IAEA ANNUAL REPORT 2017

IAEA
International Atomic Energy Agency
Atoms for Peace and Development

IAEA Annual Report 2017

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 2017.

GC(62)/3

Contents

Member States of the International Atomic Energy Agency

(as of 31 December 2017)

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

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. The IAEA's principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

The Agency at a Glance

(as of 31 December 2017)

169 Member States.

83 intergovernmental and non-governmental organizations worldwide invited to observe the Agency's General Conference.

61 years of international service.

2510 professional and support staff.

€363.8 million total Regular Budget for 2017[1]. Extrabudgetary expenditures in 2017 totalled **€100.1 million**.

€84.9 million target in 2017 for voluntary contributions to the Agency's Technical Cooperation Fund, supporting projects involving **3641** expert and lecturer assignments, **5913** meeting participants and other project personnel, **3913** participants in **222** regional and interregional training courses and **1979** fellows and scientific visitors.

144 countries and territories receiving support through the Agency's technical cooperation programme, including **35** least developed countries.

807 active technical cooperation projects at the end of 2017.

2 liaison offices (in New York and Geneva) and **2** safeguards regional offices (in Tokyo and Toronto).

15 international laboratories (Vienna, Seibersdorf and Monaco) and research centres.

11 multilateral conventions on nuclear safety, security and liability adopted under the Agency's auspices.

4 regional/cooperative agreements relating to nuclear science and technology.

134 Revised Supplementary Agreements governing the provision of technical assistance by the Agency.

135 active CRPs involving **1599** approved research, technical and doctoral contracts and research agreements. In addition, **73** Research Coordination Meetings were held.

29 active IAEA Collaborating Centres. In 2017, **4** institutions were newly designated as IAEA Collaborating Centres and **2** centres were redesignated as IAEA Collaborating Centres for a period of 4 years.

16 national donors to the voluntary Nuclear Security Fund.

181 States in which safeguards agreements were being implemented[2,3] of which **132** States had additional protocols in force, with **2102** safeguards inspections performed in 2017. Safeguards expenditures in 2017 amounted to **€137.1 million** (includes €0.1 million 2016 carryover) in the operational portion of the Regular Budget and **€27.4 million** in extrabudgetary resources.

20 national safeguards support programmes and **1** multinational support programme (European Commission).

500 000 visitors a month to iaea.org, which was revamped in 2016. The Agency's social media audience had increased to **400 000** followers on social media at the end of 2017, a 12% increase compared with the year before. As of the end of the year, the Agency had social media accounts in Arabic, French, Russian and Spanish, as well as English.

4.1 million records in the Agency's International Nuclear Information System (INIS) database, with over **540 000** full texts not readily available through commercial channels and **2.9 million** page views in 2017.

1.3 million documents, technical reports, standards, conference proceedings, journals and books in the IAEA Library and over **10 000** visitors to the Library in 2017.

138 publications, including newsletters, issued in 2017 (in print and electronic formats).

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1 At the UN average rate of exchange of US $1.122 to €1.00. The total Regular Budget was €369.0 million at the US $1.00 to €1.00 rate.

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

3 And Taiwan, China.

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.

The Board appointed by acclamation Mr Yukiya Amano to the post of Director General of the Agency for a further term of office of four years, from 1 December 2017 to 30 November 2021.

In the area of nuclear technologies, in the course of 2017 the Board considered the *Nuclear Technology Review 2017*.

In the area of safety and security, the Board discussed the *Nuclear Safety Review 2017* and the *Nuclear Security Report 2017*, and approved the *Nuclear Security Plan 2018–2021*.

As regards verification, the Board considered the *Safeguards Implementation Report for 2016*. It approved one safeguards agreement. 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 kept under its consideration the issues of 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.

The Board discussed the *Technical Cooperation Report for 2016* and approved the Agency's technical cooperation programme for 2018–2019.

The Board approved the recommendations contained in the *Proposal to the Board of Governors by the Co-Chairs of the Working Group on the Programme and Budget and the Technical Cooperation Fund Targets for 2018–2019*.

Composition of the Board of Governors (2017–2018)

Chair:

HE Mr Darmansjah DJUMALA
Ambassador
Governor from Indonesia

Vice-Chairpersons:
HE Ms Liselotte KJÆRSGAARD PLESNER
Ambassador
Governor from Denmark

HE Mr Andrej BENEDEJČIČ
Ambassador
Governor from Slovenia

Algeria
Argentina
Armenia
Australia
Belgium
Brazil
Canada
Chile
China
Costa Rica
Côte d'Ivoire
Denmark
France
Germany
India
Indonesia
Italy
Japan
Jordan
Kenya
Korea, Republic of
Netherlands
Peru
Portugal
Qatar
Russian Federation
Serbia
Singapore
Slovenia
South Africa
Sudan
United Arab Emirates
United Kingdom of Great Britain and Northern Ireland
United States of America
Venezuela, Bolivarian Republic of

The General Conference

The General Conference comprises all Member States of the Agency and meets once a year.

In 2017, the Conference approved the Board's appointment of Mr Yukiya Amano as Director General of the Agency for a further term of office of four years, from 1 December 2017 to 30 November 2021.

The Conference — upon the recommendation of the Board — approved Grenada for membership of the Agency. At the end of 2017, the Agency's membership was 169.

The Conference adopted resolutions on the Agency's financial statements for 2016 and budget for 2018; on measures to strengthen international cooperation in nuclear, radiation, transport and waste 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 and nuclear power applications; 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 Agency safeguards in the Middle East; and on personnel matters, comprising the staffing of the Agency's 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 of the Agency, approved in 1999; on the report on the promotion of the efficiency and effectiveness of the Agency's decision making process; and on the progress made towards the entry into force of the amendment to Article VI of the Statute of the Agency, approved in 1999.

Notes

- The *IAEA Annual Report 2017* aims to summarize only the significant activities of the Agency during the year in question. The main part of the report, starting on page 27, generally follows the programme structure as given in *The Agency's Programme and Budget 2016–2017* (GC(59)/2 and Mod. 1). 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, 'Overview', seeks to provide a thematic analysis of the Agency's activities within the context of notable developments during the year. More detailed information can be found in the latest editions of the Agency's *Nuclear Safety Review*, *Nuclear Security Report*, *Nuclear Technology Review*, *Technical Cooperation Report* and the *Safeguards Statement and Background to the Safeguards Statement*.
- Additional information covering various aspects of the Agency's programme is 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 4 June 2018, the Board of Governors approved the Annual Report for 2017 for transmission to the General Conference.

Abbreviations

AFRA	African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
ALMERA	Analytical Laboratories for the Measurement of Environmental Radioactivity
ANENT	Asian Network for Education in Nuclear Technology
AP	additional protocol
ARASIA	Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology
ARCAL	Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean
ARTEMIS	Integrated Review Service for Radioactive Waste and Spent Fuel Management Decommissioning and Remediation
CLP4NET	Cyber Learning Platform for Network Education and Training
CNS	Convention on Nuclear Safety
COP23	23rd session of the Conference of the Parties (UNFCCC)
CPF	Country Programme Framework
CPPNM	Convention on the Physical Protection of Nuclear Material
CRP	coordinated research project
CSA	comprehensive safeguards agreement
DSRS	disused sealed radioactive source
EduTA	Education and Training Appraisal
ENEN	European Nuclear Education Network
EPR	emergency preparedness and response
EPREV	Emergency Preparedness Review
Euratom	European Atomic Energy Community
FAO	Food and Agriculture Organization of the United Nations
GNSSN	Global Nuclear Safety and Security Network
HEU	high enriched uranium
IACRNE	Inter-Agency Committee on Radiological and Nuclear Emergencies
ICERR	IAEA-designated International Centre based on Research Reactors
ICTP	Abdus Salam International Centre for Theoretical Physics
INIR	Integrated Nuclear Infrastructure Review
INIS	International Nuclear Information System
INLEX	International Expert Group on Nuclear Liability
INPRO	International Project on Innovative Nuclear Reactors and Fuel Cycles
INSARR	Integrated Safety Assessment of Research Reactors
IPPAS	International Physical Protection Advisory Service
IRRS	Integrated Regulatory Review Service

ISCA	Independent Safety Culture Assessment
ITDB	Incident and Trafficking Database (IAEA)
JCPOA	Joint Comprehensive Plan of Action
LANENT	Latin American Network for Education in Nuclear Technology
LEU	low enriched uranium
NESA	Nuclear Energy System Assessment
NGSS	next generation surveillance system
NPCs	National Participation Costs
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
OECD	Organisation for Economic Co-operation and Development
OECD/NEA	OECD Nuclear Energy Agency
OMARR	Operation and Maintenance Assessment for Research Reactors
ORPAS	Occupational Radiation Protection Appraisal Service
OSART	Operational Safety Review Team
PACT	Programme of Action for Cancer Therapy (IAEA)
RANET	Response and Assistance Network (IAEA)
RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
ReNuAL	Renovation of the Nuclear Applications Laboratories
RSA	Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA
SALTO	Safety Aspects of Long Term Operation
SDG	Sustainable Development Goal
SEED	Site and External Events Design
SIT	sterile insect technique
SMR	small and medium sized or modular reactor
SQP	small quantities protocol
TCF	Technical Cooperation Fund
UNDAF	United Nations Development Assistance Framework
USIE	Unified System for Information Exchange in Incidents and Emergencies
VETLAB Network	Veterinary Diagnostic Laboratory Network
WHO	World Health Organization

Overview

For over six decades, the Agency has pursued the goal of accelerating and enlarging the "contribution of atomic energy to peace, health and prosperity throughout the world" while ensuring that "assistance provided by it…is not used in such a way as to further any military purpose." Under the motto 'Atoms for Peace and Development', it continues to make tangible contributions in meeting emerging global challenges in order to improve health, prosperity, peace and security around the world. By continuously adapting its diverse programmatic activities, within the framework of its Statute, the Agency has maintained the flexibility to address the evolving needs of Member States and to help them achieve their development goals.

This chapter provides an overview of some of the major global nuclear related developments in 2017 and how they were addressed through the Agency's work. During 2017, programmatic activities focused, in a balanced manner, on developing and transferring nuclear technologies for peaceful applications, enhancing nuclear safety and security, and strengthening nuclear verification and non-proliferation efforts worldwide.

NUCLEAR TECHNOLOGY

Nuclear Power

Status and trends

A total of 448 nuclear power reactors were in operation at the end of 2017, including 4 reactors newly connected to the grid. Construction started on 4 reactors, with a total of 59 reactors under construction around the world; 5 reactors were permanently shut down. The global generating capacity of nuclear energy was 392 gigawatts (electrical) (GW(e)) at the end of 2017.

"A total of 448 nuclear power reactors were in operation at the end of 2017, including 4 reactors newly connected to the grid."

Compared with 2016 levels, the Agency's 2017 projections for global installed nuclear power capacity showed an increase of 42% by 2030, an increase of 83% by 2040 and an increase of 123% by 2050 in the high case scenario. The low case scenario projected a 12% dip in capacity by 2030 and a 15% dip by 2040, before a return to current levels by 2050. During the year, 28 countries were considering or embarking on a nuclear power programme. Of the 30 countries already operating nuclear power plants, 13 were either constructing new reactors or actively completing previously suspended construction projects, and 16 had plans or proposals for building new reactors.

Major conferences

In June, the Agency organized the International Conference on Fast Reactors and Related Fuel Cycles: Next Generation Nuclear Systems for Sustainable Development (FR17)

in Yekaterinburg, Russian Federation. More than 550 experts from 27 Member States and 6 international organizations exchanged information on national and international programmes, and on new developments and experience in the field of fast reactors and related fuel cycle technologies. The conference emphasized the importance of these technologies in sustainable nuclear power generation and featured events and contests for young nuclear scientists aimed at developing innovative solutions in this field.

The Agency's Fourth International Conference on Nuclear Power Plant Life Management, held in Lyon, France, in October, attracted more than 400 nuclear energy experts from over 38 countries and 4 international organizations. Conference participants discussed cost effective ways to safely operate nuclear power plants beyond their design lifetime and emphasized the need to maintain the current fleet of nuclear reactors until the next generation of reactors become operational.

Participants in the International Ministerial Conference on Nuclear Power in the 21st Century, organized by the Agency in cooperation with the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA), concluded that nuclear power remains an important option for mitigating climate change and meeting the targets set out in the Paris Agreement and the Sustainable Development Goals (SDGs). Around 700 participants from 64 Member States and 6 organizations attended the conference, held in Abu Dhabi, United Arab Emirates, from 30 October to 1 November.

Climate change and sustainable development

At the 23rd session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP23), held in Bonn, Germany, in November, the Agency organized two side events highlighting the role of nuclear science and technology in combatting climate change and in contributing to sustainable development. It also worked with several organizations of the United Nations system to coordinate a third event, focused on Sustainable Development Goal 7 (affordable and clean energy).

At the 14th INPRO (International Project on Innovative Nuclear Reactors and Fuel Cycles) Dialogue Forum, held at the Agency's Headquarters in June, 35 participants from 23 Member States presented national and technical perspectives on the potential of nuclear energy to support the SDGs, including action to mitigate climate change.

Energy assessment services

During 2017, the Agency updated and enhanced its energy planning tools — now in use by 147 Member States — as well as the related multilingual training materials, including e-learning packages. It also conducted 45 capacity building events on energy planning through the technical cooperation programme, providing training to over 690 professionals from 70 Member States.

INPRO held two meetings to review national Nuclear Energy System Assessments (NESAs). The first was the final joint meeting of China, India and the Russian Federation on limited scope assessments of sodium cooled fast reactors using the INPRO methodology. The meeting, held in June in Vienna, enabled the three Member States to finalize their NESA country reports. At the second meeting, held in August in Vienna, INPRO carried out a final review of the strategic plan for the nuclear energy system in Ukraine. Ukraine will use the feedback to complete updates to its final NESA country report before submission to the Agency.

