization of research reactors, increasing opportunities for access to these facilities and their diverse applications, and in developing relevant qualified professionals.



ANSTO is proud of its long-standing collaboration with the IAEA (...) there are many more opportunities ahead in which we can continue to advance the United Nations Sustainable Development Goals through the application of nuclear science and technology.

Dr Suzanne Hollins

Head of Research at the Australian Nuclear Science and Technology Organisation (ANSTO) and Director of the ANSTO Graduate Institute



16

coordinated research projects in progress



3

IRRUR missions to AEOI, Iran INL, USA and MIT, USA



3

Practical Arrangements signed with CNDC, China HFIPS, China and ITU



163

people received hands-on training in nuclear science and applications



9

terabytes of material downloaded from the Nuclear Data Services database

KEY OUTPUTS

Atomic and Nuclear Data

The Agency provides fundamental nuclear data for power and non-power applications, as well as atomic data for fusion energy research. In 2023, it released a number of new graphical user interfaces, notably TALYSworld and Data Explorer, for easy access to nuclear reaction data. Additionally, the International Nuclear Data Evaluation Network contributed to improved nuclear data for

Plutonium-239 for advanced nuclear reaction simulations. The 21st International Conference on Atomic Processes in Plasmas, held in May 2023 with 127 participants, focused on atomic processes involved in the study of plasmas in fusion energy and other applications over a wide range of densities and temperatures.

Research and Applications with Accelerators and Neutron Sources

The Agency supports Member States with regard to research, infrastructure projects and education programmes on accelerators and neutron sources. In 2023, the Centre for Ion Beam Applications at the National University of Singapore was designated as a Collaborating Centre aiming to enhance the use of accelerator science and technologies in multidisciplinary applications.

Periodic training courses and workshops provided hands-on training on scientific experiments and practical applications at research reactor, ion beam and synchrotron light facilities. Research groups from around 20 Member States carried out experiments at Elettra Synchrotron Trieste, Italy, and the Ruđer Bošković Institute, Croatia.

The Agency continued its endeavours in the area of 'Atoms for Heritage' by organizing technical meetings and workshops, allowing numerous participants to enhance their knowledge about advances in nuclear analytical techniques for the characterization of heritage samples and objects. Following a joint technical briefing, the Agency and the United Nations Interregional Crime and Justice Research Institute proposed a cooperation platform on using nuclear techniques to combat illicit trafficking in cultural goods.

The Agency publication *Specific Considerations and Guidance for the Establishment of Ionizing Radiation Facilities* is intended for use by managers, staff, decision makers at the national level and other stakeholders at institutions that are seeking or supporting the establishment of new ionizing radiation facilities. The publication *Advances in Boron Neutron Capture Therapy* comprehensively reports on the current state of the related science and the supporting technology. It covers accelerator-based neutron sources, beam design, physical dosimetry, facility design and operation, pharmaceuticals, radiobiology, dose calculation, treatment planning and clinical trials.

Nuclear Instrumentation

The safe and effective use of nuclear techniques requires reliable measurement, diagnostics and control instrumentation. Advanced nuclear instrumentation is used for many sophisticated applications, such as precision imaging systems for medical diagnostics, remote sensors for environmental safety or the probing and manufacturing of the most modern materials or objects.

More than 300 person-weeks of hands-on training took place at the Agency's Nuclear Science and Instrumentation Laboratory and at partner organizations, covering gamma spectroscopy, X-ray fluorescence, neutron science, radiotracer applications, radiological mapping and nuclear security. The majority of trainees benefited from the newly refurbished Multipurpose Building at the IAEA Seibersdorf Laboratories.

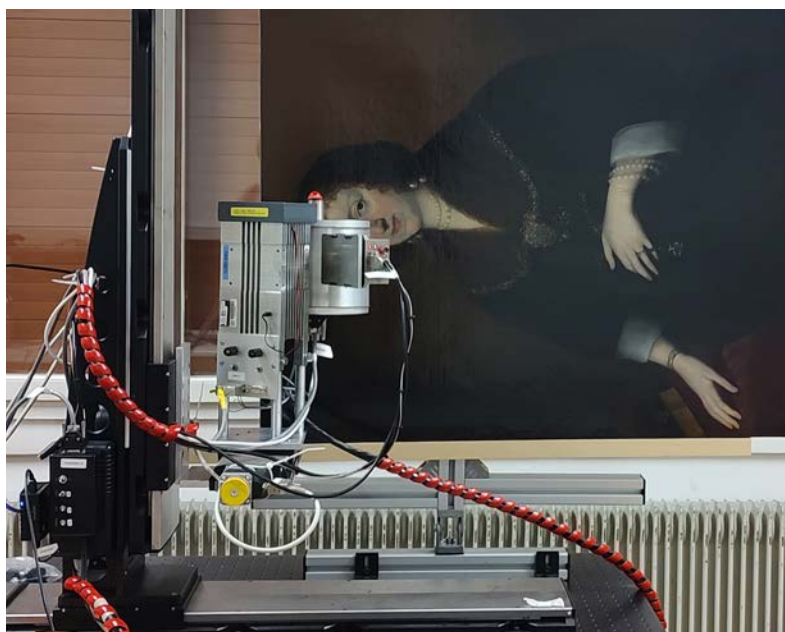
A joint ICTP-IAEA School on advanced nuclear instrumentation, held in Trieste, Italy, allowed trainees to familiarize themselves with professional software design tools and hardware platforms through tutorials and hands-on activities with an emphasis on practical applications of modern nuclear instrumentation.

The analytical capabilities of some 50 laboratories in 34 Member States were improved through proficiency tests.

In addition, as part of new partnership initiatives with the private sector, demonstration of diverse radiological mapping systems for radiation survey in field took place at the Nuclear Science and Instrumentation Laboratory in Seibersdorf.



◀ An Agency Integrated Research Reactor Utilization Review (IRRUR) mission assessed the utilization aspects of three research reactors in the Islamic Republic of Iran. A further two IRRUR missions took place at research reactors of the Idaho National Laboratory and the Massachusetts Institute of Technology in the United States of America. (Photograph courtesy of the Atomic Energy Organization of Iran)



◀ Portable macro X-ray fluorescence scanner dedicated to 2D non-destructive analysis of the elemental composition of different pigments in art pieces and artifacts of cultural and historical value. The device was designed and built as a result of a joint IAEA-ICTP project. (Photograph courtesy of ICTP)

Fusion Research

The Agency continued its support to Member States by accelerating fusion energy research and technology development to make fusion energy generation a reality.

In 2023, a new coordinated research project (CRP) was launched on the standardization of small specimen test techniques for fusion applications to facilitate actions towards the unification of terminology and the tools used in different parts of the fusion community.

The Agency organized a workshop on artificial intelligence for accelerating fusion and plasma science. The event provided a platform for researchers, developers, practitioners, entrepreneurs and policymakers to discuss AI applications to accelerate fusion and plasma science, including through joint initiatives and CRPs. In addition, the Joint ICTP–IAEA School on AI for Nuclear, Plasma and Fusion Science, organized in Trieste, Italy, provided young researchers with critical skills related to AI/machine learning and computational physics in nuclear, plasma and fusion science.

The Fifth IAEA Technical Meeting on Fusion Data Processing, Validation and Analysis, organized in Gent, Belgium, provided a forum for fusion researchers to discuss a set of topics relevant to fusion data processing, validation and analysis with a view to identifying extrapolation needs for next-step fusion devices such as ITER.

The 8th ASEAN School on Plasma and Nuclear Fusion, organized by the Thailand Institute of Nuclear Technology in cooperation with and supported by the Agency, helped

to raise awareness of fusion energy and plasma research in Southeast Asian countries and promoted interaction between young talent and leading researchers from around the world. In addition, the 12th ITER International School, also organized in cooperation with and supported by the Agency, allowed participants to get acquainted with physics of energetic particles in fusion plasmas.

In 2023, the Agency designated the Plasma Science and Fusion Center of the Massachusetts Institute of Technology (PSFC) as its first Collaborating Centre in the field of fusion. This partnership will help the Agency deliver its fusion research and technology activities for an initial period of four years (2023–2027). It will enable the Agency to access PSFC expertise in artificial intelligence applied to fusion and plasma science by bringing together these innovations in an integrated manner, while training a new generation of fusion scientists at the same time.

In addition, the Agency and the Hefei Institutes of Physical Science, Chinese Academy of Sciences, an integrated research entity in China that includes a fusion research institute, signed Practical Arrangements in physics, technology, training and education in fusion research.

Lastly, the Agency released a high-level textbook for graduate students entitled *Fundamentals of Magnetic Fusion Technology*, which covers a wide range of topics and is useful for teaching at master's degree level.

The Director General with the Director of MIT's Plasma Science and Fusion Center (PSFC), Dennis Whyte, and PSFC Research Scientist, Cristina Rea, at the signing of the PSFC Collaborating Centre agreement, September 2023.



42 publications in 2023



17 Nuclear Fuel Cycle and Waste Technology

21 Nuclear Power

4 Planning, Information and Knowledge Management



www.iaea.org/publications

176 440 online views of NE publications in 2023

MOST POPULAR PUBLICATION



Country Nuclear Power Profiles

10 471 online views

Nuclear Power, Fuel Cycle and Nuclear Science



Second International Conference on Climate Change and the role of Nuclear Power 2023: Atoms4NetZero

October 2023, Vienna
Participants: **496** in person and **530** online, from **88** Member States

This event provided a forum for Member States, representatives of relevant low carbon energy sectors, international organizations and other stakeholders to exchange information on the role of nuclear power in the energy transitions towards net zero emissions, consistent with the objectives of limiting global warming to 1.5 degrees Celsius by the end of the century.



International Symposium on Uranium Raw Material for the Nuclear Fuel Cycle

May 2023, Vienna
Participants: **176** in person and **229** online, from **63** Member States

This event allowed participants to analyse supply–demand scenarios and to present and discuss the latest developments and innovations in uranium geology, exploration, mining, processing and site decommissioning to ensure a sustainable supply of uranium for use as nuclear fuel.

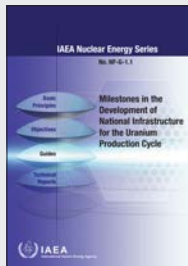


29th IAEA Fusion Energy Conference

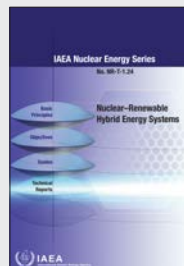
October 2023, London
Participants: **1006** in person and **1609** online, from **81** Member States

This event provided a forum for the discussion of key physics and technology issues and innovative concepts relating to the use of fusion as a future source of energy. Participants presented the outcomes of R&D efforts in national and international fusion projects, covering topics such as experiments and theory, fusion technology and materials, and socioeconomic aspects, highlighting advances made.

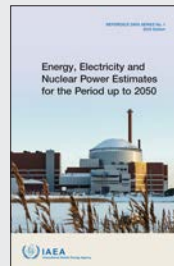
Guidance on evaluating progress towards establishing or re-establishing a national uranium production programme and planning the steps necessary to develop national infrastructure requirements for uranium production.



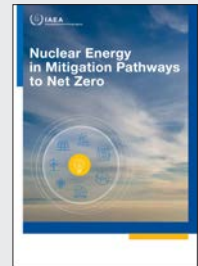
Describes the potential use of nuclear and renewable generation in coordinated configurations to support various applications beyond electricity production.



Contains estimates of energy, electricity and nuclear power trends up to the year 2050, including global and regional nuclear power projections presented as low and high cases.



Addresses the contribution of nuclear energy in global climate change mitigation pathways put forth by the Intergovernmental Panel on Climate Change and the International Energy Agency.



IAEA PUBLICATIONS AND CONFERENCES IN 2023



International Symposium on the Deployment of Floating Nuclear Power Plants – Benefits and Challenges

November 2023, Vienna
Participants: **141** in person and **20** online, from **45** Member States

This event explored and discussed the potential deployment of FNPPs to enhance the contribution of nuclear energy to achieving net zero carbon emissions. It highlighted the need for closer cooperation between the Agency and the International Maritime Organization and maritime classification societies, and the need to consider safety, security and safeguards in the early design stages.



International Conference on Nuclear Decommissioning: Addressing the Past and Ensuring the Future

May 2023, Vienna
Participants: **403** in person and **188** online, from **69** Member States

This event covered achievements, challenges and lessons learned in the decommissioning of nuclear facilities, highlighting current priority needs and sharing information on strategies and approaches that enhance the safe, secure and cost-effective implementation of programmes.

NUCLEAR TECHNOLOGY

**Nuclear Techniques
for Development
and Environmental Protection**



In 2023, nuclear sciences and applications continued to be essential tools for tackling critical development challenges. Under Rays of Hope, ZODIAC and NUTEC Plastics, nuclear sciences and applications helped bridge global gaps in cancer care, ramped up efforts to prevent new pandemics, and tackled plastic pollution. In the newly launched GloWAL Network, they will support effective water resource management, and in Atoms4Food, a new and exciting collaboration with FAO, they will help countries strengthen food and nutrition security.

Working at the cutting edge of nuclear sciences, the IAEA continues to accelerate innovation, through applied research and development, to advance sustainable development creating a better future.

Najat Mokhtar

Deputy Director General
and Head of the Department
of Nuclear Sciences and Applications

Nuclear Techniques for Development and Environmental Protection

active coordinated
research projects within the Department
of Nuclear Sciences and Applications

105

technical, consultancy and research
coordination meetings

149

active research contracts

1415

active Collaborating Centres
within the Department
of Nuclear Sciences and
Applications

54

databases

24



OA-ICC NEWS STREAM

almost **40 000** unique visitors
from **185** countries

938 posts

65 673 views

HUMAN HEALTH CAMPUS

79 446 users

365 771 page views



34

webinars

12

online courses

14

e-learning modules

186

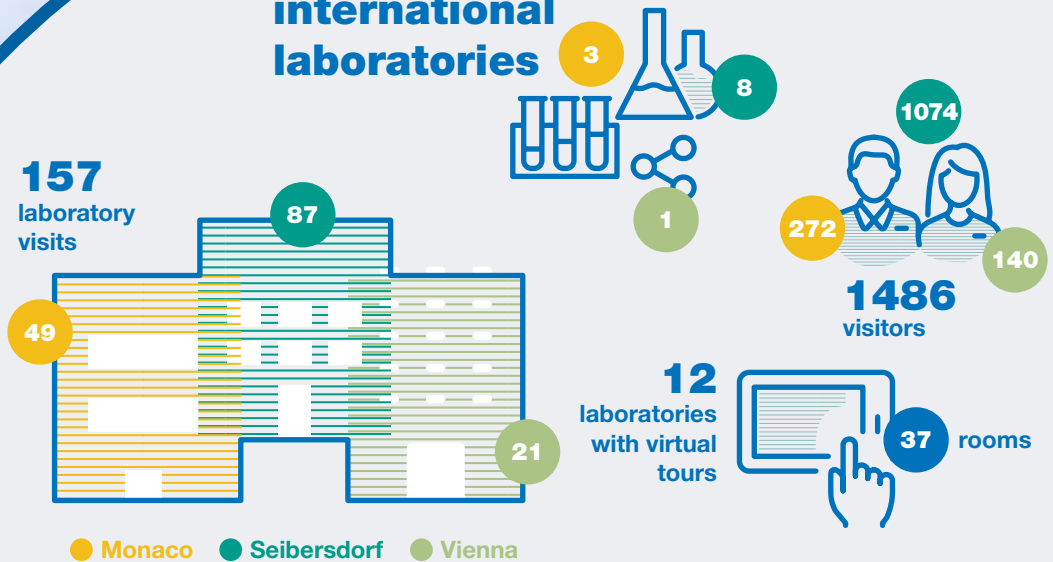
training courses and workshops

34

conferences
forums
symposiums
side events

12 international laboratories

157 laboratory visits





FOOD AND AGRICULTURE

OBJECTIVE

To increase the sustainability and resilience of food and agriculture production and related livelihoods in Member States through climate-smart agriculture approaches, including meeting challenges from animal and zoonotic diseases, plant pests, food safety risks, climate change, biothreats, and nuclear or radiological emergencies.



Viet Nam has nurtured a long-standing partnership with the FAO/IAEA through the Joint FAO/IAEA Centre, focusing on the application of nuclear techniques in food and agriculture. This collaboration, alongside the utilization of nuclear techniques, has been instrumental in our efforts to combat food insecurity and malnutrition while making substantial contributions to nationwide food security.