Support to operating nuclear power plants

The Agency conducted several events aimed at supporting human resources development programmes in Member States, including the Nuclear Operators Forum: Challenges in

Human Resources Management for Sustainable Nuclear Power Generation, attended by more than 100 experts in the field. Participants concluded that ensuring the availability of competent, qualified and capable staff, as a precondition for sustainable nuclear energy, requires a joint effort by governments, industry and academia to create functional training programmes both nationally and internationally.

Launching nuclear power programmes

The Agency continued its support of the 28 Member States considering or embarking on new nuclear power programmes. In January, it conducted an Integrated Nuclear Infrastructure Review (INIR) Phase 1 mission to Ghana. Since INIR's launch in 2009, a total of 22 INIR missions have been conducted to 16 Member States. To improve the quality and increase the consistency of these missions, the Agency published *Guidelines for Preparing and Conducting an Integrated Nuclear Infrastructure Review (INIR)* (IAEA Services Series No. 34). It also held meetings with nine embarking Member States to review or develop integrated work plans identifying and prioritizing areas for Agency support.

Capacity building, knowledge management and nuclear information

The Agency continued to support Member States in building their capacity to manage nuclear knowledge and information through training activities, schools and on-line courses. In 2017, it conducted five Knowledge Management Assist Visits to various nuclear organizations in Member States and held four Nuclear Energy Management (NEM) Schools, as well as one Nuclear Knowledge Management (NKM) School.

The number of courses hosted by the Agency's Cyber Learning Platform for Network Education and Training (CLP4NET) e-learning platform exceeded 580, and by the end of the year, there were around 21 300 registered CLP4NET users.

With Lesotho joining in 2017, the membership of the Agency's International Nuclear Information System (INIS) grew to 131 Member States and 24 international organizations. The IAEA Library continued to coordinate research support and document delivery among the 58 members of the International Nuclear Library Network.

"The number of courses hosted by the [CLP4NET] e-learning platform exceeded 580, and by the end of the year, there were around 21 300 registered CLP4NET users."

Assurance of supply

Significant progress was made on the IAEA Low Enriched Uranium (LEU) Bank project in Kazakhstan in 2017. Construction of the IAEA LEU Storage Facility was completed during the summer and the facility was inaugurated in August. The Agency issued a request for proposal for LEU acquisition in November. In 2017, two treaties for the IAEA LEU Bank entered into force: the IAEA LEU Bank Host State Agreement with the Republic of Kazakhstan and the Transit Agreement with the Russian Federation for the transit of LEU and equipment to and from the IAEA LEU Bank. The Transit Agreement with China was signed in 2017.

An LEU reserve in Angarsk, established following the Agreement of February 2011 between the Government of the Russian Federation and the Agency, remained operational.

Fuel cycle

The Agency organized some 30 meetings and workshops in 2017 aimed at increasing fuel cycle sustainability, including 3 Technical Meetings, 6 Research Coordination Meetings, a training workshop and 18 consultants meetings. These meetings focused on various aspects of uranium exploration, resources and production; environmental remediation of uranium mining sites; fuel development, design, manufacture and performance assessment; and spent fuel management.

Technology development and innovation

In October, the Agency conducted the first Technical Meeting on the Status and Evaluation of Severe Accident Simulation Codes for Water Cooled Reactors. Organized as a follow-up of the 2015 International Experts Meeting on Strengthening Research and Development Effectiveness in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant, the meeting was attended by 37 experts from 19 Member States and provided a forum for the exchange of information between code developers and end users.

In 2017, the Agency established a Technical Working Group on Small and Medium Sized or Modular Reactors to facilitate the development of this technology in Member States. In October, it organized a Technical Meeting on Technology Assessment of Small Modular Reactors for Near Term Deployment in Tunis, Tunisia, aimed at enhancing the capacity of Member States in the Middle East and North Africa region to make knowledgeable technical decisions in adopting a nuclear reactor technology. In July, the Agency issued *Instrumentation and Control Systems for Advanced Small Modular Reactors* (IAEA Nuclear Energy Series No. NP-T-3.19), addressing issues and challenges related to the design, qualification and implementation of these systems for small and medium sized or modular reactors. In response to growing interest among Member States, the Agency launched a new coordinated research project (CRP) entitled 'Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment'. The project's main objective is to develop methods for determining the appropriate size of emergency planning zones.

The Agency issued *Benchmark Analysis of EBR-II Shutdown Heat Removal Tests* (IAEA-TECDOC-1819), aimed at helping Member States to verify and validate their simulation tools for safety analysis of sodium cooled fast reactors.

In the area of non-electrical applications of nuclear power, the Agency published *Opportunities for Cogeneration with Nuclear Energy* (IAEA Nuclear Energy Series No. NP-T-4.1) and *Industrial Applications of Nuclear Energy* (IAEA Nuclear Energy Series No. NP-T-4.3). It also updated its Water Management Program (WAMP) tool, adding a new module to simulate nuclear power plants that use only reclaimed water for cooling, and conducted a training workshop on use of the tool for efficient water management in nuclear power plants.

Research reactors

The Agency released an e-learning course covering all aspects of neutron activation analysis. It continued to assist Member States, upon request, in minimizing the civilian use of high enriched uranium by supporting the conversion of research reactors and targets for radioisotope production to LEU fuel where such minimization is considered by these States to be technically and economically feasible. Activities in 2017 included the completion of a three year project to convert Ghana's miniature neutron source reactor to LEU fuel. The Belgian Nuclear Research Centre (SCK•CEN) and the United States Department of Energy's Idaho and Oak Ridge National Laboratories became IAEA-designated International Centres based on Research Reactors. The Agency also conducted pre-OMARR (Operation and Maintenance Assessment for Research Reactors) missions to Portugal and Uzbekistan.

Radioactive waste management, decommissioning and environmental remediation

The Agency issued two publications addressing the management of radioactive waste: *Selection of Technical Solutions for the Management of Radioactive Waste* (IAEA-TECDOC-1817) and *Use of the Benchmarking System for Operational Waste from WWER Reactors* (IAEA-TECDOC-1815). In the area of decommissioning and environmental remediation, the

Agency issued *Data Analysis and Collection for Costing of Research Reactor Decommissioning* (IAEA-TECDOC-1832) and the proceedings of an international conference entitled *Advancing the Implementation of Decommissioning and Environmental Remediation Programmes*.

The Agency supported preparations for the removal of 37 Category 1 and 2 disused sealed radioactive sources from Albania, Bolivia, Ecuador, Lebanon, Paraguay, Peru, the former Yugoslav Republic of Macedonia, Tunisia and Uruguay; the removals are scheduled for completion in 2018. The Agency also supported the training of some 200 experts from more than 20 Member States in conditioning, and safe and secure management of Category 3 to 5 disused sealed radioactive sources. Missions to condition disused sealed radioactive sources were conducted to Belize, China, the Dominican Republic, Ghana, the Islamic Republic of Iran, Jamaica and Malaysia.

"[The Agency] supported the training of some 200 experts from more than 20 Member States in conditioning, and safe and secure management of Category 3 to 5 disused sealed radioactive sources."

Nuclear fusion

The Agency issued *Investigations of Materials under High Repetition and Intense Fusion Pulses* (IAEA-TECDOC-1829) in December. The publication presents experimental results and related simulations of plasma–surface interaction phenomena under the extreme conditions expected in a fusion reactor. In March, the Agency initiated a CRP entitled 'Towards the Standardization of Small Specimen Test Techniques for Fusion Applications'. The project aims at producing guidelines for full standardization of small specimen testing based on common, agreed best practices for testing of reference structural materials for fusion reactors.

Nuclear data

The Agency played a significant role in the release of three major nuclear data libraries at the end of 2017: the ENDF/B-VIII (United States of America), JEFF-3.3 (OECD/NEA) and TENDL-2017 (Europe) nuclear data libraries for nuclear science and technology analyses. Through collaboration with nuclear physics experts, the Agency was able to deliver high quality isotopic evaluations of actinides and structural materials to these data libraries. It also performed integral validation with criticality benchmarks.

Accelerator applications

The Agency hosted the first Research Coordination Meeting of a CRP entitled 'Accelerator Simulation and Theoretical Modelling of Radiation Effects — SMoRE-II'. The project aims at establishing the efficacy of, and best practices for, accelerator based ion irradiation in testing of materials used for advanced reactor concepts and life extension of existing reactors.

Researchers from Member States carried out nine experiments at the Agency's end station at the IAEA–Elettra Sincrotrone Trieste X ray fluorescence beamline. The experiments focused on environmental science, fundamental X ray physics, cultural heritage and industrial applications.

Nuclear instrumentation

Together with the Abdus Salam International Centre for Theoretical Physics (ICTP), the Agency organized a Joint ICTP–IAEA School on Zynq-7000 SoC and Its Applications for Nuclear and Related Instrumentation, held in Trieste, Italy. Nineteen young scientists from 15 countries learned about 'system on chip' (SoC) technology through lectures and hands-on activities. In March, the Agency began a new CRP entitled 'Field-deployable Analytical Methods to Assess the Authenticity, Safety and Quality of Food' to identify and select appropriate analytical techniques and to develop suitable assessment protocols.

NUCLEAR SCIENCES AND APPLICATIONS

Major conferences

In April, the Agency held the first International Conference on Applications of Radiation Science and Technology (ICARST-2017) in Vienna, attracting more than 500 participants from 73 Member States. The conference provided a platform for scientists and industry professionals to discuss key developments in the application of radiation science and technology; global, regional and national initiatives for implementing proven industrial applications; and new initiatives to employ radiation technologies to meet emerging challenges.

The Agency hosted the Third FAO–IAEA International Conference on Area-wide Management of Insect Pests: Integrating the Sterile Insect and Related Nuclear and Other Techniques, in Vienna in May. The conference was attended by 360 delegates from 81 countries and 6 international organizations. There was general consensus on the need to target total pest populations rather than localized subsets, and on the need to integrate several synergistic, environment-smart technologies such as the sterile insect technique (SIT) in managing insect pests.

Participants in the second International Conference on Advances in Radiation Oncology (ICARO2), held in Vienna in June, sought to define the current role of technological, medical physics and radiobiological innovations and their potential incorporation into routine clinical practice in radiation oncology, one of the main pillars of cancer treatment. This year's conference drew 445 participants and observers from 95 Member States, with support provided by 19 professional organizations. Attendees discussed advances in technology, best practices and quality assurance methodologies, and took part in e-contouring training and automated planning demonstrations.

IAEA SCIENTIFIC FORUM

The IAEA Scientific Forum 2017, held during the 61st General Conference in September, examined the role that nuclear science plays in ensuring healthy lives and promoting well-being for all. Several high level speakers — including King Letsie III of Lesotho, the ministers of health of Cameroon and the Russian Federation, and over 40 dignitaries and experts — joined the Director General to present the role of nuclear techniques in the diagnosis, treatment and prevention of diseases, especially non-communicable diseases. In discussing the future of nuclear techniques in medicine, panellists highlighted the importance of partnerships between governments, non-governmental organizations, professional societies, international organizations and the private sector as a way to fund equipment purchases, expand access to nuclear medicine and radiotherapy procedures, and ensure a qualified workforce of health professionals.

Renovation of the Nuclear Applications Laboratories (ReNuAL)

The Renovation of the Nuclear Applications Laboratories (ReNuAL) project reached significant milestones in 2017. In September, the Agency inaugurated the new Insect Pest Control Laboratory, enabling it to provide Member States with expanded and enhanced SIT related services and training. Further extrabudgetary funds were raised during the year, bringing the overall financial contributions for modernization of the nuclear applications laboratories to nearly €32.5 million from 31 Member States and other contributors. Construction of the Flexible Modular Laboratory began in April. Efforts aimed at extending the Agency's partnerships and resource mobilization base beyond its

traditional partners resulted in a partnership concluded with Varian Medical Systems for a ten year loan of a linear accelerator to the Dosimetry Laboratory, complemented by an in-kind Member State contribution for servicing the equipment. The Agency also signed a memorandum of cooperation with Shimadzu Corporation for donation of a high speed liquid chromatograph–mass spectrometer, through the Peaceful Uses Initiative (PUI), for activities to support Member States in the area of food safety.

Food and Agriculture

Eradication of the Mediterranean fruit fly from the Dominican Republic

The Agency successfully concluded a two year technical cooperation project supporting efforts to eradicate the Mediterranean fruit fly from the Dominican Republic. At the Member State's request, the Agency, in partnership with the Food and Agriculture Organization of the United Nations (FAO) through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, provided training and technical guidance in the area-wide application of SIT to control an outbreak of Mediterranean fruit fly, a major agricultural pest. The project, which also involved the United States Department of Agriculture, the International Regional Organization for Plant and Animal Health (OIRSA), the Inter-American Institute for Cooperation on Agriculture and the joint Guatemala–Mexico–USA Moscamed Programme, established surveillance systems throughout the country and provided training to local personnel in trapping and identifying the fly, and in using complementary pest control methods. In July, the Government officially declared the Dominican Republic to be free of Mediterranean fruit fly.

"The Agency successfully concluded a two year technical cooperation project supporting efforts to eradicate the Mediterranean fruit fly from the Dominican Republic."

Animal and zoonotic disease outbreaks: Diagnosis and control

The Veterinary Diagnostic Laboratory (VETLAB) Network continued to grow, with the addition of eight national laboratories in 2017. The network now extends to 44 countries in Africa and 19 countries in Asia. During the year, the Agency provided toolboxes for sample collection, packing and shipment from the field under biosecurity conditions, and diagnostic consumables for early detection of animal and zoonotic diseases. In particular, it provided toolboxes for sampling and detection of avian influenza or suspected Ebola carrier animals to Belize, Benin, Bulgaria, the Democratic Republic of the Congo, Croatia, the Lao People's Democratic Republic, Lesotho, Mozambique, Myanmar, Namibia, South Africa, Turkey, Uganda, Viet Nam and Zimbabwe. It also supported laboratory capacity building by providing training, equipment and expert advice to 35 Member States.

Climate-smart agriculture

Tracers are important components in the measurement of soil erosion, providing information useful for developing strategies to improve soil quality and soil conservation approaches. In 2017, the Agency, through the Joint FAO/IAEA Division, developed and began validating plutonium-239 and plutonium-240 radioisotopes as tracers for assessing soil erosion. With their much lower rates of decay (half-lives of more than 6500 years) than currently used radioisotopes (caesium-137, beryllium-7 and lead-210), plutonium-239+240 will facilitate long term assessment of soil erosion and degradation.

Regional food safety networks

The Agency continued to actively support the establishment and strengthening of food safety networks among laboratories and related institutions in 36 countries in Africa, 16 countries in the Asia and the Pacific region, and 21 countries in Latin America and

the Caribbean. In 2017, it initiated an interregional networking mechanism to support the transfer of analytical technologies and to facilitate the exchange of knowledge and expertise, to help Member States within the networks to address common challenges such as international food safety standards that impact trade.

Human Health

Nuclear techniques for the early diagnosis of Alzheimer's disease

Medical imaging, and in particular nuclear medicine, can improve the early and differential diagnosis of dementia, leading to better patient care. In 2017, the Agency raised awareness about the importance of nuclear techniques in the evaluation of patients with dementia — including Alzheimer's disease — and other neurological diseases through a side event during the 61st regular session of the General Conference in September. Presentations from the event were made available on the Agency's Human Health Campus web site. The Agency also provided training in the diagnosis of Alzheimer's disease to around 120 medical professionals through training courses held in Argentina, Brazil and Chile.

Addressing malnutrition using stable isotopes

The Agency, jointly with the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), organized a workshop entitled 'Analysis of Biological Pathways to Better Understand the Double Burden of Malnutrition and to Inform Action Planning' in Vienna in October. The workshop brought together some 50 researchers and public health professionals working in the fields of nutrition and diet related non-communicable diseases in 30 countries around the world. Participants shared information on the latest evidence regarding interlinkages of different forms of malnutrition, and identified research and policy gaps to tackle the double burden of malnutrition. The joint workshop was the focus of articles in *The Lancet Global Health* and *UN Special*.

Radiation risk assessment and risk perceptions in medical imaging

During the 61st regular session of the Agency's General Conference, the Agency organized a joint side event with WHO and the United Nations Scientific Committee on the Effects of Atomic Radiation to inform health professionals and other interested parties about radiation risk assessment and risk perception in medical imaging. More than 60 participants discussed the methodologies used for assessing doses and associated risks, perception magnitude and significance of dangers linked to medical exposures, and the importance of proper risk communication to patients.

Radioisotope Production and Radiation Technology

Regulatory aspects of radiopharmaceutical production

In October, the Agency held a Technical Meeting of regulators and researchers responsible for the safe preparation and use of radiopharmaceuticals from 15 Member States, WHO and several professional societies. The meeting provided a platform for evaluating the status of regulations governing radiopharmaceutical production in different countries and for exploring the possibility of harmonizing regulations with Agency support.

Industrial applications of radiotracers and sealed sources

The Agency's activities in the area of industrial applications of radiation technologies focused on capacity building initiatives in 2017. In June and July, the Agency held a training course on industrial applications of radiotracers and sealed sources at the IAEA Collaborating Centre at the National Institute for Nuclear Science and Technology in Saclay, France, with participants from Cameroon, Côte d'Ivoire, the Democratic Republic of the Congo, Gabon, Madagascar and Morocco. A training course on industrial application of radiotracers was held in November at the National Centre for Nuclear Energy, Sciences and Technology in Morocco, with participants from Egypt, Kenya, the Sudan and Zimbabwe. Both courses were organized through the Agency's technical cooperation programme and included an examination under the certification scheme of the International Society for Tracer and Radiation Applications.

Water Resources Management

Sustainable groundwater resources management in Africa

In May, the Agency published the main findings of the technical cooperation project entitled 'Integrated and Sustainable Management of Shared Aquifer Systems and Basins of the Sahel Region'. Project participants used tritium, a naturally occurring radionuclide, to map shallow, recently recharged groundwater and to identify the main sources of recharge. The project provided the first broad overview of the region's groundwater supplies. Among the main findings were that significant reserves of good quality water are available in the region and that pollution is still limited and not yet a threat to these water sources.

Environment

Strengthened analytical capacity for rapid response

For more than 20 years, the Agency has organized annual proficiency tests that allow hundreds of laboratories to monitor and improve their performance in analysing environmental radionuclides. In June, such a proficiency test was included in the Agency's Convention Exercises (ConvEx-3) emergency response exercise for the first time. Almost 90 laboratories worldwide participated, providing rapid analysis and reporting of radionuclide activity concentrations in specially prepared water samples. Overall results showed excellent agreement with reference values, demonstrating existing Member State capabilities for fast and reliable analyses in the case of environmental emergencies.

NUCLEAR SAFETY AND SECURITY

Nuclear Safety

Priorities for nuclear safety

The Agency identified priorities for continued work in strengthening nuclear, radiation, transport and waste safety, and emergency preparedness and response. These priorities include activities related to, inter alia, ageing management and long term operation of nuclear installations; leadership and management for safety; culture for safety; and activities related to radiation and waste safety improvements, such as decommissioning of nuclear installations, radiation protection and radioactive sources management.

Safety standards

In October, with the publication of *Safety of Nuclear Fuel Cycle Facilities* (IAEA Safety Standards Series No. SSR-4), the Agency completed the revision of its Safety Requirements to take into account lessons from the Fukushima Daiichi accident. Future revisions of safety standards and publications in the IAEA Nuclear Security Series will benefit from the Nuclear Safety and Security Online User Interface platform, launched during the Agency's General Conference in September. The new platform is in addition to the official communication channels and enables authorized users to provide direct feedback on current safety standards and IAEA Nuclear Security Series publications. The IAEA Safety Glossary has been integrated into the platform, enabling future electronic versions of the safety standards to include access to Glossary definitions.

Peer review and advisory services

"During the year, the Agency conducted over 50 safety related peer review and advisory service missions to more than 40 Member States"

Member State requests for peer review and advisory services continued to increase in 2017. During the year, the Agency conducted over 50 safety related peer review and advisory service missions to more than 40 Member States, including the first two Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) missions. The Agency carried out six Integrated Regulatory Review Service (IRRS) missions and seven follow-up IRRS missions; one Emergency Preparedness Review (EPREV) mission; seven Operational Safety Review Team (OSART) missions and seven follow-up OSART missions; three Safety Aspects of Long Term Operation (SALTO) missions and one follow-up SALTO mission; five Site and External Events Design (SEED) review missions; two Education and Training Appraisal (EduTA) missions; four Occupational Radiation Protection Appraisal Service (ORPAS) missions; one Independent Safety Culture Assessment (ISCA) mission; and three Integrated Safety Assessment of Research Reactors (INSARR) missions and two follow-up INSARR missions.

The Agency continued to strengthen its peer review and advisory services and self-assessment tools by incorporating lessons learned from their implementation. In August, 38 Member States provided feedback at a Technical Meeting to Assess the Overall Structure, Effectiveness and Efficiency of Peer Review and Advisory Services in the Areas of Nuclear Safety and Security, held in Vienna.

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

The International Conference on Topical Issues in Nuclear Installation Safety: Safety Demonstration of Advanced Water Cooled Nuclear Power Plants, held in Vienna in June, drew more than 300 participants from 48 Member States. Attendees exchanged information on the latest approaches, advances and challenges in demonstrating the safety of nuclear power plants planned for the near future. During the conference, the Agency conducted a workshop on design extension conditions. Participants were provided with an overview of the Agency's design related Safety Requirements for nuclear power plants focused on design extension conditions.

In May, the Agency held the fourth International Meeting on Application of the Code of Conduct on the Safety of Research Reactors, with the participation of some 40 countries. During the year, it conducted three workshops in Vienna focusing on the safety of nuclear fuel cycle facilities. These workshops provided forums for over 72 participants from 29 Member States to share information, experience and good practices in establishing and supervising safety and protection programmes on the basis of the Agency's safety standards.

Incident and emergency preparedness and response

In response to increased Member State interest in harmonization of emergency preparedness and response arrangements, the Agency published *Guidelines on the Harmonization of Response and Assistance Capabilities for a Nuclear or Radiological Emergency* (EPR-Harmonized Assistance Capabilities 2017). It also held two workshops to assist Member States in Southeast Asia. In the first workshop, held in Singapore in June and attended by 21 participants from 10 Member States, a plan for a regional strategy for coordinating public communication in an emergency was defined. The second workshop, held in Pattaya, Thailand, from 28 August to 1 September and attended by 22 participants from 10 Member States, assisted Member States in developing adequate and harmonized emergency preparedness and response capabilities.

The Agency developed new guidelines for EPREV missions that improve the mission process, taking into account Member State experience and feedback, as well as recommendations from the Agency's Peer Review and Advisory Services Committee.

In June, the Agency conducted its largest ConvEx-3 exercise, hosted by Hungary, with the participation of 83 Member States and 11 international organizations. The 36 hour event, based on the scenario of a severe accident at the Paks nuclear power plant, allowed Member States and international organizations to evaluate their early response and the international emergency management system in a severe nuclear emergency. This year's ConvEx-3 exercise was the first to test the automatic interface between the emergency communication systems of the Agency and the European Commission.

Radioactive waste management, environmental assessments and decommissioning of nuclear facilities

The *Code of Conduct on the Safety and Security of Radioactive Sources: Guidance on the Management of Disused Radioactive Sources* (GC(61)/23) was approved by the Board of Governors and endorsed by the General Conference in September. The guidance takes into account the Agency's safety standards and nuclear security guidance, and addresses safety and security in an integrated manner.

In collaboration with Kyrgyzstan, Tajikistan, Uzbekistan, the European Bank for Reconstruction and Development, the European Commission and the State Atomic Energy Corporation "Rosatom", the Agency finalized the development of the *Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia*, providing a strategy and implementation plan for remediating uranium legacy sites in Central Asia.

Radiation protection

In December, the Agency organized the International Conference on Radiation Protection in Medicine: Achieving Change in Practice, in Vienna. The conference's 534 participants from 96 Member States and 16 international organizations discussed, inter alia, the implementation of the Bonn Call for Action to improve radiation protection in medicine.

The Agency initiated a project to develop guidance on radioactivity in food and drinking water in non-emergency situations at a regional workshop held in March. With the cooperation of FAO, the Pan American Health Organization and WHO, workshop participants from 16 Member States identified a number of areas where greater consistency and harmonization regarding control of radioactivity would be beneficial. The project, implemented in cooperation with FAO and WHO, will address natural and artificial radionuclides in food and drinking water.

Leadership and management for safety, safety culture and communication on safety

An increasing number of Member States are requesting assistance in the area of leadership and management for safety. In collaboration with the European Commission, the Agency held the first Pilot International School of Nuclear and Radiological Leadership for Safety, in Nice, France, with the participation of 20 junior and middle managers from operators and regulators. The School is designed to increase the participants' ability to effectively address issues involving culture for safety. Case studies, presentations and keynote addresses, group exercises and discussions provided participants with a better understanding of what leadership for safety means in practice in working environments containing nuclear or radiological material.

In September, the Agency issued a Safety Guide entitled *Communication and Consultation with Interested Parties by the Regulatory Body* (IAEA Safety Standards Series No. GSG-6), providing recommendations on communication and consultation about the possible radiation risks associated with facilities and activities, and about processes and decisions of the regulatory body.

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

In 2017, the Agency conducted 343 capacity building activities across its programme of work for nuclear, radiation, transport and waste safety, and emergency preparedness and response. In particular, through the analysis of mission findings it identified a need to further support Member States in strengthening their national human capacity building programmes.

In September, the National Institute of Radiological Sciences in Chiba, Japan, was designated as an IAEA Capacity Building Centre for emergency preparedness and response. The centre will provide national and international training courses, workshops and exercises related to the medical management of radiation exposures and dose assessment.

Strengthening global, regional and national networks and forums

The Agency coordinated over 100 national and regional activities under the auspices of the Global Nuclear Safety and Security Network (GNSSN). Within the GNSSN, the Secretariat developed a prototype Global Education and Training Resources platform, providing users with access to over 500 global training and educational resources and 25 e-learning modules.

In July, the Agency hosted the second coordination meeting of the Forum of Nuclear Regulatory Bodies in Africa, in Vienna. Meeting participants consolidated the position paper on the needs of the Forum, initiated in 2016, and prepared a survey for use in setting the priorities among the Forum's members.

In July, the Agency renewed its Practical Arrangements with the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO) on the 20th anniversary of its establishment, in Buenos Aires, Argentina.

Safety conventions

The Agency hosted the Seventh Review Meeting of the Contracting Parties to the Convention on Nuclear Safety in Vienna from 27 March to 7 April. The meeting, attended by more than 900 representatives of 77 Contracting Parties, approved several recommendations addressing, inter alia, evaluation of the effectiveness of the changes to the review process; topical sessions during future Review Meetings; organization of educational workshops

for countries without nuclear reactors to, inter alia, encourage participation and provide assistance in adhering to and meeting the obligations under the Convention; assessing the possibility of organizing video conferences for certain Country Group sessions; and streaming of parts of plenary sessions and the press conference on the Agency's web site. A workshop to promote adherence to the Convention was organized in Vienna in November for Member States from Asia and Latin America.