Assoc. Prof. Huynh Thanh Dat

Minister of Science and Technology, Viet Nam



31

new varieties incorporated in the FAO/IAEA Mutant Variety Database



200

sequences submitted to GenBank; 31 new genomes produced



10

analytical methods developed to support food safety and authenticity



5

guidelines published on fruit fly pest management



5

SOPs and guidelines published on the use of stable isotope techniques to assess drought tolerance and water use efficiency in crops

KEY OUTPUTS

Combating Animal and Zoonotic Diseases through the Delineation of Pathogen Genomes

As part of the ZODIAC initiative, the Agency and FAO, through the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, established and optimized next generation sequencing (NGS) and associated bioinformatics tools and transferred them to Member States to build capacity in addressing animal health challenges. NGS has the advantage of detecting unknown and unsuspected pathogens and their characteristics, providing key information to decision makers responsible for disease control.

In 2023, NGS confirmed the presence in West Africa of African swine fever virus (ASFV) genotype II, which caused severe outbreaks and contributed to the ongoing worldwide pandemic, and of four other ASFV genotypes co-circulating in Zambia, prompting informed research on the spread of ASFV and the required control strategies. In addition, pathogen genomes were sequenced in disease hotspots, providing a better understanding of pathogen diversity

and enhancing capacity to tackle outbreaks. The lumpy skin disease virus was further characterized, leading to the discovery of an ancient strain last seen in 1960 in Africa and currently circulating in South Asia. This data has been critical to inform vaccination and other control strategies.

Realizing the benefits of NGS in animal health, Member States have requested additional support to build local capacity. In 2023, the Agency and FAO provided training and standard operating procedures (SOPs) in NGS and bioinformatics to scientists from 15 African and Asian countries. The increased use of NGS led to enhanced diagnostics and strengthened surveillance programmes in 20 Member States, and is advancing research to combat infectious animal and zoonotic diseases worldwide.

Innovative Application of Radioisotopes/Stable Isotopes and Ionizing Radiation to Food Safety/Authenticity Testing and Standards Setting

To enhance food safety, promote food irradiation and combat food fraud, the Agency supported the development of analytical methods including X-ray fluorescence for metal-profiling in African and Asian millets, and immunosensors and supercritical fluid chromatography–mass spectrometry for mycotoxin testing in Belizean tortillas. Moreover, training and guidance on the detection of fraud in honey was provided to Moroccan stakeholders, while isotopic methods used for establishing vinegar and honey authenticity were adapted to monitor organic food and to trace the origins of mango, coffee and cocoa in the Philippines. Through a coordinated research project, the Agency produced the radioisotope Zinc-65 and used it to synthesize amoxicillin for fish-depletion studies. The use of positron emission tomography (PET) imaging for radiolabelled drugs in fish was also introduced. Additionally, an artificial intelligence-based tool was developed and

implemented in Colombia to interpret mass spectra and isotopic patterns in residue testing.

Worldwide, the Agency supported food safety laboratories to strengthen their capabilities. Thanks to this support, Zimbabwe’s Central Veterinary Laboratory obtained ISO/IEC 17025 accreditation — facilitating poultry exports and farmer awareness about antimicrobial use — and in Kyrgyzstan, a food safety laboratory improved service delivery and attained national reference status for testing antimicrobial residues and resistance.

With Agency support, the Commission on Phytosanitary Measures (CPM) for the International Plant Protection Convention revised and published *International Standard for Phytosanitary Measures No. 18*, which provides technical guidance on the application of irradiation as a phytosanitary measure for international trade agreements.

Pest Free Production Sites to Facilitate Fruit Trade

Pest free production sites (PFPSs) have been adopted by the CPM and are used as a pest risk mitigation scheme to facilitate fruit trade. Thanks to the Agency’s contribution, the number of PFPSs increased from 303 in 2018 to 1094 in 2023. Ecuador is among the countries that have benefited the most from the scheme’s extended use, exporting non-traditional fruits including pitahaya (dragon fruit), tree tomato

and uchuva (golden berries) to the United States of America and, more recently, to China and Peru. Bilateral workplans have been subscribed between Ecuador’s agency for regulation and control of plant and animal health, Agrocalidad, and recognized national plant protection organizations of importing countries. The workplans contain specific phytosanitary measures that must be applied by producers

▼
Scientists conduct experiments at the Agency’s Seibersdorf laboratories to delineate the complex genomes of pathogens to identify emerging and re-emerging animal and zoonotic pathogens.



and exporters for them to be eligible for participation in the export programme. Among the measures being used is the area-wide application of the sterile insect technique, which is supported by the Agency. Sterile flies are imported weekly from the mass-rearing and sterilization facility of the Moscamed programme located in El Pino, Guatemala, and are released over 855 hectares of commercial fruit crops and surrounding areas in Ecuador. Additionally, Agrocalidad staff received capacity development in surveillance, a key part of the PFPS scheme, suppression and, in particular, the handling and release of the sterile flies. A PFPS is achieved

when at least one year of surveillance demonstrates the absence of fruit flies of quarantine importance, specifically the Mediterranean fruit fly and the South American fruit fly.

The use of PFPS has increased the possibility of fruit exports in Ecuador, which has provided an incentive for the fruit industry to expand the production of these non-traditional crops. In the case of pitahaya, the production area has increased to over 1700 hectares and 34 000 tonnes of fruit are being exported. The value of these exports was more than US\$ 73 million as per September 2023.

Exploring Cosmic Radiation to Enhance Genetic Diversity for Climate-Resilient Crops

Scientists are looking to understand how cosmic radiation and microgravity impact induced genetic variation to develop crops that can withstand harsh growing conditions on Earth, particularly those imposed by climate change.

The Agency, through the Joint FAO/IAEA Centre, is leading a pioneering effort to conduct a feasibility study on seed irradiation in space for induced genetic diversity and expedited plant mutation breeding. Seeds of the model plant species *Arabidopsis thaliana* and sorghum (*Sorghum bicolor*) were sent to space for approximately five months to generate novel genetic diversity from exposure to harsh space environments. The seeds were exposed to different environments at the International Space Station; some seeds were kept inside and others were placed outside to

expose them not only to microgravity, but also to extreme temperatures and unshielded cosmic radiation.

The seeds are currently at the Agency's Plant Breeding and Genetics Laboratory in Seibersdorf and are undergoing rigorous evaluation for plant growth biology and DNA structural variation using cutting-edge technologies. Preliminary observations indicate normal morphology and reproductive behaviour in the plants arising from the seeds of both crops. The phenotypic and genetic variation within these mutant populations is being explored to identify useful traits for climate resilience and enhanced yields, with a view to developing new varieties that will contribute to global food security.

Synergizing Cosmic Ray Neutron Sensors and Remote Sensing for Water Saving Agriculture

Backed by a decade of comprehensive R&D conducted by the Joint FAO/IAEA Centre, cosmic ray neutron sensor technology experienced a significant increase in adoption rates in drought-prone regions in 2023, particularly in 23 African countries. Through different research and capacity-building mechanisms, the Agency has made concerted efforts to integrate cosmic ray neutron sensor technology with high-resolution remote sensing. The integration of these technologies promises a revolutionary shift in landscape-scale soil moisture monitoring by supporting climate-smart irrigation practices and providing crucial data on droughts and floods to decision makers and farmers. Under the US\$30 million 'Soil mapping for resilient agri-food systems in Central America and sub-Saharan Africa (SoilFER)' project, coordinated by FAO, the Agency, through the Joint FAO/IAEA Centre, developed an action plan for deploying 25 cosmic-ray neutron sensors in five countries across both regions, targeting

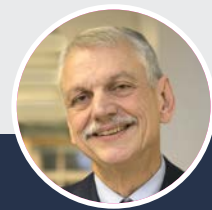
five representative agro-ecological zones per country. This strategic deployment will support better understanding of drought impacts on crop production and will provide data on effective mitigation strategies. Through the Joint FAO/IAEA Centre, the Agency supports SoilFER to enhance national soil fertility data through infrared spectroscopy and advanced mathematical modelling techniques, including artificial intelligence. This collaborative project underscores a concerted determination to fortify agricultural systems by offering comprehensive and innovative tools to adequately confront challenges posed by changing climatic conditions and ensuring more resilient agri-food systems. Soil mapping can improve efficiency in the use of fertilizers and help to boost food security and nutrition.



HUMAN HEALTH

OBJECTIVE

To support Member States in enhancing their capability to address needs relating to nutrition and the prevention, diagnosis and treatment of health problems through the development and application of nuclear and related techniques within a quality assurance framework.



There is a great opportunity and need to conduct randomized controlled trials in low and middle income countries (LMICs) to define evidence-based best practices within these settings. The IAEA HYPNO trial for head and neck cancer, a disease that disproportionately affects LMICs, is a good example. The IAEA played a crucial role facilitating the trial via the long term relationships they built with clinicians in cancer centres all over the world.

Søren M. Bentzen

Professor of Radiation Oncology and Director of the Division of Biostatistics and Bioinformatics at the University of Maryland School of Medicine, and principal investigator for the HYPNO trial



991

radiotherapy beams across **383 institutions** in **86 countries** measured by the IAEA/WHO TLD postal dose audit service



10

audits conducted
5 QUANUM
2 QUAADRIL
3 QUATRO



3

IAEA Nuclear Explained
podcast episodes on human health and nutrition



17

Agency publications produced and over 50 scientific publications featured in peer-reviewed journals

KEY OUTPUTS

Advancing Care Globally

A coordinated research project (CRP) that closed in 2023 resulted in the development and publication of groundbreaking infant body composition reference charts, allowing clinicians and researchers to better interpret related data. The use of the reference charts will help inform interventions that combat malnutrition and set up healthier childhood trajectories.

To strengthen the practice of nuclear medicine globally in a context-appropriate and safe manner, the Agency released *A Practical Guide for Pediatric Nuclear Medicine*. By presenting a hands-on approach, the guide enables physicians to use diagnostic nuclear medicine procedures successfully in children. Between its release in September 2023 and the end of the year, the publication was downloaded over 25 000 times — 13 000 in the first week alone.

The recently published results of the IAEA HYPNO trial, spanning 12 cancer centres in 10 LMICs, demonstrate the safety and effectiveness of a practice-changing, resource-sparing technique: hypofractionation. Through its use, radiation oncologists can treat head and neck cancer patients in four weeks — just over half the time that standard radiotherapy takes — by using fewer, but higher, radiation doses. For providers and patients alike, hypofractionation offers a cost-effective and convenient tool to make care more accessible and affordable, especially in LMICs.

The provision of codes of practice is highly valued by Member States, as they have a significant impact on the

quality and standardization of radiation globally. To improve the traceability, accuracy and consistency of clinical radiation dosimetry measurements in its Member States, the Agency issued *Dosimetry in Brachytherapy – An International Code of Practice for Secondary Standards Dosimetry Laboratories and Hospitals*. The publication meets the need for a systematic and internationally unified approach to brachytherapy dosimetry.

In 2023, the Agency maintained its commitment to advance cancer care globally through Rays of Hope, especially amid projections indicating that nearly three-quarters of all cancer-related deaths will occur in low and middle income countries by 2040. Under the initiative, the Agency has developed a clear and transparent process to review and select potential anchor centres, resulting in the establishment of the first five such centres in 2023. As part of the application process, institutions should comply with technical, logistical, governance and sustainability criteria, among others.

Under ZODIAC, the Agency signed a collaboration agreement with Amazon Web Services to leverage the latter's cloud-based service for the creation and development of the ZODIAC Respiratory Disease Phenotype Observatory — a secure medical imaging repository through which the Agency can foster global cooperation on the large-scale data analysis of disease patterns to enable the early detection of potential pandemics.

Ensuring Quality Care

In 2023, QUANUM, QUAADRIL and QUATRO audits helped to improve patient care through comprehensive, independent audits of clinical practices. The Agency expanded its pool of Spanish-speaking expert auditors by training complete QUATRO teams during a course at the Dosimetry Laboratory. These trained professionals from Latin America can now serve as a resource to train others in the region. In addition, the Agency published the guideline *National Networks for Radiotherapy Dosimetry Audits* to support countries in developing their own audit programmes.

To ensure the establishment and operation of quality health services within available resources, the Agency published *Basics of Quality Management for Nuclear Medicine Practices and Worldwide Implementation of Digital Mammography Imaging*.

The IAEA/WHO Network of Secondary Standards Dosimetry Laboratories (SSDLs) — which calibrates instruments for measuring radiation and is critical for accurate dose quantification by end-users — currently consists of 89 laboratories in 76 countries. In 2023, the Agency provided calibration services for 69 ionization chambers and 17 electrometers and issued 157 calibration certificates. In addition, the Agency held a technical meeting on SSDLs and quality management systems and published guidelines on establishing an SSDL for interested Member States and on the education of radiation metrologists for SSDLs.

Lastly, the Agency conducted an interlaboratory comparison study on analysis of deuterium oxide enriched water in 2023, among 50 laboratories that use Fourier transform infrared spectrometers to measure deuterium oxide in saliva samples for nutrition assessments to self-assess the quality of their measurements.

Catalysing Education and Training

To provide medical professionals with an in-depth understanding of radiotherapy set-ups, the Agency developed virtual reality models of three cancer treatment procedures. An innovative, cost-effective training tool, these models are especially advantageous when the necessary medical equipment is unavailable or has not yet been commissioned for clinical use — as was the case in Mozambique, where the Agency debuted its prototype during a training course. By enabling professionals in resource-challenged contexts to train in an immersive

learning environment, these models help close global knowledge gaps.

The Agency's Human Health Campus continued to serve as a critical resource for nuclear medicine, radiation oncology, medical physics and nutrition professionals, with new offerings ranging from a 3D realistically-rendered animation video on a nuclear technique for assessing body composition to four modules that aim to develop contouring skills for head and neck cancer radiotherapy planning.

▶ **Virtual reality goggles and the Agency's recently developed e-learning module 'Patient Setup and Positioning for Cervical Cancer External Beam Radiotherapy'.**



Leveraging Multilateralism for Global Coordinated Action

In 2023, the Agency worked with other UN agencies — including through the UN Interagency Task Force on the Prevention and Control of Non-communicable Diseases — to bring the full force of their tools and expertise directly to countries.

The Agency continued to serve on the steering committee of UN Nutrition, an interagency coordination mechanism that addresses malnutrition in all its forms. In doing so, the Agency raised awareness of the relevance of nuclear nutrition techniques for scientific and programming communities. Since November 2023, the Deputy Director General and Head of the Department of Nuclear Sciences and Applications, Ms Najat Mokhtar, has served as the UN Nutrition Chair.

To support the Global Breast Cancer Initiative, which aims

to reduce mortality from the most common form of cancer worldwide by 2.5% each year, the Agency and WHO created a common implementation framework with resource-appropriate strategies for countries in order to improve diagnosis and treatment. Both agencies also developed technical recommendations on the sustainable management of radiotherapy facilities and equipment, to help cancer departments ensure that all cancer patients can be treated safely and accurately with minimized care gaps.

The Agency also brought attention to an alarming trend. On the basis of data from its Directory of Radiotherapy Centres and from the International Agency for Research on Cancer, the WIPO Global Innovation Index 2023 revealed that cancer cases requiring radiotherapy were outpacing available technology.

Meeting the Challenges of the Present and the Demands of the Future

Theranostics — the combination of diagnostic imaging tools and therapeutic strategies — enhances diagnostic accuracy, treatment monitoring and therapeutic efficacy. By enabling medical professionals to tailor care to each patient's needs, it advances personalized medicine. To support countries in implementing emerging clinical applications in a safe and appropriate manner, the Agency organized a consultancy meeting on that topic and published four scientific peer-reviewed articles.

As the concentration and bioavailability of important nutrients are adversely impacted by changing climates and shifting food systems, nuclear techniques play an important role in generating much-needed data on how well certain food sources meet bodily needs. One such technique — the minimally invasive dual isotope tracer method, which was developed under a CRP that closed in 2023 — remains pivotal for understanding the absorption of essential amino acids

from various food sources. Data from this method continues to inform an ongoing initiative to establish a joint FAO/IAEA protein database. Supporting the new Atoms4Food initiative, the database will help to formulate evidence-based dietary guidelines and food-based interventions to ensure adequate and quality protein intake from balanced diets.

Over the next decade, clinically qualified medical physicists will play an essential role in facilitating the safe, effective and appropriate application of AI-based tools as their deployment within the medical uses of radiation grows. Against this backdrop, the Agency published *Artificial Intelligence in Medical Physics: Roles, Responsibilities, Education and Training of Clinically Qualified Medical Physicists* and trained 59 clinically qualified medical physicists during a joint workshop with the Abdus Salam International Centre for Theoretical Physics.



Workshop participants actively applying their new AI knowledge and skills in hands-on, group-based laboratory exercises.





WATER RESOURCES

OBJECTIVE

To support Member States applying isotope hydrology techniques for assessment and management of their freshwater resources, including hydroclimatic change impacts on water resources distribution and availability.



Isotope hydrology is one of the tools that we use in Antarctica. In particular, we use stable water isotopes to understand the sources of moisture and its pathways and understand processes causing extreme events in Antarctica and their importance in melting of the ice-sheets.

Irina Gorodetskaya

Senior Researcher at the Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal



443

**active GNIP
monitoring sites
in 98 Member
States at the end
of 2023**



2

**active isotope
monitoring
networks**



3

**active
Collaborating
Centres in
water resources**



33

**Agency
publications
produced**

KEY OUTPUTS

Sustainable Networks for Improved Isotope Data Generation

The Agency launched the Global Water Analysis Laboratory (GloWAL) Network at the UN 2023 Water Conference. This network will enable countries to generate and utilize isotopic water data to achieve SDG 6 on clean water and sanitation and the objectives of the UN Water Action Agenda. The network has four focus areas: the Grand Challenges related to water research; data management; capacity development; and innovation. These areas are crucial for managing freshwater resources amid climate change, population

growth and declining water quality worldwide. Australia, Switzerland and the United States of America have provided initial support to the Network and nine countries from three regions (Africa, Asia and the Pacific and Latin America and the Caribbean) have expressed interest in becoming nodes within the network. GloWAL data management will link to the Global Network of Isotopes in Precipitation (GNIP) and the Global Network of Isotopes in Rivers (GNIR) to enhance spatial and temporal data coverage in Member States.

Advancing Isotope Hydrology for Effective Water Resources Management

The 16th International Symposium on Isotope Hydrology, held in July 2023, identified the need for an Agency atom trap trace analysis facility, used to detect and measure low concentrations of certain atoms in samples, and additional mass spectrometry to expand the range of important isotope tracers for improving water management, as well as specific guidelines and specialized training activities to support the integration of these isotope tracers in water management practices. To meet these needs, the IAEA Isotope Hydrology

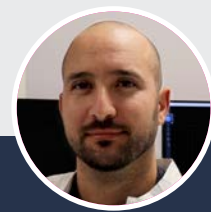
Laboratory is being expanded to accommodate the new equipment and improve training facilities. The Agency continues to promote the use of isotope hydrology for effective water management at international forums, including UN-Water activities and COP meetings. For the first time, the Agency conducted two training courses on modelling of isotope hydrology data in 2023, with all regions represented. The Agency also increased its focus on AI integration in hydrological modelling for better decision making.



MARINE ENVIRONMENT

OBJECTIVE

To support Member States to address and mitigate their most pressing marine challenges using nuclear and derived techniques while enhancing their expertise and capability to develop tailored science-based strategies for the sustainable management of marine ecosystems.



There is no human health without ocean health. Working with the IAEA to address marine contaminants and plastic pollution has been crucial in our work to advance knowledge and develop national action plans related to seafood safety.

Alejandro Garcia-Moya

Director of the Cienfuegos
Environmental Studies Centre, Cuba



26%

increase in ocean acidity since the industrial revolution



3 billion

people count seafood as their vital protein source



CRP

Evaluating the Impact of Ocean Acidification on Seafood — a Global Approach



11

countries performed experiments on 13 seafood species



3

scientific publications featured in peer-reviewed journals

KEY OUTPUTS

Our oceans and coastal seas provide unique benefits and resources to humans. Seafood, for example, is a vital protein source for over 3 billion people, contributing more than 17% of the world's animal protein supply, as well as micronutrients

and essential acids not easily found in land-based food. In 2023, the IAEA Marine Environment Laboratories continued supporting Member States in ensuring access to seafood that was safe to consume.

Seafood Safety and Associated Outputs: Marine Contaminants and Plastic Pollution

The consumption of contaminated seafood poses a direct threat to human health — a threat that is compounded by the escalating issue of plastic pollution and its effects. In 2023, within the framework of NUTEC Plastics, the Agency conducted experimental work on the fate of microplastic and nanoplastic pollution in seafood and tested the usefulness of a newly developed tool. Isotopically enriched plastics were synthesized and tested in experimental conditions to trace the transfer of microplastics along the seafood chain, with promising preliminary results. In addition, significant progress was made on the development of analytical methodologies for measuring microplastic-related contaminants in the marine environment, enabling a comprehensive survey of plastic additives and flame retardants. Additional research was conducted on the role of the biological film that naturally grows on microplastics (biofilm) in relation to the contaminant absorption capacities of microplastics and the leaching of microplastic additives, for a study assessing the fate of plasticizers on marine phytoplankton, the base of several aquatic food webs.

Regarding seafood safety, competent laboratories must monitor a comprehensive suite of contaminants. To build and maintain this competence, reliable data and reference materials

are necessary. In 2023, the Agency introduced a new certified reference fish material (IAEA-435A) with the aim of enhancing data quality assurance for the analysis of persistent organic pollutants (POPs) listed under the Stockholm Convention on Persistent Organic Pollutants, a critical aspect of identifying and addressing changing contamination patterns and trends resulting from human pollution and climate change. In addition, the Agency developed two protocols focusing on advancing the detection of marine biotoxins produced by harmful microalgae in seafood. At Monaco Ocean Week in 2023, the Agency presented the impacts of emerging chemicals on marine ecosystems and marine organisms to enhance knowledge sharing. In addition, it hosted two training courses underpinning the UNEP Mediterranean Action Plan's Programme for the Assessment and Control of Marine Pollution in the Mediterranean Region (MED POL) and trained scientists to assess and monitor the impacts of POPs. Further knowledge sharing with scientists in academia, industry, consultancies and governmental institutions took place at the International Conference on Chemistry in the Environment (ICCE 2023) through spotlight presentations that delved into leaching and sorption of microplastic-associated additives as transport vectors for organic pollutants.

Seafood Security Outputs: Advances in Research to Ensure Access to Seafood

Global access to seafood is threatened by human-driven climate pressures such as ocean warming, acidification and pollution. The Agency is actively monitoring these pressures and assessing their impact on seafood production and resources. Agency actions in this area primarily involve experimental research and capacity-building efforts, facilitated by partnerships with other stakeholders and UN agencies.

Addressing a variety of these impacts is the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), an independent group sponsored by ten UN agencies that acts in an advisory capacity on climate-related issues. To address specific marine issues, the Agency initiated GESAMP Working Group 45 on climate change- and greenhouse gas-related impacts on contaminants in the ocean to assess existing research, identify knowledge gaps and make recommendations to guide future research. Co-sponsored by the Agency, UNESCO's Intergovernmental Oceanographic Commission, the IMO, UNEP and the WMO, Working Group 45 held its final meeting in 2023 and continued drafting its report on the impacts of climate change on the fate, toxicity, speciation and bioaccumulation of contaminants in the ocean.

In 2023, the Ocean Acidification International Coordination Centre (OA-ICC), which aims to address impacts of ocean acidification on vulnerable coastal communities and their aquaculture industries, continued to host training events in order to build capacity, maintain an international presence to promote ocean acidification awareness and support

collaborative projects to advance research. OA-ICC resources, including the OA-ICC news stream, bibliographic database and biological response data portal, remain available to all Member States through the OA-ICC webpage, which is updated on the basis of daily searches of scientific literature. OA-ICC training events focused on using OA-ICC bibliographic resources to produce meta-analyses of ocean acidification impacts; understanding research methods for evaluating blue carbon and ocean change; and improving communication about ocean acidification to various audiences, including students and policymakers. In addition to capacity-building efforts, the OA-ICC hosted international experts from the Scientific Committee on Oceanic Research's 'Changing Ocean Biological Systems' working group; sponsored the first in-person meeting for the steering committee of the Global Ocean Acidification Observing Network (GOA-ON) Mediterranean regional hub; presented at the 2023 Aquatic Sciences meeting of the Association for the Sciences of Limnology and Oceanography; and participated in the annual GOA-ON Executive Council meeting.

Additionally, the OA-ICC completed a five-year coordinated research project to evaluate the impact of ocean acidification on various local seafood species with economic or cultural importance. Participating scientists from several Member States are now equipped with local and global perspectives on the impact of ocean acidification as tool to promote global mitigation measures, local investment and adaptation strategies, and best practices for ocean acidification research, including marine experimental biology.



As part of the activities of the IAEA Marine Environment Laboratories, Agency scientists partner with UNEP on the Mediterranean Action Plan's Programme for the Assessment and Control of Pollution in the Mediterranean Region. In this photo, Agency laboratory technicians train participating Member State scientists on sample preparation for trace element analysis using inductively coupled plasma mass spectrometry (ICP-MS).



Marine Radioactivity Monitoring

Data-based science is a matter of keen interest to the UN system and its global, regional and national partners and stakeholders. Environmental radioactivity monitoring laboratories across the world are responding to increasingly strict requirements from national authorities, including nuclear regulatory bodies as required by Agency safety standards, and public expectations to deliver timely and reliable data. The Agency actively supports marine environmental monitoring in Member State laboratories through long term, targeted and complementary activities to help improve and maintain data quality. These activities include interlaboratory comparisons (ILCs) and proficiency tests (PTs), which are standard methods for laboratories to assess the quality of their measurement results and to identify any necessary improvements.

In addition, since 2014, the IAEA Marine Environment Laboratories, through regular ILCs and PTs, have been assisting the Government of Japan to improve the reliability and transparency of the post-Fukushima-accident marine environmental radioactivity monitoring carried out under its Comprehensive Radiation Monitoring Plan. Eleven ILCs and eight PTs have been conducted so far and the initiative is ongoing. These exercises have helped to ensure that the data produced by Japan's marine monitoring are of high quality and demonstrate a continued high level of accuracy and competence on the part of the Japanese laboratories involved. Similar assistance in marine monitoring is available to all Agency Member States.

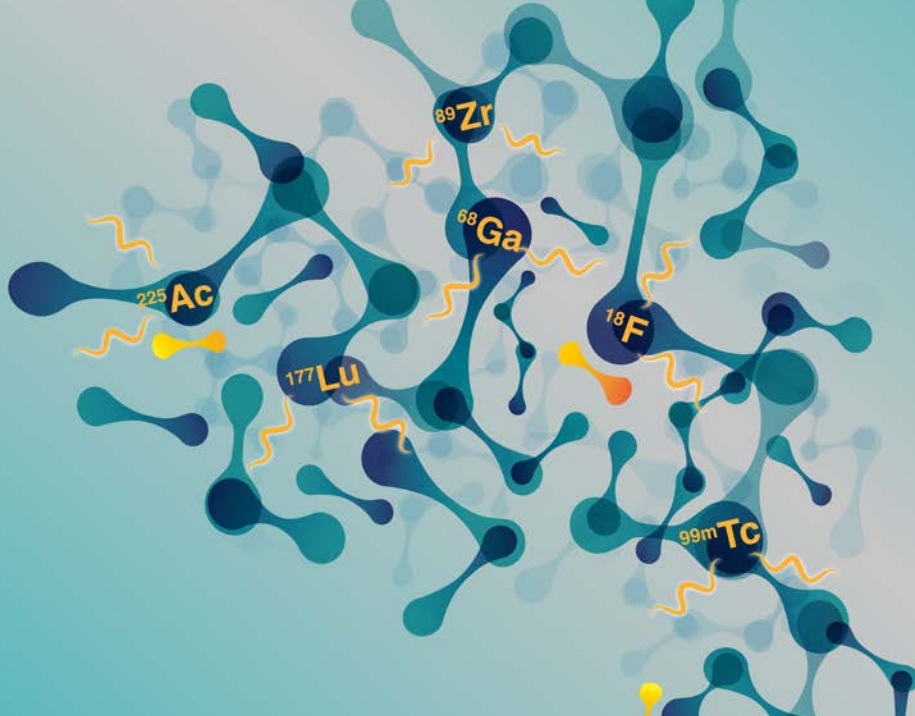
In 2023, for the most recent ILC, Agency staff and independent experts from the Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA) network participated in a mission in Japan to observe the sampling of seawater, marine sediment and fish from the sea around Fukushima Daiichi NPP. The samples were sent to Japanese, IAEA and ALMERA laboratories for analysis.

Reference materials produced by the IAEA Marine Environment Laboratories' Radiometrics Laboratory, in the context of a quality management system accredited to the ISO 17034 standard, are used ubiquitously in Member States for maintaining quality assurance and for verifying their analytical methods. The Agency's reference materials are accessible to scientists worldwide who are engaged in monitoring and research on pollution and on environmental and climate change. In 2023, the focus was on the characterization of new reference materials relevant to marine radioactivity monitoring in routine and emergency situations: seawater, which is the primary medium for the dispersion and transfer of radionuclides that have reached the marine environment, regardless of their origin; and shrimp powder, which is relevant to seafood safety.

Reference materials, ILCs and PTs — which are relevant to international and regional networks of laboratories (such as ALMERA and technical cooperation project networks) and regional marine conventions (such as the Convention on the Protection of the Marine Environment of the Baltic Sea Area and the Convention for the Protection of the Marine Environment of the North-East Atlantic) — aid in monitoring data reliability and comparability. This is critical for the IAEA-curated Marine Radioactivity Information System (MARIS), which offers online access to over 800 000 items of marine radioactivity data. MARIS facilitates various applications related to marine monitoring, including investigating radioactivity levels in different time periods and geographic areas, quantifying climate change impacts, validating marine models, assessing radiation doses and providing public information. Recent upgrades to MARIS include comprehensive mapping of radionuclide levels; mapping of sampling locations; dynamic mapping allowing users to zoom in to individual data points or to produce averages across datasets; and enhanced accessibility for mobile devices.



Plankton nets being used to take samples for analysis.



RADIOCHEMISTRY AND RADIATION TECHNOLOGY

OBJECTIVE

To support Member States in strengthening their capability to produce radioisotopes and radiopharmaceuticals.

To support Member States in applications of radiotracers and radiation technology for industrial and other uses, and in application of nuclear analytical techniques to address environmental challenges.



This event is unique since, for the first time, all professional societies from the EU, North America as well as worldwide Member States are gathering under the same roof to discuss and exchange the same interesting topic: radiopharmaceuticals.

Suzanne E. Lapi

Vice Chair of Translational Research in the Department of Radiology, University of Alabama at Birmingham, commenting on the International Symposium on Trends in Radiopharmaceuticals (ISTR-2023)



345

laboratories from 83 countries participated in a global proficiency test



107

laboratories from 58 countries participated in the ALMERA network proficiency test



1

major conference ISTR-2023



15

active Collaborating Centres

KEY OUTPUTS

Radioisotopes and Radiopharmaceuticals

In 2023, the Agency held the International Symposium on Trends in Radiopharmaceuticals (ISTR-2023), which provided scientists and other professionals working in the production of radioisotopes and radiopharmaceuticals with the largest international forum to discuss the most recent developments and challenges in the field.

In addition, numerous papers, reports, standards and relevant guidance documents were produced during the year, including in relation to accelerating the availability of improved radiopharmaceuticals. Among them were: *Guidance for Preclinical Studies with Radiopharmaceuticals, providing a route for the approval of new radiopharmaceuticals*;

Copper-64 Radiopharmaceuticals: Production, Quality Control and Clinical Applications; and guidance documents for good manufacturing practice production and regulatory oversight for radiopharmaceuticals, produced together with WHO.

In addition, two new coordinated research projects (CRPs) were launched for diagnostic and therapeutic radiopharmaceuticals ('Development of Potential Lutetium-177 Radiopharmaceuticals: Design, Radiolabelling and Nonclinical Evaluation' and 'Development of new generation of Tc-99m kits') to transfer knowledge on production and preclinical studies based on the latest targeting agents.