In May, the Agency hosted the Third Extraordinary Meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, in Vienna. The Contracting Parties amended the *Guidelines regarding the Review Process* (INFCIRC/603/Rev.6) so that the Secretariat makes publicly available each National Report 90 days after the Review Meeting, unless the Contracting Party concerned notifies the Secretariat otherwise. The Organizational Meeting for the Sixth Review Meeting of the Contracting Parties to the Joint Convention was also held in Vienna in May. To mark the 20th anniversary of the Joint Convention, adopted on 5 September 1997, a side event was organized on the margins of the General Conference. A workshop to promote adherence to the Joint Convention was organized in December in Rabat, Morocco, for Member States in the African region.

Civil liability for nuclear damage

The International Expert Group on Nuclear Liability (INLEX) is an expert group that provides advice on issues related to nuclear liability as requested by the Director General or the Director of the Office of Legal Affairs. The 17th Meeting of INLEX took place in Vienna in May. The Group considered the possible exclusion of certain low risk installations from the scope of application of the liability conventions with specific reference to the case of installations being decommissioned and of installations for the disposal of certain types of low level radioactive waste. In this respect, the Group concluded that there is no need to exclude any such installations from the scope of application of the revised Vienna Convention on Civil Liability for Nuclear Damage and of the Convention on Supplementary Compensation for Nuclear Damage. The Group also discussed other liability issues relating to disposal facilities, to transportable nuclear power plants and to the transport of nuclear material, as well as the scope of application of the nuclear liability conventions as regards radioactive products or waste. However, the Group felt that these issues required a more detailed analysis and decided to consider them further at its next meeting.

The Sixth Workshop on Civil Liability for Nuclear Damage was held in Vienna in May. The workshop provided participants with an introduction to the international legal regime of civil liability for nuclear damage. Workshops on civil liability for nuclear damage were also held in Montevideo, Uruguay, in June, and in Accra, Ghana, in November, to provide participants with information on the existing international nuclear liability regime and to advise on the development of national implementing legislation. In addition, an Agency–INLEX follow-up mission to Malaysia was conducted in February to address issues relating to the implementation of the international nuclear liability regime.

In May, the Agency published *The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage — Explanatory Texts* (IAEA International Law Series No. 3 (Revised)).

Nuclear Security

International Conference on Physical Protection of Nuclear Material and Nuclear Facilities

In November, the Agency, in cooperation with the World Institute for Nuclear Security, the World Nuclear Transport Institute and the International Criminal Police

Organization — INTERPOL, organized the International Conference on Physical Protection of Nuclear Material and Nuclear Facilities. The conference drew some 700 experts from 95 States, representing competent authorities, facility operators, shippers and carriers, and technical support organizations. Participants shared lessons learned and good practices in implementing the *Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)* (IAEA Nuclear Security Series No. 13).

Nuclear Security Plan 2018–2021

At its September meeting, the Board of Governors approved the *Nuclear Security Plan 2018–2021*. The Plan provides details of proposed Agency nuclear security activities for the period 2018–2021. It corresponds to the priorities of Member States expressed through the decisions and resolutions of the Agency's Policy-Making Organs as well as priority setting for IAEA Nuclear Security Series guidance as recommended by the Nuclear Security Guidance Committee.

Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM)

The Agency continued to promote universal adherence to the Amendment to the Convention on the Physical Protection of Nuclear Material through Technical Meetings, expert missions and promotional efforts. In November, it organized the third Technical Meeting of the Representatives of States Parties to the Convention on the Physical Protection of Nuclear Material (CPPNM) and the CPPNM Amendment, in Vienna, with the participation of 50 Parties to the CPPNM. The representatives discussed, inter alia, the Amendment, with particular emphasis on preparations for a conference of States Parties to the Amendment in 2021. In addition, the Agency conducted an expert mission to Uganda in May, to encourage adherence to the Amendment.

Capacity building

"In 2017, the Agency conducted 111 security related training activities... providing training to more than 2000 participants from 158 States."

In 2017, the Agency conducted 111 security related training activities — 57 at the national level and 54 at the international or regional level — providing training to more than 2000 participants from 158 States. It launched new e-learning modules on: Nuclear Security Threats and Risks, including a new Overview, and separate modules on Material and Facilities, Material out of Regulatory Control and Cyber Threats; Use and Maintenance of Portable HPGe Gamma-Ray Spectrometer; and Preventive and Protective Measures Against Insider Threats. The courses provide an introduction to the basic principles of nuclear security based on the Agency's nuclear security recommendations and guidance.

IPPAS missions

The Agency conducted six International Physical Protection Advisory Service (IPPAS) missions, including two follow-up IPPAS missions. In October, it hosted the third International Workshop on the International Physical Protection Advisory Service (IPPAS) for Potential Team Members of Future IPPAS Missions, in Vienna. The workshop, attended by 53 participants from 29 Member States, was aimed at increasing the number of experts able to participate in such missions.

NUCLEAR VERIFICATION[1,2]

Implementation of safeguards in 2017

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

In 2017, safeguards were applied for 181 States[3,4] with safeguards agreements in force with the Agency. Of the 127 States that had both a comprehensive safeguards agreement (CSA) and an additional protocol (AP) in force[5] the Agency drew the broader conclusion that *all* nuclear material remained in peaceful activities for 70 States[6]; for the remaining 57 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. For 46 States with a CSA but with no AP in force, the Agency concluded only that *declared* nuclear material remained in peaceful activities. For those States for which the broader conclusion has been drawn, the Agency is able to implement integrated safeguards: an optimized combination of measures available under CSAs and APs to maximize effectiveness and efficiency in fulfilling the Agency's safeguards obligations. During 2017, integrated safeguards were implemented for 65 States[7,8].

Safeguards were also implemented with regard to nuclear material in selected facilities in the five nuclear-weapon States party 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 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 the three States for which the Agency implemented safeguards pursuant to item-specific safeguards agreements based on INFCIRC/66/Rev.2, the Agency concluded that nuclear material, facilities or other items to which safeguards had been applied remained in peaceful activities.

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

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

3 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 Or an additional protocol being provisionally applied, pending its entry into force.

6 And Taiwan, China.

7 Albania, Andorra, Armenia, Australia, Austria, Bangladesh, Belgium, Botswana, Bulgaria, Burkina Faso, Canada, Chile, Croatia, Cuba, Czech Republic, Denmark, Ecuador, Estonia, Finland, Germany, Ghana, Greece, Holy See, Hungary, Iceland, Indonesia, Ireland, Italy, Jamaica, Japan, Kazakhstan, Republic of Korea, Latvia, Libya, Lithuania, Luxembourg, Madagascar, Mali, Malta, Mauritius, Monaco, Montenegro, Netherlands, New Zealand, Norway, Palau, Peru, Philippines, Poland, Portugal, Romania, Seychelles, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Tajikistan, the former Yugoslav Republic of Macedonia, Ukraine, United Republic of Tanzania, Uruguay, Uzbekistan and Viet Nam.

8 And Taiwan, China.

As of 31 December 2017, 12 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 implement the *Plan of Action to Promote the Conclusion of Safeguards Agreements and Additional Protocols*[9], which was updated in September 2017. During 2017, a CSA with a small quantities protocol (SQP) and an AP were signed for one State[10]. In addition, three States[11] brought an AP into force. One State[12] acceded to the safeguards agreement between the non-nuclear-weapon States of Euratom, Euratom and the Agency, and to the protocol additional thereto. An INFCIRC/66/Rev.2-type agreement was signed and entered into force for one State[13]. By the end of 2017, safeguards agreements were in force with 182 States and APs were in force with 132 States. An AP continued to be provisionally applied pending its entry into force for one State[14]. Moreover, an SQP became non-operative for one State.[15] By the end of 2017, 62 States had accepted the revised SQP text (which was in force for 55 of these States) and 7 States had rescinded their SQPs.

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

Throughout 2017, the Agency continued to verify and monitor the nuclear-related commitments of the Islamic Republic of Iran (Iran) under the Joint Comprehensive Plan of Action (JCPOA). During the year, the Director General submitted four reports to the Board of Governors and in parallel to the United Nations Security Council entitled *Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015)* (GOV/2017/10, GOV/2017/24, GOV/2017/35 and GOV/2017/48).

Syrian Arab Republic (Syria)

In August 2017, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic* (GOV/2017/37) covering relevant developments since the previous report in August 2016 (GOV/2016/44). 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.[16] In 2017, the Director General renewed his call on Syria to cooperate fully with the Agency in connection with

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9 Available at: *https://www.iaea.org/sites/default/files/sg-plan-of-action-2016-2017.pdf.*

10 Liberia.

11 Honduras, Senegal and Thailand.

12 Croatia.

13 Pakistan.

14 Islamic Republic of Iran.

15 United Arab Emirates.

16 The Board of Governors, in its resolution GOV/2011/41 of June 2011 (adopted by a vote), had, inter alia, called on Syria to urgently remedy its non-compliance with its NPT Safeguards Agreement and, in particular, to provide the Agency with updated reporting under its Safeguards Agreement and access to all information, sites, material and persons necessary for the Agency to verify such reporting and resolve all outstanding questions so that the Agency could provide the necessary assurance as to the exclusively peaceful nature of Syria's nuclear programme.

unresolved issues related to the Dair Alzour site and other locations. Syria has yet to respond to these calls.

On the basis of the evaluation of information provided by Syria and all other safeguards relevant information available to it, the Agency found no indication of the diversion of declared nuclear material from peaceful activities. For 2017, the Agency concluded for Syria that declared nuclear material remained in peaceful activities.

Democratic People's Republic of Korea (DPRK)

In August 2017, the Director General submitted a report to the Board of Governors and General Conference entitled *Application of Safeguards in the Democratic People's Republic of Korea* (GOV/2017/36–GC(61)/21), which provided an update of developments since the Director General's report of August 2016 (GOV/2016/45–GC(60)/16).

Since 1994, the Agency has not been able to conduct all necessary safeguards activities provided for in the DPRK's NPT Safeguards Agreement. From the end of 2002 until July 2007, the Agency was not able — and, since April 2009, has not been able — to implement any verification measures in the DPRK, and, therefore, the Agency could not draw any safeguards conclusion regarding the DPRK.

On 3 September 2017, the DPRK announced that it had conducted a nuclear test.

In 2017, no verification activities were implemented in the field but the Agency continued to monitor the DPRK's nuclear activities by using open source information, including satellite imagery and trade information. In June 2017, the Director General indicated his intention to enhance the Agency's readiness to play an essential role in verifying the DPRK's nuclear programme. To this end, in August 2017, a DPRK Team was formed within the Department of Safeguards to enhance the monitoring of the DPRK's nuclear programme; maintain updated verification approaches and procedures for the nuclear facilities known to exist within the DPRK; prepare for the Agency's return to the DPRK; and ensure the availability of appropriate verification technologies and equipment. An Executive Group was also formed within the Secretariat to consider procedural, managerial and legal matters.

During 2017, the Agency continued to observe indications that were consistent with the operation of the Yongbyon Experimental Nuclear Power Plant (5 MW(e)) which commenced the current operational cycle in early December 2015. The Agency did not observe indications of reprocessing operations at the Radiochemical Laboratory during 2017. At the Yongbyon Nuclear Fuel Rod Fabrication Plant there were indications consistent with the use of the reported centrifuge enrichment facility located within the plant. Construction work was undertaken on a building that adjoins the reported centrifuge enrichment facility. There were indications in the light water reactor construction yard of an increase in activities consistent with the fabrication of certain reactor components. The Agency has not observed indications of the delivery or introduction of major reactor components into the reactor containment building.

The Agency has not had access to the Yongbyon site. Without access to the site, the Agency cannot confirm the operational status of the facilities on the site, or the nature and purpose of the activities observed.

The continuation and further development of the DPRK's nuclear programme are a cause for grave concern. The DPRK's nuclear activities are deeply regrettable and clear violations of relevant United Nations Security Council resolutions, including resolutions 2371 (2017), 2375 (2017) and 2397 (2017). The DPRK's sixth nuclear test, announced on 3 September 2017, was also in clear violation of United Nations Security Council resolutions and is extremely regrettable.

Enhancing safeguards

During 2017, the Agency developed new State-level safeguards approaches as described in the Director General's reports GOV/2013/38 and GOV/2014/41 and Corr.1. This resulted in new State-level safeguards approaches for 62 States, bringing the total number of States for which State-level safeguards approaches have been developed to 126. In developing and implementing a State-level safeguards approach, consultations were held with the relevant State and/or regional authority, particularly on the implementation of in-field safeguards measures.

Cooperation with State and regional authorities

To assist States in building capacity for implementing their safeguards obligations, the Agency conducted seven international, regional and national training courses for those responsible for overseeing and implementing the State and regional systems of accounting for and control of nuclear material. More than 180 participants from some 40 countries attended the courses. The Agency also participated in nine other training activities organized by Member States on a bilateral basis. In 2017, the Agency carried out an Integrated Nuclear Infrastructure Review (INIR) mission to Ghana that included, inter alia, advice on how to systematically enhance the capabilities necessary for the application of safeguards while embarking on a nuclear power programme.

Safeguards equipment and tools

Throughout 2017, the Agency ensured that the instrumentation and monitoring equipment installed in nuclear facilities around the world, which is vital to effective safeguards implementation, continued to function as required. It continued with the next generation surveillance system implementation campaign, replacing outdated surveillance units. At the end of 2017, a total of 750 next generation surveillance system cameras had been installed.