Applications of Radiotracers and Radiation Technology

The Agency actively supported the publication of a new ISO standard, 'Measurement of fluid flow rate in closed conduits — Radioactive tracer methods' (ISO 24460:2023), to facilitate radiotracer applications in industrial processes.

Under NUTEC Plastics, a new CRP was launched to generate sustainable alternatives to petrol-based plastics. Using radiation-mediated conversion, biomass feedstocks from

renewable waste sources can potentially be transformed into new biobased and biodegradable plastic solutions.

In addition, the Agency's Terrestrial Environmental Radiochemistry Laboratory implemented recurring global and ALMERA network proficiency tests for radioactive environmental monitoring, with a record 452 participating laboratories in 2023.

26 publications in 2023



3 Environment

13 Human Health

3 Radioisotope Production
and Radiation Technology

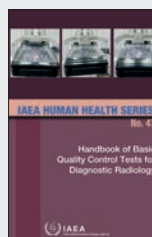
7 Nuclear Science



www.iaea.org/publications

250 664 online views
of NA publications in 2023

MOST POPULAR PUBLICATION



Handbook of Basic Quality Control
Tests for Diagnostic Radiology

14 792 online views

Nuclear Techniques for Development and Environmental Protection



Joint ICTP-IAEA Workshop on Artificial Intelligence in Ionizing Radiation for Medical Physicists

November 2023, Trieste

Participants: **59** in person, from **50** Member States

This event equipped early and mid-career clinically qualified medical physicists with the knowledge and skills to facilitate the safe, effective, and appropriate application of artificial intelligence-based tools in the medical uses of radiation.



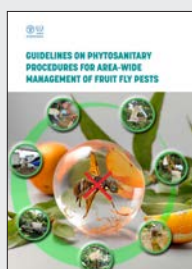
Ministerial Roundtable on Climate Change and Food Security: The Role of Nuclear Science and Technology

December 2023, Dubai

Participants: **40** in person, plus online participants

This Agency-FAO joint side event at COP28 showcased the invaluable contribution of nuclear techniques to increasing the resilience of global agri-food systems against climate change and raised awareness about Atoms4Food, launched in 2023.

This guideline describes the most widely used phytosanitary procedures for the management of fruit flies that infest fruits and vegetables and are of quarantine and economic importance.



The most downloaded Agency publication of 2023, this handbook helps radiology departments around the world to ensure safety and quality when using X-rays.



Recognizing the importance of adaptation to the climate change impact on water resources, the Agency has developed guidelines and recommendations on the selection and application of isotope-enabled hydrological models.



This publication summarizes the results of an interlaboratory comparison on the determination of trace elements and methylmercury in a fish sample, organized in 2021 to support Member States in the area of seafood safety monitoring.



IAEA PUBLICATIONS AND CONFERENCES IN 2023



Workshop on Ocean Change and Blue Carbon

August–September 2023, Monaco
Participants: **18** in person, from **14** Member States

This two-week workshop, combining practical and theoretical sessions, was organized by the Agency to empower Member States to conduct pertinent research on blue carbon and develop optimal evidence-based solutions.



International Symposium on Isotope Hydrology: Sustainable Water Resources in a Changing World

July 2023, Vienna
Participants: **358** in person, from **71** Member States

This event brought together scientists, managers, policymakers and stakeholders in the field of water resources management to discuss the latest scientific advances in isotope hydrology tools and techniques and how these developments can support global water security at a variety of scales.

NUCLEAR SAFETY AND SECURITY



Building and maintaining a robust global framework for nuclear safety and security is a long term, demanding imperative, which requires patience and perseverance. Nuclear safety and security are sovereign responsibilities, but nuclear safety and security at the global level can be robust only if national safety and security frameworks are strong and consistently apply international safety standards and nuclear security guidance. There are no borders for nuclear safety and security implications.

Lydie Evrard

Deputy Director General
and Head of the Department
of Nuclear Safety and Security

Nuclear Safety and Security

172
safety-related
training activities

125
security-related
training activities

Member States
assisted with physical
protection upgrades

9

safety- and security-
related peer review and
advisory services

63

55
safety-
related

8
security-
related

incidents reported
to the Incident
and Trafficking
Database

168

93

Parties to the Convention on Nuclear Safety

2 new Parties

89

Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

1 new Party

133

Parties to the Convention on Early Notification of a Nuclear Accident

1 new Party

128

Parties to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency

1 new Party

164

Parties to the Convention on the Physical Protection of Nuclear Material

No new Parties

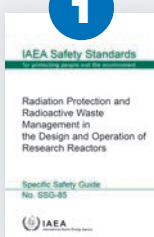
135

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

4 new Parties

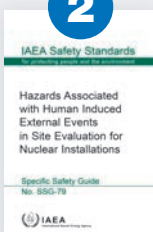
Most viewed IAEA Safety Standards published in 2023

1



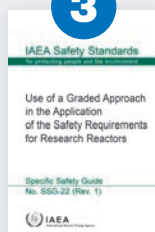
2712 views

2



2410 views

3



2391 views

In 2023, a total of 17 IAEA Safety Standards were published.



65 years of IAEA Safety Standards



INCIDENT AND EMERGENCY PREPAREDNESS AND RESPONSE

OBJECTIVES

To maintain and further enhance efficient Agency, national and international EPR capabilities and arrangements for effective response to nuclear or radiological incidents and emergencies independent of the triggering event(s).

To improve exchange of information on nuclear or radiological incidents and emergencies among Member States, international stakeholders, and the public and media in the preparedness stage of, and during response to, nuclear or radiological incidents and emergencies, independent of the triggering event(s).



The IAEA conducted an EPREV mission of the nuclear emergency arrangements in Canada in 2019 and a follow-up mission in 2023. Canada responded to all recommendations from international counterparts, demonstrating Canada's commitment to continuous improvement of our emergency preparedness programme and protecting the health and safety of Canadians.

Keith T. Henderson

Director of the Radiation Protection Bureau,
Health Canada



6

Convention Exercises conducted

2 ConvEx-1
4 ConvEx-2
(involving 120 Member States)



30

EPR training events implemented globally



41

registered RANET countries



50

States providing radiation monitoring data through IRMIS on a routine basis



107

incidents reported by Member States

KEY OUTPUTS

Testing Readiness for Emergency Response

Member States continue to seek Agency support in improving the preparation, conduct and evaluation of national emergency exercises. The Agency participated in two regional large-scale exercises in 2023, in Norway and Romania. During these exercises, the Agency's field response team was deployed together with other assistance teams from Member States and integrated in the national response capabilities.

In 2023, the Agency conducted four internal full response mode exercises (FREX) to demonstrate the ability of the Incident and Emergency System (IES) to respond to a simulated nuclear or radiological incident or emergency and to train Secretariat staff within the IES. Each eight-hour FREX was attended by 35–40 staff members. A FREX conducted in October 2023 was done in conjunction with the above-mentioned regional large-scale exercise in Romania and was used to test the operational arrangements for implementing the Agency's response roles.

National and International Emergency Preparedness

Efficient information exchange and emergency communication are essential to mitigate risks and ensure effective crisis response mechanisms. In the first six months of 2023, the Agency's Incident and Emergency Centre (IEC) was instrumental in maintaining systematic contact with Agency field teams in Ukraine and with the State Nuclear Regulatory Inspectorate of Ukraine. The IEC kept records of the data provided by the field teams and contributed to the assessment of the potential consequences of nuclear safety-related developments at NPPs in Ukraine.

The IEC also conducted 30 emergency preparedness and response (EPR) training activities in 2023, held in all regions and covering topics such as national EPR arrangements, self-assessments, implementation of exercises, protection strategy, first responders, response to events triggered by a security event, and lessons learned.



SAFETY OF NUCLEAR INSTALLATIONS

OBJECTIVES

To support Member States in improving the safety of nuclear installations during site evaluation, design, construction and operation through the availability and application of up-to-date safety standards.

To support Member States in establishing and enhancing their national safety infrastructure through the conduct of safety review services and facilitation of adherence to, and implementation of, the Convention on Nuclear Safety and the Code of Conduct on the Safety of Research Reactors.

To support Member States in capacity building through human resource development, education and training, and knowledge management and knowledge networks by means of international cooperation, including exchange of information and operating experience, and coordination of research and development activities.



The OSART mission enabled an in-depth assessment of the site and an enriching sharing of the best global practices thanks to the team's combined expertise. The recommendations and suggestions will help us ensure a continuous improvement of the plant's operational safety.

Peter Farkaš

Director of Bohunice NPP, Slovakia



98.8%

of issues raised during OSART and SALTO missions addressed



1200

beneficiaries from safety-related training events



102

operating experiences shared via FINAS IRS IRSRR

KEY OUTPUTS

Assisting Countries in Developing Further their National Safety Infrastructures and Regulatory Frameworks

In 2023, the Agency continued to promote and support the establishment of comprehensive safety infrastructures and regulatory frameworks to ensure the safety of nuclear installations throughout their lifetimes.

The Joint Eighth and Ninth Review Meeting of the Contracting Parties to the Convention on Nuclear Safety (CNS) was held in March 2023, with 934 participants from 81 Member States – the highest level of participation by Contracting Parties to date, reflecting the sustained international commitment to nuclear safety.

The Agency conducted two advisory missions on periodic safety review of research reactors, in Brazil and Jordan. It also held technical meetings and workshops on topics related to the safety of research reactors, including the Code of Conduct on the Safety of Research Reactors; digital instrumentation and control systems; operating experience feedback; safety performance indicators; ageing management; management systems; and research reactor experiments. Furthermore, there were two training workshops on assessment of national nuclear infrastructure to support new research reactor projects, held in Lusaka and Vienna. These activities contributed to further enhancing the regulatory oversight and operational safety of research reactors.

The Agency also conducted technical meetings on the consideration of human factors and on chemical and fire safety at nuclear fuel cycle facilities, as well as workshops on operating experience feedback and on safety considerations in the use of advanced technologies, including artificial intelligence, at nuclear fuel cycle facilities.

Three training courses were held for reviewers in Integrated Regulatory Review Service (IRRS) missions, in Paris, Vienna and Washington DC. The Agency also held three international workshops to exchange information, experience and lessons learned from IRRS missions and to discuss recent developments and further improvements in the planning and implementation of such missions.

In addition, the Agency continued supporting Member States in ensuring the safe and secure use of advanced nuclear technologies, including small modular reactors (SMRs). In particular, the regulatory track of the Nuclear Harmonization and Standardization Initiative (NHSI) continued its work to develop a series of tools and technical publications aimed at helping regulators work together in the context of regulatory reviews of new reactors.

Promoting Safety Assessment of Nuclear Installations Including Advanced and Innovative Reactors

With the aim of ensuring that safety is adequately considered in all future developments in Member States, the Agency held technical meetings in 2023 addressing safety matters related to existing NPPs and first-of-a-kind technologies. These meetings covered topics such as safety demonstration

of innovative technology in power reactor designs; safety approach for liquid metal cooled fast reactors; modernization of instrumentation and control; fusion design safety and regulation; and safety implications of the use of artificial intelligence in NPPs.

Analysing Climate Change Challenges to the Safety of Nuclear Installations

In 2023, the Agency approved a new three-year coordinated research project entitled 'Climate Change Challenges to the Safety of Nuclear Installations', focusing on hazard calculation and operational provisions and investigating the resilience of new and existing nuclear infrastructures to climate-related extreme scenarios. The study will analyse the impact of climate change on weather-related hazards by comparing national practices and evaluating available simulation tools.

The Agency also held a technical meeting on probabilistic safety assessment (PSA) of nuclear installations in relation to external events and their combinations, in order to present recent work on PSA safety standards and technical documents, with an emphasis on the modelling of scenarios for severe external events other than seismic.

Improving Nuclear Power Plant Safety Worldwide

In 2023, the Agency completed 40 years of Operational Safety Review Team (OSART) missions, having delivered 222 missions and 162 follow-up missions. OSART mission reports continue to identify recommendations and suggestions regarding setting, communicating and meeting NPP management expectations, strengthening the conduct of safe operations, optimizing maintenance activities, and

strengthening accident management and on-site emergency preparedness and response.

The Agency also held international workshops on hazards in deterministic safety analysis and common cause failures in instrumentation and control systems, and interregional workshops on SMR safety.



The Director General at the opening of the Joint Eighth and Ninth Review Meeting of the Contracting Parties to the CNS, Vienna, March 2023.



Supporting International Exchange of Operating Experience for Nuclear Installations

Learning from operational experience in nuclear installations is key for advancing safety, and benefits the entire nuclear safety community. In 2023, the Agency upgraded the IT platform supporting its operating experience reporting systems — including the International Reporting System for Operating Experience (IRS) for NPPs, the Incident Reporting

System for Research Reactors (IRSRR) and the Fuel Incident Notification and Analysis System (FINAS) for nuclear fuel cycle facilities — to enhance the effectiveness of these systems through an improved user interface and to provide for better information analysis.

Civil Liability for Nuclear Damage

Establishing coherent nuclear liability mechanisms, at the national and global levels, is crucial for ensuring prompt, adequate, equitable and non-discriminatory compensation for nuclear incidents. In June 2023, the Agency acted as the Secretariat of the Third Meeting of the Contracting Parties and Signatories to the Convention on Supplementary Compensation for Nuclear Damage, held in Tokyo. The International Expert Group on Nuclear Liability (INLEX) held its 23rd regular meeting in July 2023, followed by a workshop

for diplomats on civil liability for nuclear damage. A regional IAEA-INLEX workshop for Latin America was organized in October 2023, in Rio de Janeiro, Brazil. During the 67th regular session of the General Conference, a side event was held to celebrate the 20th anniversary of the establishment of INLEX. In addition to providing legislative assistance to Member States on nuclear liability, the Secretariat also conducted outreach missions jointly with INLEX.



INSARR mission to the LVR-15 research reactor, Czech Republic, February 2023. (Photograph courtesy of the LVR-15 research reactor)



Technical Safety Review mission to Kozloduy NPP, Bulgaria, March 2023. (Photograph courtesy of Kozloduy NPP)





RADIATION AND TRANSPORT SAFETY

OBJECTIVES

To support Member States in improving radiation safety of people and the environment through the development of safety standards and by providing for their application.

To support Member States in establishing the appropriate safety infrastructure through support and implementation of the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary guidance, as well as through safety reviews and advisory services.

To support Member States in capacity building through education and training, and in encouraging the exchange of information and experience.



The ORPAS mission will accelerate our national efforts to develop a strong and sustainable occupational radiation protection system for a healthy workforce.

Pontsho Pusoetsile

Permanent Secretary of the Botswana Ministry of Communications, Knowledge and Technology



4

additional countries expressed commitment to the Code of Conduct on the Safety and Security of Radioactive Sources



5

additional countries expressed commitment to the Guidance on the Import and Export of Radioactive Sources



12

additional countries expressed commitment to the Guidance on the Management of Disused Radioactive Sources

KEY OUTPUTS

Concept of Exemption, International Trade and Cooperation with International Organizations and Other Specialized Agencies

In 2023, the Agency published a new General Safety Guide providing revised recommendations on applying the concept of exemption for practices or sources within practices from regulatory control, and continued developing a Safety Report on radiation safety in the trade of non-food commodities.

In addition, the Agency hosted a technical meeting to share and discuss national experience in managing radiation safety in the international and national trade of non-food

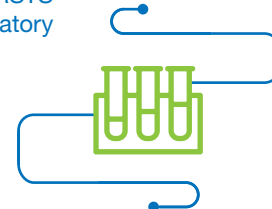
commodities, in order to provide more detailed technical information related to the preparation of a related draft Safety Report.

The Agency also continued working with the International Commission on Radiological Protection and other international organizations and specialized agencies to review the fitness for purpose of the current system of radiological protection.

Radiation Safety Technical Services Laboratory

In 2023, the Agency's Radiation Safety Technical Services (RSTS) Laboratory, which operates both at the Vienna International Centre and at the IAEA Seibersdorf laboratories, continued to provide radiation monitoring services to individuals, including Agency workers, experts, trainees and visitors who could be exposed to radiation during Agency activities. For the 17th year in a row, the Laboratory also undertook an internal audit within the ISO quality management system, and continued working on refurbishment and acquiring additional laboratory space in Seibersdorf.

2600
individuals
monitored
through
the RSTS
Laboratory



50 100
measurements
for individual
monitoring



28 600
measurements
for workplace
monitoring

Supporting the Application of Agency Safety Standards

In parallel with the implementation of a number of peer reviews and advisory services, the Agency developed e-learning courses and organized in-person workshops to further strengthen its Occupational Radiation Protection Appraisal Service (ORPAS) and its Integrated Regulatory Review Service (IRRS). Workshops on lessons learned, gathering team leaders, reviewers and host counterparts, were organized in 2023 both for ORPAS reviewers and for IRRS reviewers. In addition, the ORPAS Database was developed and made available.

The Agency's work in the area of occupational radiation protection focused mainly on the exchange of operational experience between Member States in the control, monitoring and recording of occupational exposure, providing valuable and actionable lessons about radiation safety at work. In 2023, the Agency published a *Safety Report entitled Neutron Monitoring for Radiation Protection*.

Meanwhile, the Information Exchange on Occupational Exposure in Medicine, Industry and Research added a new module to cover industrial operations involving naturally occurring radioactive material (NORM) and the first ever intercomparison exercise for NORM analysis — which is essential for prior radiological characterization of workplaces involving NORM — was performed in the European region, to be implemented in all regions in the future. Furthermore,

the Agency organized an African regional intercomparison exercise on individual monitoring for external exposure.

In addition, the Agency held Postgraduate Educational Courses (PGEC) in Radiation Protection and the Safety of Radiation Sources for young professionals in Argentina, Ghana, Greece, Indonesia, Jordan, Kenya and Morocco in a number of languages.

To support Member States in further building their national competence, the Agency trained trainers of radiation protection officers (RPOs) from medical and industrial facilities in more than 50 countries. Medical radiographers from the Caribbean region were trained in the role of RPO at diagnostic and interventional radiology facilities. Furthermore, regulators and training providers from Latin America drafted or updated their national strategies for education and training in radiation, transport and waste safety according to the Agency's methodology after participating in a related regional workshop.

The transport safety e-learning platform that is available to all Member States was enhanced through the inclusion of new modules that ensure alignment with the latest edition of the *Regulations for the Safe Transport of Radioactive Material*, and new multilingual modules.

PGEC participants in Jordan investigate the properties of alpha, beta and gamma radiation. (Photograph courtesy of the Jordan Atomic Energy Commission)



Denials and Delays of Shipment of Radioactive Material

In 2023, the Agency held two meetings of the Denial of Shipment Working Group, where participants discussed and analysed cases of denial of and delays in the shipment of radioactive material, identified possible solutions based on root cause analysis and developed a strategy for promoting public awareness and communication with the transport industry. The Working Group recommended that Member States should be called on to facilitate the safe and secure transport of radioactive material and to identify, if they had not already done so, a national focal point on denials of shipment of radioactive material. It was also recommended

that the Secretariat hold an open-ended meeting of legal and technical experts on a non-binding instrument on the facilitation of safe and secure transport of radioactive material.

In addition, the Agency enhanced its cooperation with the International Civil Aviation Organization (ICAO) to facilitate the safe transport of medical radioisotopes in accordance with the Agency's safety standards and ICAO standards for global civil aviation safety and security. A joint statement was signed by the IAEA Director General and the ICAO Secretary General in November 2023.

20th Anniversary of the Code of Conduct on the Safety and Security of Radioactive Sources

In 2023, the Agency held the 6th Open-Ended Meeting of Technical and Legal Experts for Sharing Information on States' Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources, providing an opportunity to celebrate the 20th anniversary of the approval of the Code of Conduct by the Board of Governors. The Code is a legally non-binding instrument to assist States in establishing and maintaining a high level of safety and security of radioactive sources throughout their life cycle. The meeting recommended that the Agency continue to encourage political support to the Code and its supplementary Guidance and assist States in their implementation. By the end of 2023, 149 States had expressed political commitment

to the Code, 134 to the Guidance on the Import and Export of Radioactive Sources and 64 to the Guidance on the Management of Disused Radioactive Sources. The meeting further recommended that the Agency continue to implement the recommendations from the International Meeting of the Points of Contact for the Purpose of Facilitating the Export and Import of Radioactive Sources in Accordance with the Guidance on the Import and Export of Radioactive Sources, which took place for the first time in January 2023. Based on these recommendations, the Agency is working to enhance tools and assistance related to the effective and sustainable implementation of the Code and Guidance.



The Director General at the opening of the 6th Open-Ended Meeting of Technical and Legal Experts for Sharing Information on States' Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources, Vienna, May–June 2023.





RADIOACTIVE WASTE MANAGEMENT AND ENVIRONMENTAL SAFETY

OBJECTIVES

To support Member States in improving the safety of radioactive waste and spent fuel management, including geological repositories for high level waste, decommissioning, remediation and environmental releases, through the development of safety standards and providing for their application.

To support Member States in improving the safety of radioactive waste and spent fuel management, including geological repositories for high level waste, decommissioning, remediation and environmental releases through peer reviews and advisory services; and to assist in their adherence to, and facilitate the implementation of, the Joint Convention.

To support Member States in capacity building through education and training and by encouraging the exchange of information and experience.



It is timely to carefully consider the implications of Agenda 2030 and the Sustainable Development Goals for the international framework for safety. By learning from decommissioning, waste management, remediation and environmental protection, we may position ourselves better in carrying out future activities in a way that is safe and sustainable.

Carl-Magnus Larsson

Chair of the International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation: Ensuring Safety and Enabling Sustainability



100

early career professionals signed up to learn more about radiological environmental impact assessments



25

Member States actively participated in the International Project on Decommissioning of Small Facilities



23

countries contributed to the DIRATA database



50

experts from Central Asia participated in events hosted by the Coordination Group for Uranium Legacy Sites

KEY OUTPUTS

Methods for Radiological and Environmental Impact Assessment

The Methods for Radiological and Environmental Impact Assessment (MEREIA) programme provides a forum for professionals to jointly develop a more harmonized framework for assessing the impact of radionuclides in, or released to, the environment. The programme has six working groups, each addressing one of the following situations identified by Member States for the purpose of radiological and environmental impact assessments: discharges to a fjord; historical marine dumping; former uranium mining and milling; discharges from an operational surface waste disposal facility; behaviour of radionuclides

in forest and freshwater catchments after an accident; and a breached caesium source in an urban area. This enables the discussion of challenges faced by Member States.

In 2023, MEREIA facilitated knowledge transfer and capacity building with a focus on the development of young professionals, including through a programme of webinars covering basic concepts and specialized topics; educational sessions on cross-cutting technical topics; and hands-on activities on the use of models and assessment tools.

Application of the Concept of Clearance

In 2023, the Agency published a new General Safety Guide providing recommendations on applying the concept of clearance for materials, objects and buildings to be released from regulatory control. Clearance aligns well with the 2030 Agenda for Sustainable Development in that it enables the recycling and reuse of materials and minimizes the volume of waste requiring disposal. It is considered a valuable option by an increasing number of States, especially given the large quantities of materials expected from future decommissioning projects.

The Agency provides guidance to Member States on generic clearance, whereby cleared material can be used for any purpose, and specific clearance, whereby material can be used only for pre-specified purposes. Both of these featured in capacity building events in 2023. Work in 2023 also focused on methods and models for deriving specific clearance levels to support decisions on whether material containing levels of radioactivity slightly above the general clearance levels can be safely recycled or disposed of in conventional landfill.



NUCLEAR SECURITY

OBJECTIVES

To promote adherence to relevant legally and non-legally binding international instruments to enhance nuclear security globally.

To assist States in establishing, maintaining and sustaining national nuclear security regimes for nuclear and other radioactive materials, including during transport, and associated facilities used for peaceful purposes.

To play the central role of facilitating and enhancing international cooperation and increasing visibility and awareness through communication on nuclear security.



The IPPAS team advice will facilitate Zambia's efforts towards enhancing the safe and secure applications of nuclear science and technology in the country. In addition, it will help strengthen Zambia's nuclear security regime, which is key for building confidence among the regulatory body, the operators, the public and other national stakeholders.

Dr Boster D. Siwila

Executive Director of Zambia's Radiation Protection Authority



**12 Jul
2021**

**groundbreaking
ceremony** for the
Nuclear Security Training
and Demonstration
Centre (NSTDC)



**3 Oct
2023**

**opening of
the NSTDC**



2100

square metres
of specialized
technical
infrastructure and
equipment



23

training courses
available



1000

trainees
expected
per year

KEY OUTPUTS

Promoting Universalization of the Convention on the Physical Protection of Nuclear Material and its Amendment

In 2023, the Agency continued encouraging universal adherence to and effective implementation of the Convention on the Physical Protection of Nuclear Material (CPPNM) and its Amendment (A/CPPNM) and provided technical and legislative assistance upon request to this end. During the year,

an additional four States became Parties to the A/CPPNM, and the Agency further increased the number of national and regional workshops promoting its universalization, with a particular focus — at the request of Member States — on engaging decision makers as well as technical experts.

Regional workshop to promote the universalization of the A/CPPNM, Zimbabwe, March 2023.



Establishing a Unique International Nuclear Security Training Centre to Tackle Global Nuclear Terrorism

In October 2023, the Agency opened its Nuclear Security Training and Demonstration Centre (NSTDC) in Seibersdorf, Austria, to help strengthen countries' abilities to tackle nuclear terrorism (see photo on page 96). The Centre is equipped with specialized technical infrastructure and equipment and offers training courses and workshops in the areas of physical protection of nuclear and other radioactive material

and associated facilities, and of detection and response to criminal or intentional unauthorized acts. The Centre is housed in a Multipurpose Building and bolsters the Agency's ability to respond to countries' nuclear security capacity-building needs. More than €18 million in extrabudgetary funding from 15 donors, as well as in-kind contributions, were received to build and operate the Multipurpose Building.

Addressing Computer Security Threats to Ensure Nuclear Security and Safety

Mitigating risks posed by threats to computer security continues to be an important area of work in order to ensure nuclear security. During 2023, the Agency conducted 43 computer security-related events including, among other things, the development of new initiatives related to computer security regulations; scenario-based exercises; virtual training environments; and the integration of computer security training modules across courses at the NSTDC to support Member State capacity building.

In June 2023, the Agency held the International Conference on Computer Security in the Nuclear World: Security for Safety (CyberCon23). CyberCon23 affirmed the Agency's unique and continuing role in fostering cooperation between countries and enabling the sharing of technical information and best practices in the adoption of rapidly developing technologies. Attendance from a diverse participant group reflected the high priority that the international nuclear security community places on computer security.



Members of the IPPAS team visit the Cancer Diseases Hospital in Lusaka, September 2023. (Photograph courtesy of the Zambian Radiation Protection Authority)



Identifying Nuclear Security Needs

Agency missions, including the International Physical Protection Advisory Service (IPPAS), the International Nuclear Security Advisory Service (INSServ) and the Advisory Mission on Regulatory Infrastructure for Radiation Safety and Nuclear Security (RISS), provide States with invaluable information that is used to develop action plans within the Integrated Nuclear Security Sustainability Plan (INSSP) framework. INSSPs assist States, upon request, in applying a systematic and comprehensive approach to enhancing their nuclear security regimes. Ninety-two States currently have approved INSSPs.

In 2023, the Agency conducted five IPPAS, three INSServ and five RISS missions. Since 1996, a total of 102 IPPAS missions have been conducted, upon request, in 60 Member States. In September 2023, the milestone of 100 IPPAS missions was achieved through the completion of an IPPAS mission to Zambia. With coordination from designated points of contact, Member States continued using the IPPAS Good Practices Database as a tool for information sharing, collective learning, benchmarking and continuous improvement.

Enhancing Member State Capabilities to Implement Nuclear Security Measures During Major Public Events

In 2023, the Agency supported the planning or implementation of six major public events (MPEs) including large sporting events, a religious event and a major international conference. It also provided training for 168 personnel from a range of

national nuclear security agencies and loaned 409 items of radiation detection equipment for efforts related to MPEs. Launched in 2004, the Agency's MPE programme has supported a total of 73 MPEs in 45 Member States to date.

Managing the Safety–Security Interface

Where possible, the Agency seeks to address areas where safety and security considerations overlap or are related to one another. Under the Regulatory Infrastructure Development Project, the Agency conducted two Schools on Nuclear and Radiological Leadership for Safety and Nuclear Security, in English and in French, for Member States from the African region in May and August 2023. The purpose of these events was to train early- to mid-career professionals so as to promote strong leadership and culture in the areas of radiation safety and nuclear security in organizations

exercising regulatory control over facilities and activities that use radiation sources and other radioactive material.

The Agency also held two regional training courses on the authorization and inspection of radiation safety and nuclear security: one in Lusaka for medical practices, and one in Rabat for industrial practices. These courses trained regulatory staff of the respective regions to perform core regulatory functions of authorization, including review, assessment, inspection and enforcement, considering both radiation safety and nuclear security aspects.



▲ Agency mission and technical visit to Benin, September 2023, as part of nuclear security-related assistance for the Pétanque World Championships.



Internal Radiation Safety
and Nuclear Security
Regulator

Ensuring safety and security of the Agency's facilities and activities

Internal regulatory oversight for radiation safety and nuclear security



15
authorizations



2
regulatory
inspections



37
approvals



18
investigations
of events



47
review
and assessment
reports

Nuclear Safety and Security

CONFERENCES 2023



International Conference on Effective Nuclear and Radiation Regulatory Systems: Preparing for the Future in a Rapidly Changing Environment

February 2023, Abu Dhabi
Participants: **434** in person and
196 online, from **95** Member States

This event focused on the safety and security of advanced reactors and new technologies, challenges related to the application of nuclear and non-nuclear technologies throughout their life cycle, regulatory agility and resilience, and being prepared for the unexpected. A 'call for action' document was issued.



International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation: Ensuring Safety and Enabling Sustainability

November 2023, Vienna
Participants: **447** in person and
490 online, from **105** Member States

This event explored the relationship between safety and sustainability in the context of managing radioactive waste and environmental releases, decommissioning and remediation. It concluded with the strong consensus that lifetime safety is a key component of sustainability and that sustainability informs our approach to safety.

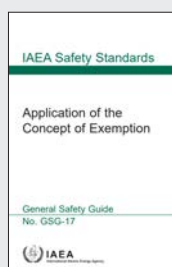


International Conference on Computer Security in the Nuclear World: Security for Safety

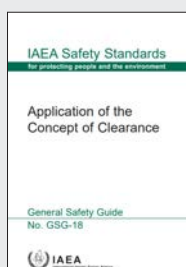
June 2023, Vienna
Participants: **339** in person and
268 online, from **62** Member States

This event focused on the evolving nature of computer security in the nuclear field and featured a main computer security demonstration and seven State-level demonstrations highlighting various aspects of the mitigation and risk management of cyber-attacks.

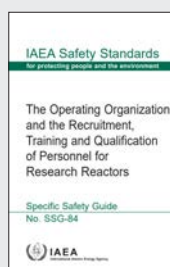
Provides recommendations on the application of the concept of exemption in planned exposure situations.



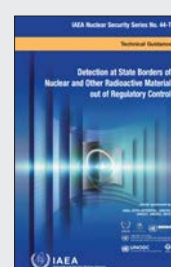
Provides recommendations on the application of the concept of clearance for materials, objects and buildings that are to be released from regulatory control.



Provides recommendations on the operating organization of a research reactor, and on the recruitment, training and qualification of personnel.



Provides guidance to States on planning, implementing and evaluating systems and measures to detect at State borders nuclear and other radioactive material out of regulatory control.



IAEA PUBLICATIONS 2023



Peer Review and Advisory Services

	number of missions
IRRS	9
SEED	6
OSART	11
SALTO	3
TSR	1
INSARR	5
EPREV	1
ARTEMIS	10
INIR	2
ISCA	1
ORPAS	1
RISS	5
INSServ	3
IPPAS	5



Leadership School

7 International Schools
on Nuclear and Radiological Leadership for Safety

3 leadership schools at the national level

More than **180** participants from
51 Member States

Schools delivered in **3** languages

Launch of the NS X account in December 2023

IAEA NS
@IAEANS

Safety and security enable countries to enjoy the many benefits offered by nuclear and radiation technology.

Follow us

NUCLEAR VERIFICATION



“

By implementing safeguards in 189 States during 2023, the IAEA continued to provide the world with assurances that nuclear material and technology remained in peaceful use.