Safeguards analytical services

In 2017, the Agency collected 599 nuclear material samples, which were analysed by the Agency's Nuclear Material Laboratory. It also collected 483 environmental samples during the year, which were analysed by the Network of Analytical Laboratories, including at the Agency's Environmental Sample Laboratory and the Nuclear Material Laboratory.

Developing the safeguards workforce

In 2017, the Agency conducted 173 safeguards training courses to provide safeguards inspectors and analysts with the necessary technical and behavioural competencies. These included two sessions of the Introductory Course on Agency Safeguards held at Agency Headquarters for 24 newly recruited inspectors, and several courses held at nuclear facilities to enhance practical competencies for safeguards implementation in the field.

"In 2017, the Agency conducted 173 safeguards training courses to provide safeguards inspectors and analysts with the necessary technical and behavioural competencies."

Information technology: MOSAIC

By the end of 2017, the Modernization of Safeguards Information Technology (MOSAIC) project had delivered 17 newly developed or refurbished software applications or systems, while continuing to strengthen measures for the secure protection of safeguards data. Overall, MOSAIC continued to make steady progress towards its planned completion by May 2018.

Preparing for the future

Under the departmental strategic planning framework, the Agency held a workshop on emerging technologies in February, which fostered the update of the *Research and Development Plan (R&D)* and the biennial *Development and Implementation Support Programme for Nuclear Verification 2018–2019*. These two documents inform Member States about required support to improve the Agency's technical capabilities. The Development and Implementation Support Programme for Nuclear Verification comprises 314 support programme tasks in 24 projects. At the end of 2017, 20 States[17] and the European Commission had formal support programmes with the Agency.

MANAGEMENT OF TECHNICAL COOPERATION FOR DEVELOPMENT

The technical cooperation programme in 2017

The technical cooperation programme is the Agency's key mechanism for transferring technology and building capacities in the peaceful use of nuclear science and technology. In 2017, safety and security accounted for the highest proportion of actuals (disbursements) delivered through the technical cooperation programme, at 25.0%. This was followed by health and nutrition at 24.3%, and by food and agriculture at 19.4%. By the end of the year, financial implementation of the Technical Cooperation Fund (TCF) stood at 86.3%. Regarding non-financial implementation, the programme supported, inter alia, 3641 expert and lecture assignments, 222 regional and interregional training courses, and 1979 fellowships and scientific visits.

First international conference on the technical cooperation programme

As part of the activities to mark its 60th anniversary, the Agency hosted the first International Conference on the IAEA Technical Cooperation Programme: Sixty Years and Beyond — Contributing to Development, highlighting the programme's role in helping Member States achieve their development priorities. Held in Vienna from 30 May to 1 June, the conference brought together over 1200 participants from 160 countries and 27 organizations, and was attended by three Heads of State or Government and 16 Ministers. Participants shared success stories demonstrating how the technical cooperation programme has transferred technology, supported capacity building and facilitated international cooperation. Attendees explored new, and strengthened existing, partnerships and discussed the contribution that the programme can make to Member State efforts to achieve their SDGs.

Technical cooperation and the global development context

Member States are increasingly emphasizing the links between the technical cooperation programme and global and national commitments on climate change and the SDGs. The Agency highlighted the importance of nuclear science and technology and its contribution to achieving the SDGs at the United Nations High-level Political Forum on Sustainable Development through a side event entitled 'Science with Impact: Sustainable Development through Nuclear Technology'. The event was co-hosted by the Permanent Missions of Botswana and of Malaysia to the United Nations.

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[17] Argentina, Australia, Belgium, Brazil, Canada, China, Czech Republic, Finland, France, Germany, Hungary, Japan, Republic of Korea, Netherlands, Russian Federation, South Africa, Spain, Sweden, United Kingdom and United States of America.

Twenty Country Programme Frameworks and 12 United Nations Development Assistance Frameworks were co-signed in 2017.

Overview of regional activities

Africa

In Africa, activities to support Member States focused on human resource capacity building, networking, partnership facilitation and procurement of equipment. Priority was given to interventions in the fields of human health, agriculture and food security, water resource management, and legal and regulatory frameworks for radiation safety.

In the area of cancer treatment, several countries, including Botswana, Côte d'Ivoire, Ethiopia, Madagascar, Mali, Mozambique, Niger, Senegal, Uganda, the United Republic of Tanzania and Zimbabwe, reached the final stage of establishing, re-establishing, strengthening or expanding their radiotherapy services in 2017, with Agency support. In Côte d'Ivoire, the Agency provided training for six radiation oncologists and medical physicists serving in the country's first national radiotherapy centre, inaugurated in December.

The Agency is helping Member States to improve several mutant lines in various crops, including rice lines with drought and blast disease resistance in Egypt, and cowpea and sorghum with better yields in drought conditions in Namibia. In 2017, Zimbabwe officially released a more drought resistant variety of cowpea. Soil and water management practices were improved, using isotopic techniques, to enhance crop productivity in the Sudan and to reduce soil erosion in Morocco. In Benin and Mauritania, livestock productivity was improved through cross-breeding programmes and artificial insemination using nuclear derived techniques, contributing to improved food security. Senegal continued its long term efforts to eradicate the tsetse fly in the Niayes area through the application of SIT, with support from the Agency. Positive socioeconomic impact is visible in Niayes, where, free of the threat of tsetse, it has become possible to improve cattle breeds and to substantially increase milk and meat production.

The Agency sponsored a meeting of representatives of 39 African Member States, who developed a strategy to strengthen national and regional capacities to detect, and take appropriate early measures against, emerging zoonotic diseases such as the Ebola virus, Marburg fever, monkeypox and highly pathogenic avian flu. The strategy enhances cooperation among national actors from the public health, veterinary and wildlife services.

In 2017, emphasis was placed on building the capacities of waste regulators and operators for the safe management of radioactive waste. At training and demonstration exercises conducted in Egypt and Morocco, the Agency provided basic training in waste conditioning operations and in the storage of low activity gamma sources and neutron sources to more than 120 representatives of waste operators from 30 African Member States. It also provided support to Ghana to advance the country's planned disposal of disused sealed radioactive sources. An upgraded mobile hot cell that, after adequate conditioning and packaging, allows for their direct disposal into borehole facilities was developed as part of a technical cooperation project; the new capabilities were demonstrated by the South African Nuclear Energy Corporation.

Asia and the Pacific

In the Asia and the Pacific region, the key areas of focus in 2017 were safety and security, food and agriculture, and human health and nutrition.

The Agency provided internationally recognized and accredited training programmes through the IAEA Curricula for Nuclear Medicine Professionals. Two regional workshops were conducted in 2017, attended by 65 trainees from 18 Member States, and related

training materials were developed. The training programmes, developed by the Agency and collaborators from regional academic institutions, provide a framework for the systematic, sustainable and harmonized development of human health professional competencies. The workshops enhanced regional capacities in applying hybrid imaging in: oncology; neuroimaging; nuclear cardiology; diagnosis of infection/inflammation; paediatric and therapeutic nuclear medicine; and applications of theranostics (which 'personalizes' medicine by combining diagnosis and therapeutics). In Cambodia, the Agency continued to support the establishment of the National Cancer Centre through the provision of long term training, equipment and expert advice. The Centre is designed to cover up to 60% of the national demand for cancer diagnosis and treatment.

"The training programmes...provide a framework for the systematic, sustainable and harmonized development of human health professional competencies."

The Agency supported efforts by the Philippines to fully automate its gamma irradiation facility, providing technical assistance in the review of the design and specifications for the fully automated system. The new system will significantly enhance the safety and throughput of the facility, enabling it to meet growing industry demands for services such as food preservation, sterilization of medical equipment and industrial processing. The International Centre for Synchrotron Light for Experimental Science and Applications in the Middle East, a major international centre for scientific research in the Middle East that has benefited from significant Agency support, was inaugurated in May. The centre will enable scientists from the region to cooperate on advanced technology research projects.

Bangladesh made significant progress in crop improvement using mutation breeding in 2017. With the Agency's assistance, it produced new crop varieties with increased yield and salt and submergence tolerance, and over 6000 tonnes of rice seeds were distributed to farmers across the country. In the Lao People's Democratic Republic, the Agency helped the National Animal Health Laboratory to improve disease diagnosis and control activities for various transboundary animal diseases.

Radiation safety infrastructure in the Asia and the Pacific region was upgraded in 2017 through national and regional projects. Technical cooperation activities included support for participation in a postgraduate educational training course and a 'train the trainers' course for radiation safety officers. In addition, 19 participants from 10 countries took part in the School for Drafting Regulations on Radiation Safety. The Agency provided various tools to support Member State efforts to manage their regulatory activities, protect personnel occupationally exposed to radiation and conduct dose assessments for medical purposes. For example, Kuwait, Mongolia, Palau and Sri Lanka received the Regulatory Authority Information System (RAIS) software, a tool to assist Member States in managing their regulatory control programmes in accordance with Agency safety standards. The Agency also launched a regional effort involving 12 Member States aimed at enhancing emergency preparedness and response at the local, regional and international levels, focusing specifically on using radiation technologies to support the mitigation and recovery of civil structures affected by natural disasters.

The Agency continued to support efforts to introduce nuclear science and technology to students in secondary schools in the region. In an assessment in 2017, it was reported that over 1300 teachers were trained in pilot countries, and in total, the project reached more than 24 700 secondary school students.

Europe and Central Asia

The 32 Member States in the Europe and Central Asia region that participate in the technical cooperation programme display significant differences in their level of socioeconomic development and their application of nuclear technologies. The development of institutional and human resource capacities and the enhancement of cooperation among Member States are important features of the technical cooperation programme's activities in the region. In 2017, these activities focused on four thematic areas that were identified as priorities in the updated Regional Profile and in many Country Programme

Frameworks: nuclear and radiation safety, nuclear energy, human health, and isotope and radiation technology applications.

Demand for technical cooperation services related to nuclear power continued to increase in the region, where the development of nuclear power programmes is under way or under consideration in several countries. Two regional projects, entitled 'Strengthening Nuclear Power Plant Lifetime Management for Long Term Operation' and 'Enhancing Energy Planning, Nuclear Power Infrastructure Development and Nuclear Safety Regulatory Oversight', continued to support the development of nuclear power infrastructure. The Agency provided three Member States with assistance in strategy development, feasibility, financing and nuclear power infrastructure programme management related to the 19 issues identified in the Agency's Milestones approach. For example, Kazakhstan, which is considering the construction of a nuclear power plant (Phase I of the Milestones approach), was visited by Agency experts to assist it in making an informed decision on the future of nuclear power in the country.

The Agency organized a group fellowship training event at the Institute for Nuclear Technology, in Zagreb, Croatia, to build capacity by familiarizing participants with advanced non-destructive examination/in-service inspection technology and maintenance optimization techniques. The event was attended by nine fellows from the five countries in the Europe region having nuclear power plants. Participants gained practical experience valuable for the preparation of licence submissions for plant life management.

Agency support for nuclear medicine and cancer treatment services continued to be in high demand. The Agency provided training and workshops in English and Russian as part of a regional project to improve and harmonize quality assurance and quality control in medical applications of X rays. During the year, 117 project participants from 14 countries developed a simple descriptive handbook for harmonized quality control protocols for diagnostic radiology, which can be used as a reference for performance testing of major modalities in diagnostic radiology departments. In Estonia, the Agency provided training to enable medical practitioners to upgrade their knowledge and skills, and supported improvements to the country's operational infrastructure allowing new diagnostic and therapeutic methods to be made available for cancer patients.

Latin America and the Caribbean

In the Latin American and the Caribbean region, technical cooperation assistance provided in 2017 was directed mainly to the areas of human health and nutrition, followed by safety, food and agriculture, and water and the environment.

In health, activities focused on building capacity in radiation medicine; launching a one year master's programme on advanced radiotherapy; and supporting the training of professionals working with paediatric patients in diagnostic imaging modalities and radionuclide therapies. Several Member States prioritized the establishment of brachytherapy programmes for gynaecological tumours. With the Agency supporting equipment provision and training, the first public brachytherapy service in Honduras was inaugurated at San Felipe General Hospital.

In the area of safety, the regional programme focused on strengthening regulatory infrastructure, improving safety for end users, and reinforcing emergency preparedness and response capabilities. A new approach to delivering safety assistance through national and regional programmes was incorporated into the design of projects for the coming technical cooperation cycle. New Agency Member States in the Caribbean received expert support throughout 2017 to establish regulatory infrastructure and to strengthen control of radioactive sources.

Other regional projects in 2017 helped strengthen Member States' capacity to manage natural resources such as water, and to identify appropriate energy mixes to meet future energy demand. Initial steps towards the establishment of a Caribbean Observing Network

for Ocean Acidification, which will monitor ocean acidification and its impact on harmful algal blooms, were taken with the identification of Colombia, Costa Rica, Cuba and Mexico to serve as reference centres for monitoring.

The Agency successfully concluded its emergency assistance to the Dominican Republic in support of eradicating the Mediterranean fruit fly, a major agricultural pest. National capabilities were developed for the area-wide application of SIT, which contributed to the resumption of exports of fruit and vegetables that had been banned following the fly outbreak.

Programme of Action for Cancer Therapy (PACT)

The Agency continued to address the need of Member States to establish or enhance radiotherapy programmes. Activities in 2017 focused on reviewing national capacities for cancer control, addressing funding gaps in cancer related technical cooperation projects and mobilizing additional resources for sustainable cancer services. In collaboration with key partners and donors, the Agency helped low and middle income Member States to enhance the effectiveness of radiation medicine services as part of a comprehensive cancer control framework, and supported the training of health professionals and fundraising to boost cancer control activities. The Agency established a new partnership with the International Federation of Pharmaceutical Manufacturers and Associations.