Massimo Aparo
Deputy Director General
and Head of the Department of Safeguards

Nuclear Verification

190

States* with
safeguards
agreements
in force

of which

142 States
had additional
protocols in force

3136
verification
activities
undertaken

nuclear facilities and
locations outside
facilities under
safeguards

1367

significant quantities
of nuclear material
under safeguards

235 939

days of in-field verification

14 302

*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.



Conclusions**

74

States

all nuclear material remained in peaceful activities

107

States

declared nuclear material remained in peaceful activities

3

States

nuclear material, facilities or other items to which safeguards had been applied remained in peaceful activities

5

States

nuclear material in selected facilities to which safeguards had been applied remained in peaceful activities

** 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.



NUCLEAR VERIFICATION^{1,2}

OBJECTIVE

To deter the proliferation of nuclear weapons by detecting early the misuse of nuclear material or technology and by providing credible assurances that States are honouring their safeguards obligations, and, in accordance with the Agency's Statute, assist with other verification tasks, including in connection with nuclear disarmament or arms control agreements, as requested by States and approved by the Board of Governors.

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 State Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) is based on the number of instruments of ratification, accession or succession that have been deposited.



26 000

seals
verified



600

environmental
samples and

565

nuclear material
samples collected



1376

surveillance
cameras
maintained at
nuclear facilities



1768

commercial
satellite images
acquired

KEY OUTPUTS

Implementation of Safeguards in 2023

Over the course of 2023, the Agency carried out 3136 verification activities (2975 in 2022) and spent 14 302 days in the field conducting those activities (14 066 in 2022). This ensured that the Agency was able to draw soundly based conclusions for all States for which safeguards were implemented by the Agency for 2023.

At the end of 2023, the Agency drew a safeguards conclusion for each State for which safeguards were applied. This conclusion was based on an evaluation of all safeguards relevant information available to the Agency in exercising its rights and fulfilling its safeguards obligations for the year.

In 2023, safeguards were applied for 189 States^{3,4} with safeguards agreements in force with the Agency. Of the 136 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 States⁵; for the remaining 62 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 45 States with a CSA but with no AP in force, the Agency concluded only that *declared* nuclear material remained in peaceful activities.

For States with a CSA in force with an operative small quantities protocol (SQP) based on the original standard text, the Agency will no longer be able to continue 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.

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.

³ 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.

⁴ And Taiwan, China.

⁵ And Taiwan, China.

As of 31 December 2023, four 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 SQPs through implementation of the *Plan of Action to Promote the Conclusion of Safeguards*

Agreements and Additional Protocols, which was updated in September 2023. During 2023, a CSA with an SQP and an AP entered into force for Sao Tome and Principe. An AP entered into force for the Plurinational State of Bolivia. An SQP was amended for Nauru.

The status of safeguards agreements and APs as of 31 December 2023 is shown in Table A6 in the Annex to this report. At the end of 2023, 100 States with CSAs in force had operative SQPs, of which 79 SQPs were based on the revised standard text. Eleven States had rescinded their SQPs.



The Director General signs Sao Tome and Principe's CSA, SQP and AP on 31 March 2023, at which point these instruments entered into force.



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 CSAs — 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 safeguards approaches. Hence, during 2023, the Secretariat continued to engage in consultations with the States concerned to consider the possible implications for the application of Agency safeguards. The Director General submitted two reports to the Board of Governors on naval nuclear propulsion in 2023, one for Australia and the other for Brazil.

The Deputy Director General and Head of the Department of Safeguards with staff of the Office for Verification in Iran.



Islamic Republic of Iran

Since February 2021, Iran has not been implementing any of its nuclear-related commitments under the Joint Comprehensive Plan of Action (JCPOA), including implementation of the AP. This has seriously affected the Agency's JCPOA-related verification and monitoring. During 2023, the Director General submitted to the Board of Governors, and in parallel to the UN Security Council, four quarterly reports and two update reports, entitled *Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015)*.

By the end of 2023, outstanding safeguards issues related to the presence of uranium particles of anthropogenic origin at two undeclared locations in Iran remained unresolved. 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 to the Board of Governors four quarterly reports and one update report, entitled *NPT Safeguards Agreement with the Islamic Republic of Iran*.

Syrian Arab Republic

In August 2023, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic*. The Director General informed the Board of Governors that no new information had come to the knowledge of the Agency

that would have an impact on the Agency's assessment that it was very likely that a building destroyed at the Dair Alzour site was a nuclear reactor that should have been declared to the Agency by Syria.⁶

Democratic People's Republic of Korea

In August 2023, 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 2023, no verification activities were implemented in the field, but the Agency continued to monitor developments in the nuclear programme of the 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. Without such access, the Agency cannot confirm the operational status or configuration/design features of the facilities or locations, or the nature and purpose of the activities conducted therein. The continuation of the DPRK's nuclear programme, a clear violation of relevant UN Security Council resolutions, is deeply regrettable.

⁶ The Board of Governors, in its resolution GOV/2011/41 of June 2011 (adopted by a vote), had, inter alia, found that Syria's undeclared construction of a nuclear reactor at Dair Alzour and failure to provide design information for the facility constituted non-compliance by Syria with its obligations under its NPT Safeguards Agreement with the Agency in the context of Article XII.C of the Agency's Statute and called upon Syria to remedy urgently its non-compliance and resolve all outstanding questions so that the Agency could provide the necessary assurances as to the exclusively peaceful nature of Syria's nuclear programme.

Enhancing Safeguards

State-level safeguards implementation

The Agency concluded its project aimed at improving the development and implementation of State-level safeguards approaches (SLAs). This resulted in standardization of the assessment of State nuclear fuel cycle capabilities, standardized technical objectives, and the introduction of technical objective performance targets. IT tools were enhanced and extensive internal guidance documentation was prepared to ensure consistent application. During the year, SLAs for 14 States⁷ with the broader conclusion were updated or developed applying the improved methodology.

Cooperation with State and regional authorities

In 2023, the Agency conducted over 25 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 (RSAC). These events were a combination of in-person and virtual training courses, as well as scientific visits. In total, more than 400 experts from 80 States were trained on safeguards-related topics. This work was carried out with the support of Australia, Japan, the Republic of Korea, the United States of America and the European Commission. The Agency also worked with partners and regional networks, including the Japanese Atomic Energy Agency's Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN), the US Department of Energy's International Nuclear Safeguards and Engagement Program (INSEP), the Asia-Pacific Safeguards Network (APSN) and the African Commission on Nuclear Energy (AFCONE).

The Agency updated the safeguards e-learning website on the Cyber Learning Platform for Network Education and Training (elearning.iaea.org), which was visited by

more than 3000 new users over the course of the year. In total, more than 8000 representatives from over 110 States were registered on the safeguards e-learning site by 31 December 2023.

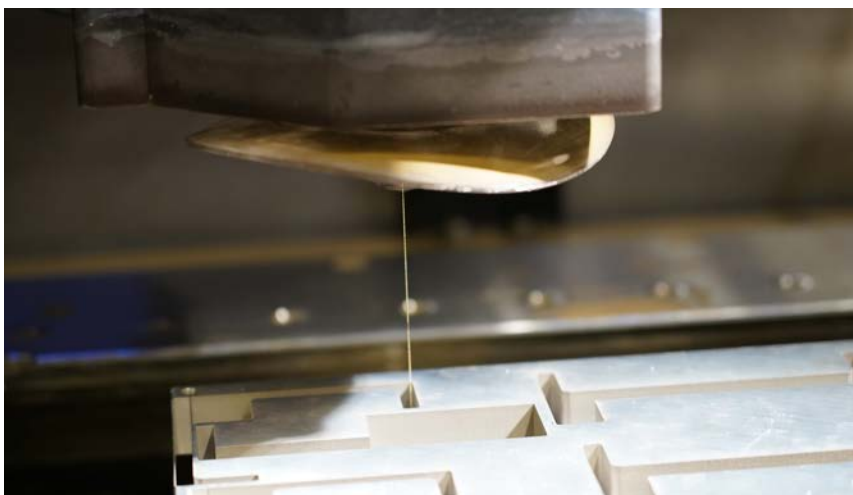
The Agency continued its series of interactive webinars aimed at enhancing national authorities' understanding of their Agency safeguards obligations, and supporting effective and efficient safeguards implementation. Four webinars were held, covering topics such as strengthening SSACs, assistance to States, design information and nuclear material accountancy. With an average of 135 participants for each session, a total of over 750 individuals representing over 100 States participated.

Safeguards equipment and tools

By the end of the year, the Agency had 757 surveillance systems with 1376 (1414) cameras operating or ready to use at 232 (238) facilities in 35 (35) States⁸. The Agency also supports and jointly uses 406 surveillance cameras which are owned by State or regional authorities. The transition to the latest generation of surveillance systems (based on DCM-C5/-A1 camera modules) was almost complete by the end of 2023.

In 2023, the next generation Cherenkov viewing device was used routinely at facilities with large inventories of low burnup and/or long-cooling-time spent fuel assemblies. The robotized Cherenkov viewing device was successfully tested thanks to Member State Support Programme support and was used for safeguards verification in one Member State.

▶ **A Mitsubishi MP1200 Connect wire electrical discharge machine (EDM), used to create the unique identification and authentication features for the new field-verifiable passive seal (FVPS).**



⁷ And Taiwan, China.
⁸ And Taiwan, China.

The Agency started to replace traditional E-CAP metal seals with field verifiable passive seals, which can be verified on site more quickly and simply, thus reducing the need to repatriate seals to Agency Headquarters for verification. A new high resolution cadmium zinc telluride detector was validated by Agency technical experts and authorized for verification activities. Its integration into various non-destructive assay systems will support the replacement of previous generation non-destructive assay equipment. Authorization for the laser curtain for containment, which uses lasers to detect possible intrusion in a safeguarded area in a nuclear facility, was extended to all facilities worldwide.

Safeguards analytical services and methodologies

As of December 2023, 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, four additional laboratories for various forms of sample analysis were in the process of qualification.

In 2023, the Agency collected 565 nuclear material samples for nuclear material accountancy and 140 nuclear material samples for material characterization. The large majority of these were analysed by the Agency's Nuclear Material Laboratory. In addition, two heavy water samples were collected for analysis by the NWAL. The Agency also collected 600 environmental samples, resulting in the analysis of 1158 subsamples.

Developing the Safeguards Workforce

In 2023, the Agency conducted 63 distinct safeguards staff training courses (as some were held more than once, a total of 116 offerings were provided overall, of which 27 were held outside Vienna), helping to provide safeguards inspectors, analysts and support staff with the necessary core and functional competencies. The Introductory Course on Agency Safeguards for Agency inspectors was held for 15 inspectors.

The Safeguards Traineeship Programme for young graduates and junior professionals commenced in February 2023, involving eight participants with a 50/50 female/male ratio from Bangladesh, Georgia, Lesotho, Madagascar, Sierra Leone, the Sudan, Viet Nam and Zambia. Since 1983, the Agency has trained 183 safeguards trainees from 73 States.

Partnerships

The Agency forged new partnerships in support of Agency safeguards during the course of the year. In 2023, it established two new Member State Support Programmes (MSSPs), with Norway and the United Arab Emirates, bringing

the total number of MSSPs to 24. To further broaden the support base for Agency safeguards, it also signed Practical Arrangements with the Vienna Center for Disarmament and Non-Proliferation.

Agency inspectors undergoing training at IAEA Headquarters.

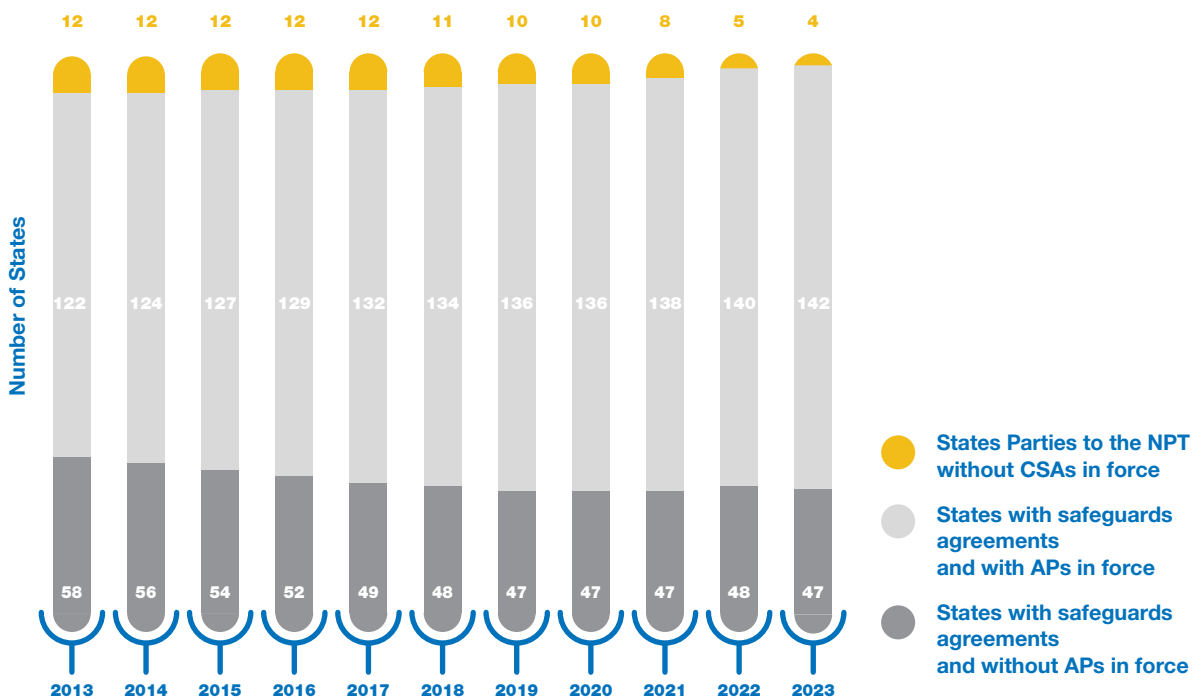




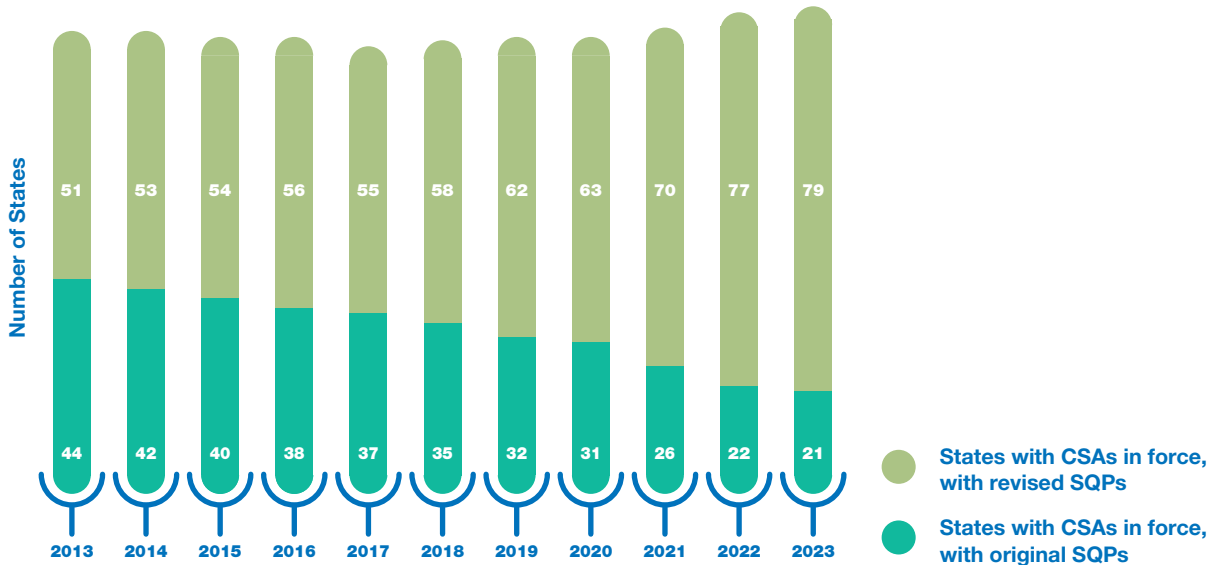
Nuclear Verification

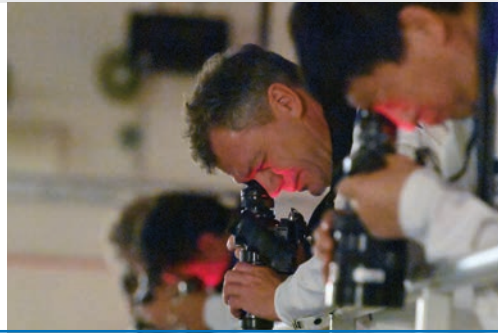
States with safeguards agreements and APs in force, 2013–2023

(the Democratic People's Republic of Korea is not included)

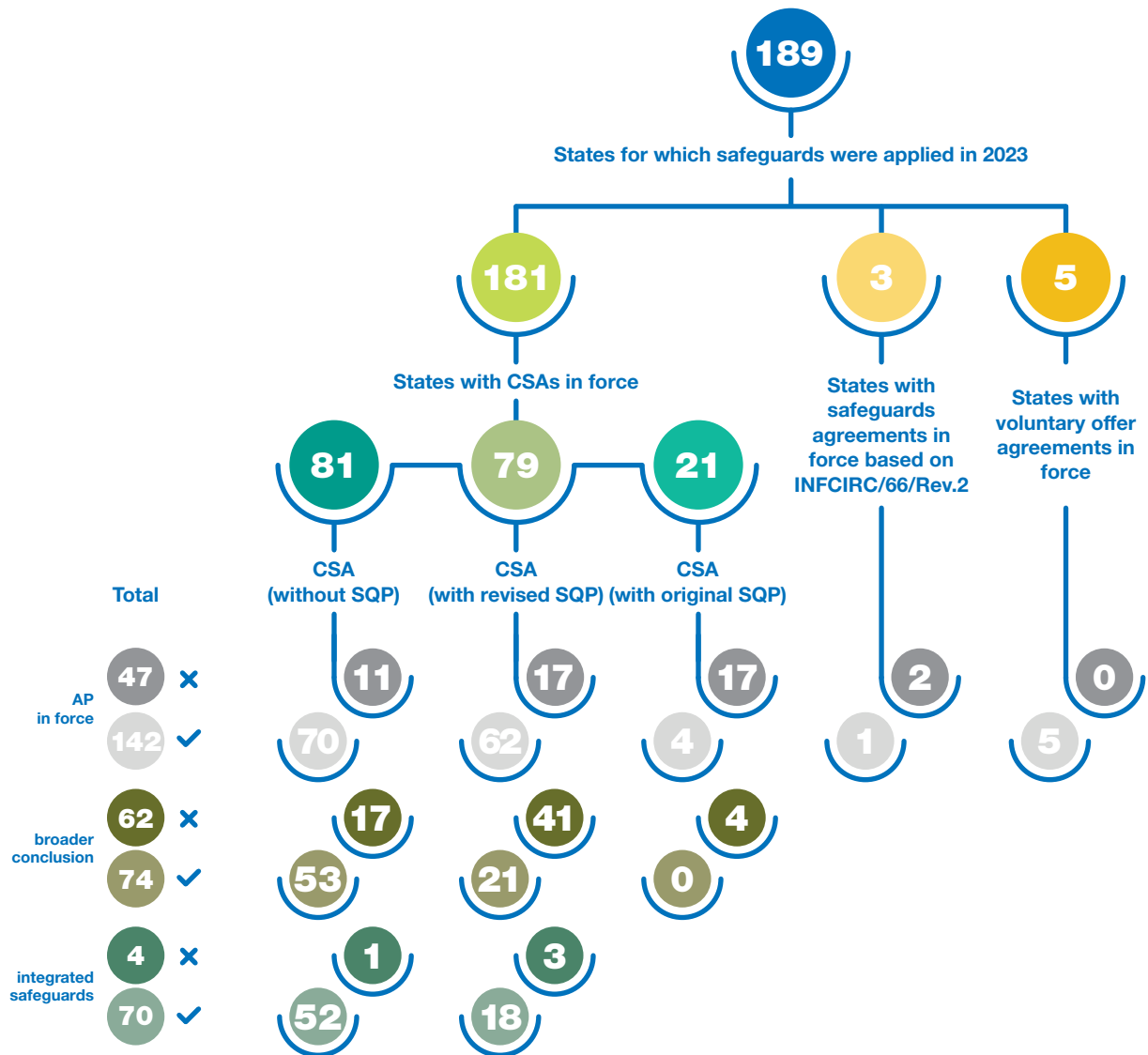


Number of States with SQPs, 2013–2023





Status of Agency safeguards in 2023
(the Democratic People's Republic of Korea is not included)



MANAGEMENT OF TECHNICAL COOPERATION FOR DEVELOPMENT



“

The technical cooperation programme is the IAEA's primary mechanism to support socioeconomic development in Member States and the achievement of the Sustainable Development Goals. The programme delivers support in key development areas including health and nutrition, food and agriculture, water and the environment, industrial applications, and nuclear knowledge development and management. The programme helps Member States to identify and meet future energy needs, and assists in improving radiation safety and nuclear security worldwide, including through legislative assistance.

Hua Liu

Deputy Director General
and Head of the Department of Technical Cooperation

Management of Technical Cooperation for Development

150
countries and territories received support through the technical cooperation programme

including **35**
least developed countries

partnership agreements signed:
1 memorandum of understanding;
12 Practical Arrangements

13

Country Programme Frameworks signed

16

imPACT review missions

10

legislative activities

65

Resources mobilized to support major initiatives:

RAYSON OF HOPE:
€20 million

ZODIAC:
€1.7 million

OTHERS:
€9 million



1241

fellows
442 women

1104

active projects

150 projects closed

600 projects in closure at the end of 2023

632

scientific visitors
229 women

2699

expert and lecturer assignments
851 women

196

regional and interregional training courses

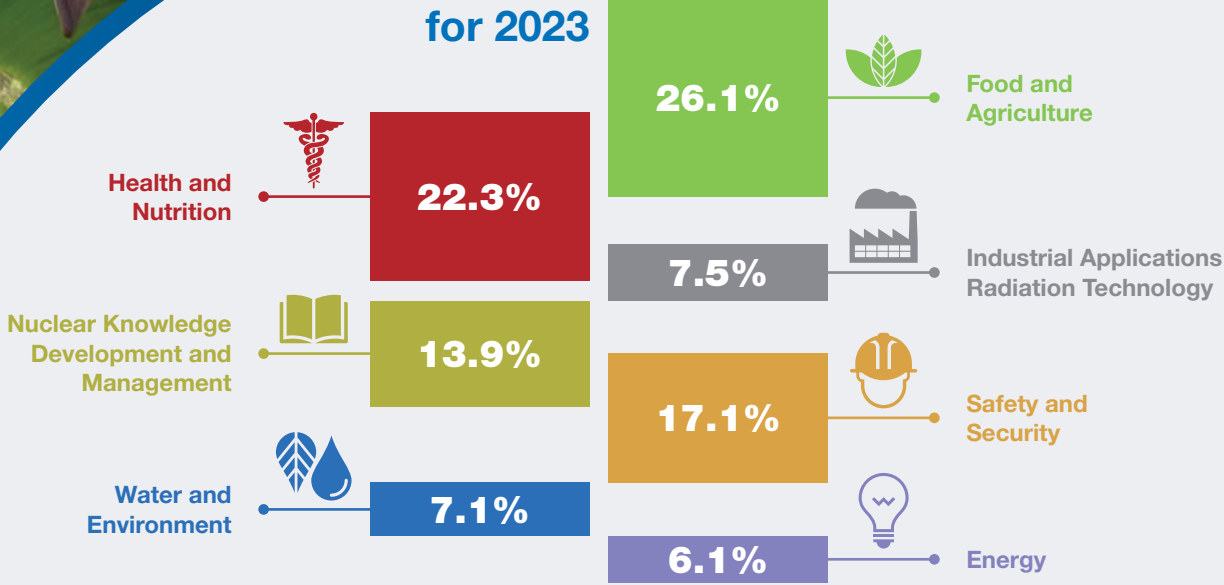
3944 training course participants
1627 women

560

meetings

5253 meeting participants
2114 women

Actuals by technical field for 2023



Actuals: the equivalent of disbursements in line with the terminology in use since the implementation of the Agency-wide Information System for Programme Support.



TECHNICAL COOPERATION

OBJECTIVES

To manage, develop and implement a needs-based, responsive technical cooperation programme in an effective and efficient manner, and thus to strengthen the technical capacities of Member States in the peaceful application and safe use of nuclear technologies for sustainable development.



**93.7
million**

TCF target



**91.3
million**

TCF
contributions
received



97.5%

TCF rate of
attainment



**30.7
million**

extrabudgetary
contributions
received

KEY OUTPUTS

The Technical Cooperation Programme in 2023

In 2023, 150 countries and territories took part in the technical cooperation (TC) programme through over 1100 projects that helped them to address priorities in health and nutrition, food and agriculture, water and the environment, industrial applications, and nuclear knowledge development and management. The programme also provided Member States with assistance in climate change monitoring and adaptation and clean energy, and in training and encouraging the next generation of nuclear scientists and researchers. The major Agency initiatives ZODIAC, NUTEC Plastics and Rays of Hope support the delivery of development activities, in particular TC activities that require major funding for equipment, by mobilizing funds, conducting awareness-raising and bringing together partners. The initiatives, in particular Rays of Hope, have also helped countries to address financial challenges

relating to the physical infrastructure needed to house Agency support. This assistance has been provided, for instance, through the development of bankable documents and support for drafting funding proposals.

In November 2023, the Board of Governors approved the TC programme for 2024–2025, comprising 458 new TC projects. The ongoing effort to focus on comprehensive, impactful projects is reflected in the more streamlined project portfolio for the new TC cycle.

To strengthen national delivery of the TC programme, a regular group fellowship was established for National Liaison Assistants (NLAs). In 2023, two cohorts of NLAs were trained at Agency Headquarters.

Programme Delivery and Financial Highlights

The TC programme provides support in the form of capacity building, knowledge sharing, partnership building, support for networking and procurement. The TCF implementation rate for 2023 was 85.5%, with support provided, inter alia, for 1241 fellowships, 632 scientific visits, 560 meetings and 196 training courses. In total, the Agency supported participation in the TC programme in 11 070 instances, with women representing 40% of all participants.

The TCF rate of attainment reached 97.5% by the end of December 2023, representing some €91.3 million. Extrabudgetary funds of €30.7 million were mobilized to support activities related to the major initiatives and unfunded components of the TC programme, not including an amount of €0.2 million in in-kind contributions.

Achievements in Africa

With the support of the Agency, a curriculum for the first Master of Science in Nutrition and Nuclear Techniques was introduced at the International University of Rabat, Morocco, and at North-West University, South Africa. Ten candidates from French-speaking countries began their MSc studies in October 2023 in Rabat, and five candidates from English-speaking countries were selected to start the programme in South Africa in early 2024. E-learning modules for a master's programme in radiopharmacy were also finalized with Agency support and are ready for use in several African universities.

In Abidjan, Côte d'Ivoire, the installation and testing of an alpha spectrometry laboratory was completed, while in Senegal, releases of sterile male mosquitoes were intensified in 2023. New varieties of rice and sorghum with higher yields and adaptability to drought conditions were developed for use in Africa. In Ghana and Rwanda, the average yield of cassava in project demonstration plots and participating farms was increased from around 20 tonnes to over 70 tonnes per hectare with Agency support.

In Mozambique, the Agency supported the launch of a brachytherapy unit at Maputo Central Hospital, and in Côte d'Ivoire, installation and acceptance tests were completed for the new nuclear medicine facility in Abidjan. A linear accelerator (linac) was installed at Tripoli University Hospital, Libya, in October 2023, and in Ethiopia, installation and acceptance testing for the new nuclear medicine facility at Black Lion Hospital was completed. In addition, Botswana opened its first public radiotherapy centre at the Sir Ketumile Masire Teaching Hospital in July 2023 with Agency support. Procurement of a cyclotron for Benin was initiated, and the training of nuclear medicine professionals in Algiers began in partnership with the Government of Algeria. Two linacs were procured for Kenya with Agency support, for installation in early 2024. The Government of Lesotho allocated €10 million to the construction of a radiotherapy facility, and civil works began at the site in Maseru. Agency support for the training of critical staff is ongoing and a CT scanner is being procured through government cost-sharing.

Achievements in Asia and the Pacific

Three PhD students from the Islamic Republic of Iran, Mongolia and the Philippines, supported by the Agency, completed two years of study in radiation emergency medicine at Japan's Hiroshima University under the Phoenix Leader Education Program for Renaissance from Radiation Disaster, and six candidates selected by the Agency enrolled in a master's programme in nuclear engineering and management at China's Tsinghua University.

With Agency facilitation, secondary school teachers underwent training under the accredited professional training programme conducted by the Australian Nuclear Science and Technology Organisation. The teachers also exchanged good practices at a regional seminar in Oman, highlighting effective practices in integrating nuclear science and technology in secondary education. The website for the Asian Network for Education in Nuclear Technology, a network supported by the Agency, now hosts secondary education materials and



◀ The first patient being treated at the new nuclear medicine facility at Black Lion Hospital, Ethiopia. (Photograph courtesy of Tamirat Sheleme/Elsmed Group)

the International Nuclear Science and Technology Academy (INSTA), also supported by the Agency, launched the INSTA Executive Education Programme for Educators, aimed at further enhancing the relevant knowledge and skills of university lecturers.

In addition, the Agency supported the establishment of the International Nuclear Science Olympiad. Clear rules and procedures, a curriculum and sample problems were agreed in preparation for the first Olympiad.

The Co-operative Agreement for Arab States in Asia for Research, Development and Training related to

Nuclear Science and Technology (ARASIA), with Agency support, formed resource mobilization and outreach and communication committees. The operational ARASIA Fund, which is managed by the Agency, enables resource mobilization for the ARASIA TC programme.

The Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA), with Agency support, launched four socioeconomic studies on nuclear medicine, food safety, air quality and isotope hydrology in 2023.

Achievements in Europe and Central Asia

In 2023, technical cooperation efforts in Europe and Central Asia focused strongly on supporting all Member States requesting assistance to develop nuclear power infrastructure and to support capacity building on the technology and applications of small modular reactors (SMRs) (and microreactors) as a contribution to climate change mitigation. The Agency held 23 events on developing nuclear infrastructure and 16 events on SMRs, the events supported through two interregional TC projects that are part of broad Agency mechanisms and initiatives in nuclear infrastructure development and SMR deployment.

Collaboration with the Agency's newest Member State in the region, Turkmenistan, was strengthened. The country's first national TC programme is under way.

Novel mechanisms enabling the delivery of equipment to Ukraine were established to ensure implementation of the national TC portfolio. National training courses outside Ukraine, virtual expert missions and individual training at the Agency and other host countries were organized.

In 2023, Belarus put into operation the second unit of its NPP. This achievement completes 15 years of Agency assistance to initiate a nuclear power programme in Belarus.



Participants at a nuclear science and technology education workshop in Oman showcase diverse learning facilitation tools, such as interactive presentations, educational games and assessment strategies, demonstrating their effective use in introducing nuclear science to classrooms. (Photograph courtesy of Ivan Lim)



The Director General meeting the Kazakh Minister of Energy, Almasadam Satkaliyev, to sign Kazakhstan's CPF for 2023–2028, ensuring closer interaction in areas related to the development of nuclear power infrastructure, nuclear and radiation safety, food security and nuclear medicine.



The Agency provided the country with support to build the capacity of the operating organization to further develop its integrated management system, and assisted the regulatory body in enhancing supervision of the NPP's safety structures and components, safety culture and oversight procedures.

With the support of the Agency, the layout for the PET-CT facility in Montenegro was finalized.

Lastly, the new *Regional Profile for Europe and Central Asia for 2022–2027* was published in English and Russian.

Achievements in Latin America and the Caribbean

The Agency supported the establishment of the Caribbean Radiation Safety and Security Network in 2023. The new network will strengthen and harmonize regulatory frameworks for nuclear safety and security, waste and transport safety, and emergency preparedness and response, and will support the exchange of regulatory experience and practices among regulatory bodies in Agency and Caribbean Community Member States.

The first mobile electron beam linac for the treatment of industrial effluent in Latin America was installed in Brazil in 2023 with Agency support. In Ecuador, an irradiation centre was inaugurated at the National Polytechnic School, with new infrastructure and the repowering of the existing irradiator. The Regional Network of Research Reactors and Related Institutions in Latin American and the Caribbean was launched at the 67th regular session of the General Conference. In addition, Practical Arrangements with the University of the West Indies were extended to strengthen collaboration in education and training on nuclear applications.