"the Agency helped low and middle income Member States to enhance the effectiveness of radiation medicine services as part of a comprehensive cancer control framework, and supported the training of health professionals and fundraising to boost cancer control activities."

The Agency, in cooperation with the Organisation of Islamic Cooperation and the Islamic Development Bank, prepared and conducted the IAEA–OIC–IsDB meeting in the Sudan with the participation of 16 Member States, development banks and WHO to review funding gaps for cancer control priorities, and supported Member States in the development of funding proposals and bankable documents to expand cancer related diagnostic and treatment capacities. In 2017, the Korea Institute of Radiological and Medical Sciences provided training in advanced radiotherapy techniques to its 35th fellow since 2013.

The Agency, jointly with WHO, conducted imPACT ('integrated missions of PACT') Review missions to four Member States — Burundi, the Democratic Republic of the Congo, Swaziland and Togo. The imPACT missions assessed national cancer control needs and capacities and provided recommendations for addressing the national cancer burden. Costa Rica, Lesotho, Mozambique, Nicaragua and Rwanda received expert advisory support for the development of national cancer control plans. Fiji received expert assistance to develop a roadmap to implement its national cancer control plan, and to conduct a detailed costing exercise for the establishment of a radiotherapy facility.

A meeting of 29 international cancer experts was held in Vienna in January to identify challenges and propose solutions to improve access to affordable, quality, sustainable radiotherapy technology and services in low and middle income Member States. The Agency continued to participate in key global health events such as the World Health Summit held in October in Berlin, which brought together 2000 representatives from academia, government, the private sector and civil society from 100 countries. The Agency stressed its role in fostering innovation and expanding access to quality health care, highlighting the importance of the integration of radiation medicine in sustainable comprehensive national cancer control strategies. Potential funding and partnership opportunities were additionally explored.

Legislative assistance

In 2017, the Agency continued to provide legislative assistance to its Member States through the technical cooperation programme. Country specific bilateral legislative assistance was provided to 20 Member States through written comments and advice on drafting national nuclear legislation, and four regional and five national workshops or training courses on nuclear law were organized during the year.

The Agency also organized the seventh session of the Nuclear Law Institute in Baden, Austria, in October. Sixty participants from Member States attended the training. The Nuclear Law Institute is designed to meet increasing Member State demand for legislative assistance and to enable participants to acquire a solid understanding of all aspects of nuclear law, with a particular focus on legislative drafting.

Technical cooperation programme management

The Agency provided support to Member States and staff in 2017 through a series of training events, workshops and briefing sessions covering every phase of the technical cooperation programme cycle. The goal was to increase the efficiency, effectiveness and results orientation of programmes and projects throughout the planning, implementation and review stages.

Quality assurance activities related to the design of the 2018–2019 programme cycle were implemented through a two step mechanism. The Agency first provided project teams with feedback and guidance on the requirements for high quality project design; it then conducted a final quality review of all projects submitted by Member States. All quality reviews assessed two aspects of project design: the extent to which the project addressed an area of real need in which there was a national programme enjoying strong government commitment and support; and the extent to which the project design complied with the logical framework approach. This comprehensive approach was aimed at ensuring the quality of individual project designs and enabling comparison with previous technical cooperation cycles, and identifying lessons learned and areas for improvement in future cycles.

The Agency's new platform for electronic submission of Project Progress Assessment Reports became fully operational in 2017. The new system enables quicker and more relevant reporting by Member States and feedback from the Secretariat.

Financial resources

The technical cooperation programme is funded by contributions to the TCF, as well as through extrabudgetary contributions, government cost sharing and contributions in kind. Overall, new resources reached a total of some €105.6 million in 2017, with approximately €83.3 million for the TCF (including assessed programme costs, National Participation Costs and miscellaneous income), €21.7 million in extrabudgetary resources, and about €0.6 million representing in kind contributions.

The rate of attainment for the TCF stood at 99.6% on pledges and at 97.7% on payments at the end of 2017, while payment of National Participation Costs totalled €0.6 million.

Actuals

In 2017, approximately €85 million was disbursed to 144 countries or territories, of which 35 were least developed countries, reflecting the Agency's ongoing effort to address the development needs of those States.

"The proportion of women in the professional and higher categories was 29% and that of women in senior management positions…had reached 28.3% as of the end of 2017."

MANAGEMENT ISSUES

Gender equality and gender mainstreaming

The proportion of women in the professional and higher categories was 29% and that of women in senior management positions (D level or higher) had reached 28.3% as of the end of 2017. In June, the Director General and Deputy Director General and

Head of the Department of Management became International Gender Champions and made commitments to advance the Agency's work on gender equality. In September, the Secretariat conducted the first Agency-wide survey on gender equality; the data provided are being used to determine levels of awareness, knowledge and skills in relation to gender equality and to develop focused awareness raising and training activities.

Multilingual web site

In June, as the first phase of the multilingual web site project, the Agency launched web sites in Arabic, Chinese, French, Russian and Spanish. The second phase of the multilingual web site project was initiated in October in order to expand the information available in languages other than English.

Agency-wide Information System for Programme Support (AIPS)

The final component of the Agency-wide Information System for Programme Support (AIPS) — a new portal for Member States — went live in May 2017, and the AIPS project was officially closed at the end of June, on time and on budget.

Information and IT security

The Agency continued an initiative, begun in 2016, aimed at strengthening its information and IT security. Projects undertaken in 2017 focused on development of more comprehensive information security rules and procedures, preparation of an information security awareness programme to be rolled out in 2018, and implementation of additional security controls on the Agency's IT infrastructure.

Partnerships and resource mobilization

The Secretariat continued to implement the Strategic Guidelines on Partnerships and Resource Mobilization with a one-house approach. As reported to the Board of Governors in November,[18] it strengthened the partnerships and resource mobilization coordination mechanisms; undertook additional partnerships and resource mobilization efforts, particularly with non-traditional partners; strengthened internal information sharing, coordination mechanisms and tools; and enhanced staff members' capacity in partnerships and resource mobilization. The Secretariat also enhanced communication and outreach to external stakeholders; supported Member States in partnerships and resource mobilization activities; continued the Agency's existing collaboration arrangements; and developed new partnerships, particularly with Member State institutions to promote technology transfer, and with non-traditional partners such as international financial and regional organizations, the private sector, national and international professional organizations, and United Nations agencies and other international organizations.

Management of the Seibersdorf site

The Agency introduced an integrated framework to provide site-wide security, safety, infrastructure, maintenance, communication and outreach, and a broad spectrum of other support services to the Agency's laboratories in Seibersdorf. During the year it commissioned a master plan for the Seibersdorf site, a key component of the framework.

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[18] See *Report on the Implementation of Strategic Guidelines on Partnerships and Resource Mobilization* (GOV/INF/2017/13).

Nuclear Technology

Nuclear Power

Objective

To assist Member States embarking on new nuclear power programmes in planning and building their national nuclear infrastructures. To provide integrated support to Member States with existing nuclear power plants and to those planning new nuclear build in order to help improve operating performance and help ensure safe, secure, efficient and reliable long-term operation through the implementation of good practices and innovative approaches, and lessons learned from the Fukushima Daiichi accident. To provide collaborative frameworks for operators of water-cooled reactors to benefit from advances in technology, and for Member States to facilitate effective development of fast reactors and gas-cooled reactors and to expand the safe use of non-electric applications.

Launching Nuclear Power Programmes

The Agency's programme to assist countries interested in launching nuclear power programmes marked its tenth year in 2017. Throughout the year, the Agency continued to support 28 Member States considering or embarking on a nuclear power programme (Table 1). Agency technical cooperation projects addressed areas such as leadership and management systems, workforce planning and human resource development, managing financial risks associated with nuclear power projects, and resource requirements for nuclear power infrastructure development. Through interregional, regional and national workshops, training courses and fellowships, the Agency provided practical training in various infrastructure issues to more than 300 people, including members of nuclear power development projects, regulatory bodies and technical support organizations.

TABLE 1. Number of Member States considering or embarking on a nuclear power programme, according to their official statements (as of 31 December 2017)

First nuclear power plant started construction/under construction	3
First nuclear power plant ordered	2
Decided to introduce nuclear power and started preparing the appropriate infrastructure	4
Active preparation for a possible nuclear power programme with no final decision	7
Considering nuclear power programme	12

The Agency also supported Member States through its Integrated Nuclear Infrastructure Review (INIR) service. During the year, the number of INIR missions deployed since the service's launch in 2009 reached 22, involving 16 Member States (Table 2). In 2017, the Agency conducted an INIR Phase 1 mission to Ghana, and undertook support missions to

review and provide guidance on the self-evaluation reports developed by the Niger and the Sudan in their preparations for INIR missions. To improve the quality and consistency of INIR missions, the Agency published *Guidelines for Preparing and Conducting an Integrated Nuclear Infrastructure Review (INIR)* (IAEA Services Series No. 34). In October, it conducted a workshop with representatives of Belarus aimed at enhancing understanding of the INIR Phase 3 methodology and preparation of the self-evaluation report, and at clarifying the conditions of the national infrastructure evaluation in Phase 3.

TABLE 2. INIR missions conducted to Member States as of 31 December 2017

Region	Embarking	Expanding
Africa	Ghana, Kenya, Morocco, Nigeria	South Africa
Asia and the Pacific	Bangladesh, Indonesia, Jordan, Malaysia, Thailand, United Arab Emirates, Viet Nam	
Europe	Belarus, Kazakhstan, Poland, Turkey	

Agency activities in 2017 focused on increasing Member State awareness and understanding of the Milestones approach and key infrastructure issues such as funding and financing, management, human resource development, and stakeholder involvement. In July, the Agency published *Managing the Financial Risk Associated with the Financing of New Nuclear Power Plant Projects* (IAEA Nuclear Energy Series No. NG-T-4.6), providing Member States with a framework for considering issues of risk allocation and project structure, financing and economics. In August, it held a Technical Meeting in Vienna to present and elaborate on the publication. The meeting, attended by 31 participants from 18 Member States, enabled experts and participants from newcomer countries to share knowledge on financial risk allocation and mitigation. At a Technical Meeting on Resource Requirements for Nuclear Power Infrastructure Development, held in December in Vienna, 32 experts from 19 Member States and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA) compiled information on the resources needed to develop the infrastructure for a nuclear power programme.

The International Ministerial Conference on Nuclear Power in the 21st Century, organized in cooperation with the OECD/NEA, was held in Abu Dhabi, United Arab Emirates, in October–November. The conference drew around 700 participants from 64 Member States and 6 organizations, and included national statements and panel discussions on: nuclear power as the key to solving the 3Es (energy–economy–environment) trilemma; challenges in developing nuclear power infrastructure; safety and reliability aspects of nuclear energy; and innovations and advances in nuclear technologies. Participants confirmed that nuclear power remains an important option for climate change mitigation and for reaching the targets set out in the Paris Agreement and the Sustainable Development Goals. On the margins of the conference, the Khalifa University of Science and Technology was designated as an Agency Collaborating Centre, to promote capacity building and the sharing of experience in nuclear power infrastructure development over the next four years.

In 2017, the Agency launched a new project on management systems for embarking countries, funded through the Peaceful Uses Initiative. In September, 17 experts from governments, owner/operators and regulatory bodies in 7 Member States took part in a consultants meeting on Enhancing Leadership and Management Systems in Countries Introducing Nuclear Power Programmes, held in Vienna. Participants discussed the challenges that organizations face in developing their management systems, and identified key activities and possible means of support to embarking Member States in the area of integrated management systems. During the year, the Agency held workshops for seven Member States on modelling human resource requirements using the Agency's Nuclear

Power Human Resources (NPHR) workforce modelling tool and on workforce planning for new nuclear power programmes.

Stakeholder involvement continued to be an important area of focus for countries at all stages of nuclear infrastructure development. In June, 66 participants from 36 Member States attended a Technical Meeting on Stakeholder Involvement and Public Information that featured a role-playing simulation of a town hall meeting on a new nuclear power plant project.

The Agency added a new 'Procurement' module to its on-line e-learning course based on the Milestones approach for nuclear newcomers. A total of 17 Milestone modules are now available on the Agency's web site.

The Agency continued to enhance its Country Nuclear Infrastructure Profiles (CNIPs) mechanism, used to monitor the status of nuclear power infrastructure in Member States, and its Integrated Work Plan (IWP) mechanism, a tool for integrating Agency support for nuclear power programme development. In 2017, it created a shared platform where Member States and Agency staff can collaborate on CNIPs and IWPs, and used the improved mechanisms to plan activities in embarking Member States with active nuclear infrastructure development programmes. The Agency held meetings with nine embarking countries to develop or update IWPs and CNIPs during the year.

Operating Nuclear Power Plants and Expanding Nuclear Power Programmes

Around 60% of the nuclear power reactors in operation in 2017 had been in operation for 30 years or longer (Fig. 1). While a nuclear reactor is typically licensed for 30–40 years, their operating lifespans can be extended significantly, following special safety reviews and assessments of their essential structures, systems and components. Over 400 nuclear energy experts from 38 Member States and 4 international organizations discussed methods for safely operating nuclear power plants beyond their design lifetime in a cost effective way at the Fourth International Conference on Nuclear Power Plant Life Management, organized by the Agency in Lyon, France, in October.