Efforts were intensified to build capacities to address the banana disease Fusarium wilt, including through experience sharing with other countries such as Australia and China. Two regional training courses on nuclear-induced mutations and screening methods were followed by a study visit to learn how Australia is managing this disease.

Construction began on the bunker for a linac and brachytherapy services at San Felipe General Hospital, Honduras, and technical support was provided for the design of a bunker for a similar services in the Dominican Republic. Panama and Uruguay received Agency technical support for the development of new oncological facilities, and in March 2023, radiation oncologists from the region graduated from the third edition of the Agency-supported master's course in advanced radiotherapy in Chile. Eight additional radiation oncologists from the region began studies for the fourth edition of the course in October 2023.



Members of the Regional Network of Research Reactors and Related Institutions in Latin America and the Caribbean at the RP-10 research reactor, Peruvian Institute of Nuclear Energy (IPEN), during the second meeting of the Network in August 2023. (Photograph courtesy of IPEN)



Programme of Action for Cancer Therapy

Activities under the Programme of Action for Cancer Therapy (PACT), in collaboration with WHO and the International Agency for Research on Cancer (IARC), focused on providing Member States with comprehensive, evidence-based evaluations to enhance their national cancer control programmes (NCCPs). Notably, PACT conducted ten imPACT reviews and provided seven countries with support to formulate their NCCPs. Three countries (Jordan, Nigeria and the Sudan) received technical feedback on the final drafts of their NCCPs. Follow-up to imPACT review recommendations was conducted in Iraq, the Syrian Arab Republic and Uruguay, and preparatory activities began for imPACT reviews in The Gambia, Indonesia, Mongolia, Mozambique and Peru.

A bankable document for the consolidation and expansion of Kenya's radiotherapy facilities was completed, and bankable documents for the first public sector facilities in Burundi and the Democratic Republic of the Congo, and for the consolidation and expansion of facilities in Uganda, are nearing completion.

The Agency participated in meetings of the WHO Regional Committees for Africa, the Eastern Mediterranean, Europe, the Americas, South East Asia and the Western Pacific, delivering statements at the ministerial plenary sessions. It also hosted the IAEA-IARC-WHO annual consultation to advance collaboration on cancer control.

Ten African cancer control experts received Agency support to participate in the African Organisation for Research and Training in Cancer (AORTIC) International Conference on Cancer. The Agency was invited to present its work in cancer control at two side events, one hosted by Varian and another hosted by the United Kingdom and the United States of America under the Sustained Dialogue on Peaceful Uses (SDPU). The Agency also attended a further SDPU event in Ghana on enhancing access to nuclear medicine in West Africa.

Engagement with private sector partners for Rays of Hope was strengthened, with the launch of a call for expressions of interest for anchor centres on the United Nations Global Marketplace. A Rays of Hope briefing was conducted for the World Bank.

Supporting and Strengthening Delivery of the Technical Cooperation Programme: The Major Initiatives

Considerable progress has been made to address cancer through the TC programme. Rays of Hope has helped to raise awareness, build partnerships and mobilize funds. In Africa, the Director General laid the foundation stone for the first public sector radiotherapy facility in the Democratic Republic of the Congo in November 2023. In Asia and the Pacific, Practical Arrangements with the Consortium of Universities and Institutions in Japan support teleradiology for the Pacific Islands, led by Tohoku University; and capacity building on theranostics and the use of radiopharmaceuticals. The Agency also signed a Letter of Intent with the Minister of Health of Indonesia to support the national expansion of radiation medicine. In addition, a new triangular partnership between the Agency, the Republic of Korea and Mongolia strengthens nuclear medicine and radiation oncology in Mongolia, benefitting the First and Second State Central Hospitals and the National Cancer Centre. In Latin America and the Caribbean, a third linac for the treatment of cancer patients was inaugurated in October 2023 at Paraguay's National Cancer Institute. Procurement for the provision of more than 30 mammography units for the region, which will help to strengthen the region's capacity to detect breast cancer, was finalized within the framework of the Regional Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) and Rays of Hope.

In November 2023, the Agency attended the Intergovernmental Negotiating Committee on Plastic Pollution in Nairobi to present how NUTEC Plastics addresses plastic pollution at source and in the ocean, and to ensure the Agency's involvement in the negotiations as an observer. The Agency also continues to contribute to the G20 Reports on Actions against Marine Plastic Litter. Experimental proofs of concept for plastic recycling using irradiation were achieved in Indonesia, Malaysia, the Philippines and Thailand, and were initiated in Argentina, Brazil and Mexico. Sixty-three Member States are currently participating in marine plastics monitoring. In Asia and the Pacific, 17 laboratories were equipped with sampling and analysis kits and staff received related training. Monitoring equipment was installed in the Galapagos Islands, Ecuador, to support environmental monitoring and the study of the impact of microplastic pollution in coastal and marine ecosystems.

During 2023, 25 participants from 17 ZODIAC national laboratories in 19 countries and territories in the Asia and the Pacific region received training. In Latin America and the Caribbean, the ZODIAC national laboratories of Chile, Mexico, Panama and Paraguay started receiving equipment detection packages for serology and molecular techniques.

Technical Cooperation and the Global Development Context

The Agency participated in the UN High-level Political Forum on Sustainable Development, with an exhibition and a joint side event with the United Nations Office for South-South Cooperation, the United Nations Development Programme and the Governments of South Africa and Tajikistan, to demonstrate the critical role of South-South and triangular cooperation in ensuring the sustainability of efforts to attain water- and energy-related SDGs. An Agency side event and exhibition was organized at the 5th United Nations Conference on the Least Developed Countries, and the Agency took part as lead discussant at the Multi-stakeholder Forum on Science, Technology and Innovation for the SDGs and participated in the World Health Summit. It also took part extensively at side events on the margins of COP28,

demonstrating the role of nuclear science and technology in mitigating, monitoring and adapting to climate change.

In addition, the Agency attended the Paris Peace Forum, the 10th Roundtable on Financing Water organized by OECD and the African Development Bank, the UN Global Compact Leaders Summit, London Sustainability Week and the Annual Meeting of the World Bank Group and the International Monetary Fund. It played an active role in UN coordination meetings, including those of the Inter-Agency Mechanism for South-South and Triangular Cooperation, the United Nations Economic and Social Council and the Commission for Science and Technology for Development.

Emergency Response

The TC programme is designed for flexibility, which means that it can respond quickly to requests for emergency support. Equipment for the Syrian Arab Republic and Türkiye was procured following the earthquake in February 2023, and Vanuatu was provided with X-ray equipment and other necessary materials after destructive cyclones in March 2023. Libya received assistance following a cyclone and Burkina Faso was supported in addressing an outbreak of dengue fever. Emergency support was provided to the national reference laboratories of Bosnia and Herzegovina, Croatia, Montenegro and Serbia to diagnose and control an

outbreak of African swine fever. The Agency also supported Cyprus in its efforts to suppress the *Aedes aegypti* mosquito, which carries serious tropical diseases like dengue, Zika and chikungunya. In addition, a critical trial using the sterile insect technique to suppress the yellow fever mosquito was successfully initiated in Cyprus, with 100 000 sterile male mosquitoes shipped weekly from the Agency's Seibersdorf laboratories to the island.



The Director General with the Democratic Republic of the Congo's Minister of Scientific Research, Gilbert Kabanda Kurhenga, and Minister of Higher and University Education, Muhindo Nzangi Butondo, laying the foundation stone for the country's first public sector radiotherapy facility, November 2023.



Technical Cooperation Programme Management

All Office of Internal Oversight Services recommendations issued prior to 2023 have been implemented and closed, and all designs presented for the 2024–2025 TC programme cycle were assessed as being of good quality. Support was provided for a study of the socioeconomic impact of ARCAL projects over the past 15 years, and four e-learning packages

on the methodology of the logical framework approach and project progress assessment reporting were released. A dashboard for the Country Programme Framework (CPF), a strategic planning document, was developed with the aim of facilitating the planning and coordination of the development and update of CPFs.

Legislative Assistance and Treaty Event

Under its legislative assistance programme, the Agency supported Member States by providing comments on draft and enacted national nuclear legislation; holding bilateral meetings with officials and national, subregional and regional workshops; and delivering training on nuclear law.

Armenia, the Bahamas, Barbados, Benin, Brunei Darussalam, Colombia, Dominica, The Gambia, Grenada, Madagascar, Malaysia, Myanmar, Nicaragua, Rwanda, the Philippines, Qatar, Saudi Arabia, Serbia, Sri Lanka, Trinidad and Tobago, Turkmenistan, Uganda and the Bolivarian Republic of Venezuela received assistance in the form of comments and advice on draft and enacted national nuclear legislation.

Bilateral meetings were held with decision makers, policymakers and other senior officials, as well as legislators in 19 Member States. National workshops on nuclear law were also held with Armenia, Benin, Colombia, El Salvador, Malaysia, Mongolia, Myanmar, Nepal, Nicaragua, Paraguay, the Philippines, Turkmenistan, Sri Lanka, the Bolivarian Republic of Venezuela and Zambia.

Two regional and subregional workshops for Europe and Central Asia were held in Bar, Montenegro, in September 2023 and in Dushanbe, Tajikistan (for Russian-speaking Member States), in March 2023.

In October 2023, the 11th session of the Nuclear Law Institute (NLI), supported through the TC programme, was held in Vienna. Participants from 52 Member States acquired a solid understanding of all aspects of nuclear law, with a particular focus on legislative drafting.

The Agency delivered introductory courses on nuclear law at three universities as part of a university partnership initiative. It also trained professors and other faculty staff in nuclear law at the NLI and the OECD/NEA International School of Nuclear Law, and at a training course on nuclear law held at Agency Headquarters in November 2023.



The annual Treaty Event took place during the 67th regular session of the General Conference, providing three Member States (Belarus, Egypt and Zimbabwe) with an opportunity to deposit their instruments of ratification, acceptance, or approval of, or of accession to, the multilateral treaties relating to nuclear safety, nuclear security and civil liability for nuclear damage, deposited with the Director General.



Technical Cooperation in 2023



New & extended partnerships, MOUs and partnership agreements

Consortium of Universities and Institutions in Japan, China National Nuclear Corporation, China Atomic Energy Authority, Japanese Society for Non-Destructive Inspection, Ministry of Health of Mongolia and Korea Institute of Radiological and Medical Sciences, Ministry of Science and ICT of the Republic of Korea, Ministry of Public Health of the State of Qatar, St Jude's Children's Research Hospital, the University of West Indies, GE HealthCare, Siemens Healthineers, Elekta, the OPEC Fund for International Development and the RCA Regional Office



Interregional

23 interregional projects
224 expert and lecturer assignments
36 interregional training courses



NCCP support to

Benin, Botswana, Burundi, Guinea, Guyana, Kenya and Sierra Leone



Latin America and the Caribbean

31 countries receiving support
186 national projects
46 regional projects
238 fellowships and scientific visits
46 regional training courses
985 training course participants
563 expert and lecturer assignments



Nuclear Law

23 Member States received advice on national nuclear legislation
15 national nuclear law workshops held

Project numbers refer to projects active at the end of 2023.



Europe

33 countries receiving support
176 national projects
36 regional projects
326 fellowships and scientific visits
25 regional training courses
828 training course participants
466 expert and lecturer assignments



Asia and the Pacific

40 countries and territories receiving support
317 national projects
70 regional projects
513 fellowships and scientific visits
49 regional training courses
1022 training course participants
660 expert and lecturer assignments



Countries with new CPFs

Algeria, Bahrain, Benin, Burkina Faso, Cameroon, Democratic Republic of the Congo, Greece, Kazakhstan, Kenya, Lesotho, Malta, Nigeria, Paraguay, Thailand, United Republic of Tanzania, and Türkiye



Africa

46 countries receiving support
210 national projects
40 regional projects
796 fellowships and scientific visits
40 regional training courses
1109 training course participants
590 expert and lecturer assignments



imPACT reviews

Cambodia, Comoros, Djibouti, El Salvador, Ethiopia, Fiji, Guinea, Jordan, Papua New Guinea and the Bolivarian Republic of Venezuela

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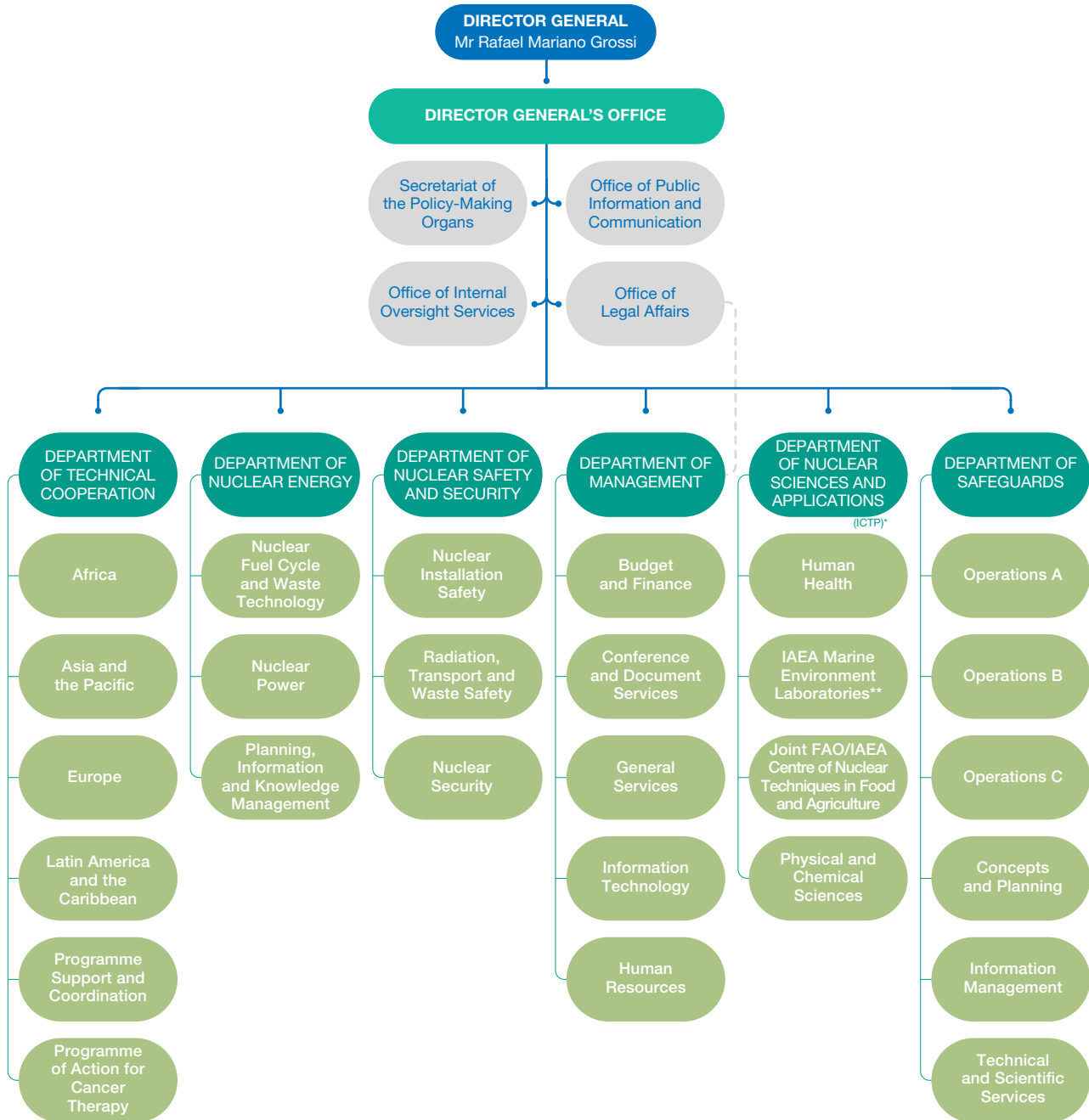
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ORGANIZATIONAL CHART



* The Abdus Salam International Centre for Theoretical Physics (ICTP), legally referred to as the “International Centre for Theoretical Physics”, is operated as a joint programme by UNESCO and the Agency. Administration is carried out by UNESCO on behalf of both organizations.

** With the participation of UNEP and IOC.