To provide further support to its Member States in this field, the Agency published the *Handbook on Ageing Management for Nuclear Power Plants* (IAEA Nuclear Energy Series No. NP-T-3.24), providing information on ageing mechanisms; the effects of ageing on structures, systems and components; the regulatory framework; and innovative techniques

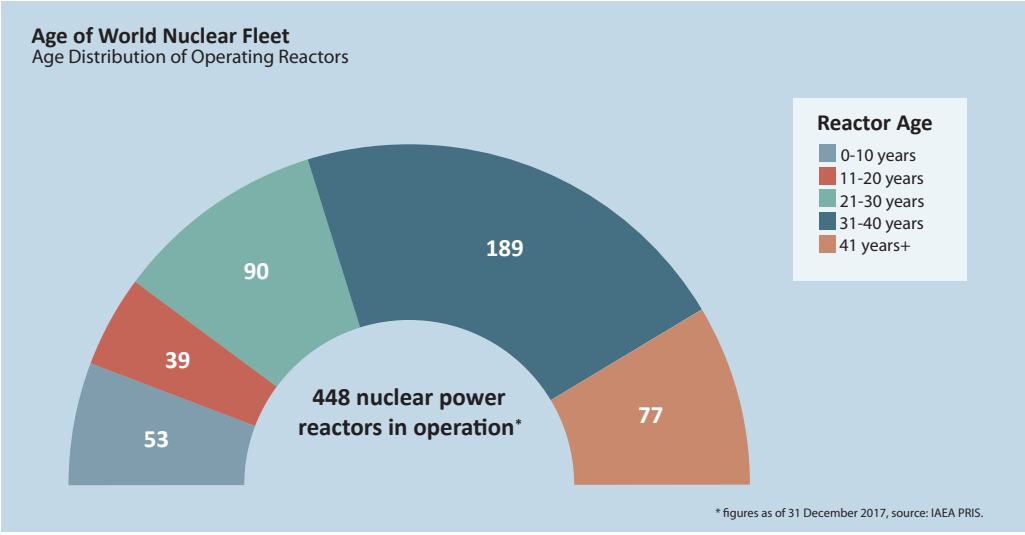

FIG. 1. Age distribution of operating nuclear power reactors as of 31 December 2017.

and research and development in the field. It also published *Benchmark Analysis for Condition Monitoring Test Techniques of Aged Low Voltage Cables in Nuclear Power Plants* (IAEA-TECDOC-1825), describing the fundamentals of cable performance and identifying condition monitoring techniques that show potential for further development and eventual implementation in cable ageing management programmes.

At a meeting of the Technical Working Group on Life Management of Nuclear Power Plants in February, 31 working group members and observers from 19 Member States and an international organization exchanged information regarding plant life management for long term operation. In May, 36 members of the Technical Working Group on Nuclear Power Plant Instrumentation and Control and observers from 20 Member States and an international organization met to plan the Agency's instrumentation and control (I&C) programme for 2018–2021.

In March, the Agency organized a Technical Meeting on Operational Experience with Implementation of Post-Fukushima Actions in Nuclear Power Plants, where 38 owner/operator and technical support organization experts from 19 Member States and 4 international organizations emphasized the importance of maintaining safety and increasing the efficiency and effectiveness of investments in safety enhancements at nuclear power plants.

To respond to growing Member State demand for assistance in the field of digital system reliability and computer security, the Agency organized a Technical Meeting on Engineering and Design Aspects of Computer Security in Instrumentation and Control Systems for Nuclear Power Plants, held in May in Gloucester, United Kingdom. At the meeting, 85 experts from 24 Member States emphasized the need for computer security controls to be considered in the design of I&C systems and the importance of strengthening Member States' understanding of the engineering and design aspects of computer security.

"85 experts from 24 Member States emphasized the need for computer security controls to be considered in the design of I&C systems"

At a Technical Meeting on the IAEA's Power Reactor Information System (PRIS) organized by the Agency in May, 33 experts from 23 Member States and international organizations called for the development of a construction module and a decommissioning module to supplement the existing modules in PRIS.

The Agency, together with the World Nuclear Association and the World Association of Nuclear Operators, organized a Technical Meeting on Roles, Responsibilities and Interfaces between Design Authority, Responsible Designers and Technical Support Organizations, held in December in London, United Kingdom. The 40 participating experts from 16 Member States and 3 international organizations shared experience, knowledge and good practices in defining and establishing a 'design authority' and technical support organizations, and explored effective processes and interfaces between the owner/operator organizations and the designers.

Integrated Management Systems

The Agency continued to disseminate good practices in the management of nuclear projects. At a Technical Meeting on Management and Leadership of Nuclear Power Projects from New Build to Decommissioning, held in Vienna in August, 40 participants from 26 Member States and an international organization emphasized the importance of strengthening the role of leadership and earlier planning in the management of nuclear power projects.

Participants in a Technical Meeting held in Vienna in November discussed the related topic of international quality and management standards. More than 50 experts from 26 Member States and 2 international organizations underlined the importance of good planning in ensuring the sustainability of nuclear installations from cradle to grave.

Capacity Building and Management Support

At the Nuclear Operators Forum, held as a side event on the margins of the 61st regular session of the Agency's General Conference, more than 100 representatives of the nuclear industry and academia discussed the key challenges in developing human resources to support nuclear power programmes in the future. Participants concluded that building and maintaining workforce competency across the full spectrum of operations is crucial for the sustainability and economic competitiveness of nuclear power.

A Technical Meeting on New Ways of Learning and the 'Capacity Building Initiative' Digital Portal explored and provided practical guidance on good practices in new learning approaches and techniques driven and enabled by digital technologies. At the meeting, held in July, 40 experts from regulatory bodies, owner/operator organizations and academia in 21 Member States developed concepts and a framework for new ways of learning.

In August, the Agency organized a Technical Meeting on Human Performance Reliability and Resilience in Nuclear Power Plant Operations in Oak Ridge, Tennessee, United States of America, with the participation of 56 psychometric experts and engineers from regulatory bodies, owner/operator organizations and academia from 18 Member States. Participants focused on behavioural assessments and evaluations across national nuclear workforces, and established a community of practice for the human performance sub-portal on the Agency's Human Resource Development digital hub.

At a Technical Meeting on Nuclear Training Accreditation Models and Activities, held at the Agency's Headquarters in October, 28 education and training experts from 19 Member States discussed the key features of a systematic approach to training based on current nuclear training programmes, including the role and implementation of consultation forums. Participants also reviewed Agency guidance related to such training programmes.

Nuclear Technology Development

Advanced water cooled reactors

The Agency held a Workshop on Advances in Understanding the Progression of Severe Accidents in Boiling Water Reactors in July, with 33 participants from 13 Member States and the OECD/NEA, including representatives of utilities, reactor vendors, regulatory bodies, universities and research organizations. In response to a recommendation from experts at the International Experts Meeting on Strengthening Research and Development Effectiveness in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant, the Agency initiated a new project on severe accident modelling and simulation, and the verification and validation of simulation codes. The first Technical Meeting on the Status and Evaluation of Severe Accident Simulation Codes for Water Cooled Reactors, held in October with 37 participants from 19 Member States and 8 international organizations, provided code developers and end users an opportunity to review the current status of and innovations in simulation codes, and to identify limitations and gaps in the field.

In March, the Agency held a Technical Meeting on New Concepts in Innovative Water Cooled Reactor Technology, with 19 participants from 16 Member States. The meeting participants discussed the need to increase the competitiveness of nuclear power technology, while continuing to meet rigorous safety requirements, to ensure its use worldwide in the future. The coordinated research project (CRP) entitled 'Prediction of Axial and Radial Creep in Pressure Tubes' was completed during the year, addressing an important ageing issue for heavy water reactors. The CRP led to the creation of a test version of a pressure tube creep database and a set of tools that may help nuclear power plant operators to predict the service life of reactor pressure tubes.

The Agency conducted two training workshops on reactor technology assessment to assist newcomer countries in adopting this assessment methodology and in learning about the scope and volume of the data required for successful technology selection against country specific development goals, site requirements and energy needs. During the year, the Agency conducted training courses on the physics and technology of advanced reactors, including small and medium sized or modular reactors (SMRs). The courses, held in five Member States, made use of PC based basic principle simulators to provide valuable hands-on learning to more than 120 participants.

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Small and medium sized or modular reactors

Responding to increased interest from Member States, the Agency established a new Technical Working Group on Small and Medium Sized or Modular Reactors to discuss recent advances in SMR technology, identify topics of common interest for future collaboration through information exchange and cooperative research, and provide guidance on programmatic activities in this area.

Thirty-six experts from 14 Member States, including 7 embarking countries in the Middle East and North Africa region, took part in the Technical Meeting on Technology Assessment of Small Modular Reactors for Near Term Deployment, held in Tunis, Tunisia, in October. Focusing on the latest status of SMR designs and technologies, and on issues and challenges for near term deployment, the event enhanced the capacity of participating Member States to make knowledgeable technical decisions in adopting a nuclear reactor technology.

The Agency held the first Research Coordination Meeting of a CRP entitled 'Design and Performance Assessment of Passive Engineered Safety Features in Advanced Small Modular Reactors', at its Headquarters in August. The participants identified and assessed the design approaches adopted for passive safety systems in water cooled SMRs, and developed a project work plan.

In July, the Agency published *Instrumentation and Control Systems for Advanced Small Modular Reactors* (IAEA Nuclear Energy Series No. NP-T-3.19), addressing the specific issues and challenges related to the design, qualification and implementation of I&C systems for SMRs.

Fast reactors

In June, the Agency conducted the International Conference on Fast Reactors and Related Fuel Cycles: Next Generation Nuclear Systems for Sustainable Development (FR17) in Yekaterinburg, Russian Federation. Over 550 nuclear engineers, scientists and decision makers from 27 countries and 6 international organizations discussed a broad range of topics, including advanced fast reactor design concepts, safety and licensing, operations and decommissioning, fuels and fuel cycle options, coolants, tests and simulations, and reactor economics and performance. Participants also discussed proliferation resistance and physical protection, capacity building, and professional development. The conference featured events and contests for young scientists and engineers on innovative solutions for a low carbon future.

In August, the Agency published *Benchmark Analysis of EBR-II Shutdown Heat Removal Tests* (IAEA-TECDOC-1819), presenting the results and main achievements of a CRP to validate modelling and simulation tools for the safety analysis of the sodium cooled fast reactors.

High temperature reactors

An Agency side event entitled 'Nuclear High Temperature Heat for Industrial Processes', held on the margins of the 61st regular session of the Agency's General Conference, attracted significant interest from Member States. The side event demonstrated that industry can utilize high temperature heat supplied by advanced nuclear reactors to cut carbon dioxide emissions, and that the technology is deployable today and could be incorporated into strategic plans as part of a more sustainable future.

The Technical Working Group on Gas Cooled Reactors met in October and evaluated the status of and activities in gas cooled reactor technology, including technology readiness evaluations, safety requirement studies, high fidelity methodology development and knowledge preservation, as well as irradiation graphite data and software tools.

Non-electric Applications of Nuclear Power

The Agency issued two publications on non-electric applications of nuclear power in 2017. *Opportunities for Cogeneration with Nuclear Energy* (IAEA Nuclear Energy Series No. NP-T-4.1) provides an overview of the application of cogeneration with nuclear energy, which may offer advantages such as increased efficiency, better cost effectiveness and reduced environmental impact. *Industrial Applications of Nuclear Energy* (IAEA Nuclear Energy Series No. NP-T-4.3) gives an overview of the potential use of nuclear energy for industrial systems and processes, which have a strong demand for process heat/steam and power, and identifies the types of nuclear power reactor that can be used for various industrial applications.

The Agency hosted the sixth meeting of the Technical Working Group on Nuclear Desalination, in November, with eight participants from seven Member States. Three other Technical Meetings held in 2017 focused on: the techno-economics of and opportunities for non-electric applications of SMRs; the role of nuclear hydrogen production in the context of the hydrogen economy; and the responsibilities of users and vendors in nuclear desalination projects. The Agency also updated its Water Management Program (WAMP) tool for efficient water management in water cooled reactors, and conducted a training workshop with 14 participants from 14 Member States.

Enhancing Global Nuclear Energy Sustainability through Innovation

The 14th INPRO Dialogue Forum on the Potential of Nuclear Energy to Support the Sustainable Development Goals, Including Climate Change Mitigation was held in Vienna in June. Thirty-five participants from 23 Member States presented national policy perspectives on nuclear power's potential contribution to combatting climate change and achieving sustainable development goals.

In October, the Agency held a European Regional Training Course on Nuclear Energy System Modelling and Assessment Using the INPRO Methodology, in Warsaw, Poland, attended by 12 experts from 5 Member States. A Technical Meeting on the INPRO Study on Cooperative Approaches to the Back End of the Nuclear Fuel Cycle: Drivers and Institutional, Economic and Legal Impediments was held in January at the Agency's Headquarters, with 19 participants from 15 Member States and the OECD/NEA. At the Technical Meeting to Review the Updating of the INPRO Manual Volumes on Proliferation Resistance and on Overview of the INPRO Methodology, held in October, 22 participants from 18 Member States and the European Commission recommended that the INPRO Steering Committee consider a full revision of the INPRO Manual volume on proliferation resistance.

Nuclear Fuel Cycle and Materials Technologies

Objective

To advance the development and implementation of an increasingly safe, reliable, efficient, proliferation resistant and environmentally sustainable nuclear fuel cycle (NFC), providing the maximum benefit to Member States. To assist and support Member States in strengthening their capabilities and improving practices in radioactive waste management (RWM), decommissioning and remediation of contaminated sites and to support States embarking on nuclear power and developing countries to develop necessary RWM infrastructure. To collect data on damaged fuel and storage facilities and to assist Member States discuss and share ideas and information on nuclear fuel behaviour under severe conditions. To assist Member States decommission nuclear sites affected by accidents and to remediate off-site contaminated areas.

Uranium Resources and Production

The Agency updated and expanded its World Distribution of Uranium Deposits (UDEPO) database to include more than 1000 additional uranium deposits and 800 new deposit locations, including unconformity type uranium deposits. The work was carried out during two consultants meetings held in Vienna in August and September.

In May, the Agency organized a Training Workshop on Uranium Geochemistry in the Asia-Pacific Region, held in Thailand. The workshop, with 36 participants from 19 countries, highlighted the sustainability related challenges of geochemical aspects of uranium recovery using a comprehensive extraction approach, with a focus on technical, environmental, economic, governance and social issues.

A Technical Meeting of the Uranium Mining and Remediation Exchange Group (UMREG) was held in Bessines-sur-Gartempe, France, in October (Fig. 1). Over 40 experts from

FIG. 1. Participants in the UMREG Technical Meeting review the map of the Bernardan site during a field trip to observe historic and current remediation activities of former uranium mines in the area.

20 Member States and an international organization discussed the management of legacy situations, and the safe and appropriate development of uranium resources. Participants highlighted the importance of considering post-mining and post-processing issues during the planning and operational stages of a project.

The 54th Meeting of the Joint OECD/NEA–IAEA Uranium Group was held in Paris in November, with 48 delegates from 33 countries. Participants discussed the latest estimates of worldwide uranium supply and demand, to be included in *Uranium 2018: Resources, Production and Demand* (the 'Red Book').

Nuclear Power Reactor Fuel

Through coordinated research projects (CRPs) and training meetings, the Agency continued to assist Member States in sharing information on the development, design, manufacture and performance assessment of fuel for all types of nuclear power reactor. Particular emphasis was given to the development of fuels with increased accident tolerance and the analysis of fuel behaviour in accident conditions.

At the third Research Coordination Meeting of the CRP entitled 'Reliability of High Power, Extended Burnup and Advanced PHWR Fuels', held in Vienna in October–November, the project's five partners, from five Member States, evaluated the final results of this CRP, which seeks to resolve the challenges involved in deploying advanced pressurized heavy water reactor fuels. In November, the third Research Coordination Meeting of the CRP entitled 'Fuel Modelling in Accident Conditions (FUMAC)' was held in Vienna. The 24 project partners from 18 Member States evaluated the final results of the CRP, aimed at better understanding the behaviour of nuclear fuel in accident conditions in order to enhance nuclear safety.

The Agency expanded its technical and training programme in the field of nuclear power reactor fuel, holding meetings on nuclear fuel in the Islamic Republic of Iran, Poland and Viet Nam.

Management of Spent Fuel from Nuclear Power Reactors

The first Research Coordination Meeting of the CRP entitled 'Management of Severely Damaged Spent Fuel and Corium' was held in Vienna in February. The project, involving seven Member States, is aimed at expanding the existing knowledge base and identifying optimal approaches for managing severely damaged spent fuel.

In October, the Agency hosted the first Research Coordination Meeting of the CRP entitled 'Ageing Management Programmes for Dry Storage Systems', involving five Member States. Meeting participants exchanged the latest research and development, and experience related to the ageing of systems, structures and components, and to monitoring, inspection and surveillance programmes.

Eighteen experts from ten Member States attended a Technical Meeting on Advanced Fuel Cycles to Improve the Sustainability of Nuclear Power through the Minimization of High Level Waste, held in Vienna in October. Participants discussed different technical perspectives of different spent fuel management options currently under consideration by Member States, focusing on waste burden minimization, with the aim of producing an Agency technical report for policy and decision makers.

Radioactive Waste Management, Decommissioning and Environmental Remediation

The Agency continued to assist its Member States in addressing a wide range of radioactive waste challenges. In July, it conducted the first Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) mission. The 12 day mission to the State-owned Nuclear Plant Management Company (SOGIN) reviewed Italy's programme for decommissioning nuclear facilities and managing radioactive waste. The Agency also conducted an ARTEMIS review of Poland's National Plan of Radioactive Waste and Spent Nuclear Fuel Management, in October. Requests for ARTEMIS reviews were received from eight other Member States.

The Agency updated and expanded its e-learning content on 'Spent Fuel and Radioactive Waste Management', 'Decommissioning' and 'Environmental Remediation'. Three new modules were added to the 'Radioactive Waste and Disused Sealed Radioactive Sources (DSRS) Management' course. Three additional modules were included in the 'Environmental Remediation' course, and updates were made to the 'Geological Disposal' course. The e-learning materials under this curriculum, comprising nine courses (48 modules and 94 lectures), can be accessed on-line at the Agency's learning management system on the Cyber Learning Platform for Network Education and Training (CLP4NET).

Radioactive Waste Management

In response to Member State interest in the planning of radioactive waste management activities, the Agency issued *Selection of Technical Solutions for the Management of Radioactive Waste* (IAEA-TECDOC-1817). The new publication identifies and reviews criteria for selecting waste management technologies, compares different technical options and offers a systematic approach to selecting the most appropriate solution.

The Agency finalized the report on the first phase of the project entitled 'Status and Trends in Spent Fuel and Radioactive Waste Management'. The project, carried out in close cooperation with the European Commission and the OECD/NEA, was designed to promote the benefits of reporting inventories of spent nuclear fuel and radioactive waste.

The Agency published *Use of the Benchmarking System for Operational Waste from WWER Reactors* (IAEA-TECDOC-1815), providing an overview of best practices for benchmarking low and intermediate level waste generated and managed during the normal operating life of water cooled, water moderated reactors. Such benchmarking can help Member States to minimize waste arising during operation.

Decommissioning and Environmental Remediation

Over 110 participants from 26 Member States attended the Workshop on Current and Emerging Methods for Optimising Safety and Efficiency in Nuclear Decommissioning, organized by the Institute for Energy Technology, Norway, in collaboration with the Agency and the OECD/NEA. The workshop addressed current topics such as practical applications of research and development as well as advanced technologies in decommissioning. Workshop participants confirmed the importance of information exchange between decommissioning researchers and implementers.

The Agency published the proceedings of the International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes, held in Madrid, Spain, in 2016. The publication provides a summary of each session, current challenges, and the main approaches to further advance decommissioning and environmental remediation, as identified by participants. In December, it issued *Data*

Analysis and Collection for Costing of Research Reactor Decommissioning (IAEA-TECDOC-1832), providing representative input data and benchmarking data needed to estimate the overall cost of decommissioning during the early planning stages.

Management of Disused Sealed Radioactive Sources

The Workshop on Strengthening Security of Radioactive Sources in Central Asia, organized by the Agency in cooperation with the Nuclear Threat Initiative, the Moscow-based Center for Energy and Security Studies and the Government of Kazakhstan, was attended by 50 experts from 6 Member States. Participants highlighted the need for continued assistance to Member States in building and enhancing the capacities of both regulators and operators, in order to strengthen nuclear and radiological security in the region.

The Agency provided support to Member States in assessing the available options for the management of disused sealed radioactive sources (DSRSs), including co-disposal with other waste at suitable facilities, recycling and repatriation, and disposal in dedicated boreholes. It continued its support for borehole disposal projects in Ghana and Malaysia, including commissioning tests of key equipment.

The Agency supported preparations for the removal of 37 Category 1 and 2 sources from Albania, the Plurinational State of Bolivia, Ecuador, Lebanon, Paraguay, Peru, the former Yugoslav Republic of Macedonia, Tunisia and Uruguay; the removals are scheduled for completion in 2018. The Agency also helped train some 200 local personnel from over 20 Member States in the conditioning and safe and secure management of Category 3 to 5 DSRSs. Missions for conditioning DSRSs were conducted to Belize, China, the Dominican Republic, Ghana, the Islamic Republic of Iran, Jamaica and Malaysia.

"The Agency also helped train some 200 local personnel from over 20 Member States in the conditioning and safe and secure management of Category 3 to 5 DSRSs"

In an effort to scale up the safe and secure management of DSRSs, the Agency introduced a new concept of Qualified Technical Centres. The aim is to increase the worldwide capability to manage DSRSs by encouraging countries with well equipped centres and trained personnel to provide technical services for the management of DSRSs within their countries and regionally. The concept was launched at a side event during the 61st regular session of the Agency's General Conference.

Capacity Building and Nuclear Knowledge for Sustainable Energy Development

Objective

To strengthen Member State capacities in energy and nuclear power planning to elaborate sustainable energy strategies and conduct studies for energy system and electricity supply options, energy investment planning, and energy environment policy formulation. To build Member State capacities to manage nuclear knowledge and provide knowledge management services and assistance. To procure and provide printed and electronic information in the area of nuclear science and technology to the IAEA Secretariat and Member States.

Energy Modelling, Databanks and Capacity Building

Through national and regional technical cooperation projects, the Agency conducted 45 capacity building events on energy planning in Africa, Eastern Europe and Latin America and the Caribbean in 2017. Over 690 professionals from 70 Member States were trained through distance training and face-to-face training events. The Agency and the United Nations Economic Commission for Africa joined efforts to help build capacity in energy planning in African countries.

In response to Member State requests, the Agency expanded and improved its annual publication *Energy, Electricity and Nuclear Power Estimates for the Period up to 2050* (Reference Data Series No. 1). The 2017 edition contains more detailed descriptions of the current situation and the projections for the future.

Energy–Economy–Environment (3E) Analysis

At the 23rd session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP23) held in Bonn, Germany, in November, the Agency was selected as the focal point for the United Nations exhibit on energy, industry, innovation and infrastructure. It also led the United Nations energy side event, in cooperation with several United Nations agencies, focused on the organizations' efforts to build their member countries' capacity to evaluate resource systems in an integrated way. The aim is to improve understanding of the trade-offs in energy, land and water use, and their impact on the climate, to enable States to make informed policies and decisions. To increase outreach, the Agency teamed up with the International Emissions Trading Association and organized two more side events highlighting the contributions of nuclear power to climate change mitigation and the role of innovation in nuclear power technologies.

Ahead of COP23, the Agency produced three new brochures highlighting the role of nuclear science and technology in climate mitigation, adaptation and monitoring: *The IAEA and Climate Change*; *Nuclear Power for Sustainable Development*; and *Nuclear Power and Market*

Mechanisms under the Paris Agreement. It continued to monitor and support the work of the Intergovernmental Panel on Climate Change (IPCC), participating in the Expert Review of the First Order Draft of the IPCC Special Report on Global Warming of 1.5°C.

As part of an ongoing coordinated research project aimed at assessing the national and regional economic effects of nuclear programmes, the Agency released EMPOWER, a software tool enabling countries to evaluate their specific macroeconomic conditions for establishing a national position. The tool will be used as part of a new macroeconomic modelling and capacity building service for Member States.

During 2017, in collaboration with the United Nations Department of Economic and Social Affairs and the United Nations Development Programme, the Agency provided project scoping and training on tools for integrated assessment of CLEW (climate, land, energy and water) in the Plurinational State of Bolivia, Ghana, Nicaragua and Uganda.

Nuclear Knowledge Management

During the year, the number of courses hosted on the Agency's Cyber Learning Platform for Network Education and Training (CLP4NET) e-learning platform surpassed 580, with around 21 300 registered users by the end of 2017.

The Agency's International Nuclear Management Academy (INMA) programme continued to generate global interest. Four universities — Texas A&M University in the United States of America, the University of Tokyo in Japan, and North-West University and the University of the Witwatersrand in South Africa — hosted INMA peer review assessment missions, aimed at evaluating the compliance of their nuclear technology management programmes with INMA requirements. Five more universities are in the process of setting up degree programmes that would meet the competency requirements of INMA, aimed at increasing the availability of master's level courses for managers in the nuclear sector.

In 2017, the Agency carried out five Knowledge Management Assist Visits: to the joint stock company Atomstroyexport in the Russian Federation in March; to the Ignalina nuclear power plant in Lithuania in April; to the Daya Bay nuclear power plant in China in May; to the joint stock company ČEZ and the Temelín nuclear power plant in the Czech Republic in May–June; and to the joint stock company Slovenské elektrárne and the Mochovce nuclear power plant in Slovakia in October. The visits focused on reviewing and supporting the knowledge management programmes of these institutions, ranging from design and operation to decommissioning aspects.

The Agency's Nuclear Energy Management Schools and Nuclear Knowledge Management Schools continued to attract future managers. Four Nuclear Energy Management Schools — held in Japan, the Russian Federation, the United Arab Emirates and the International Centre for Theoretical Physics in Italy — were attended by 145 students from 31 Member States. The Nuclear Knowledge Management School at the International Centre for Theoretical Physics was attended by 60 students from 25 Member States. During the year, the Agency reached agreement with all regional host organizations aimed at streamlining, documenting, coordinating and systemizing the implementation of Nuclear Energy Management Schools.

Collection and Dissemination of Nuclear Information

The membership of the International Nuclear Information System (INIS) increased in 2017 to 131 Member States and 24 international organizations. INIS reached 4.1 million records, including over half a million full texts that are not readily available through commercial channels. The Agency added 103 879 bibliographic records and over 8000 full

texts to the INIS repository, which had over 2.9 million page views during the year. The INIS Multilingual Thesaurus continued to serve the international community in eight languages. The Agency replaced commercial search software with open source software, resulting in savings.

Participants from 22 Member States attended an INIS training seminar held in October in Vienna. The seminar was aimed at building capacity and improving many aspects of the operational capabilities of national INIS centres.

"the number of electronic journals available through the Library increased to over 53 300"

The IAEA Library continued to ensure that information resources and services remained current, cost effective and easily accessible: the number of electronic journals available through the Library increased to over 53 300; more than 10 000 people visited the Library; over 1800 items were checked out; and over 1700 interlibrary loans were enabled.

The Agency created over 1100 personalized Library user profiles, in response to continued requests for tailored packaging of nuclear information products and services. It also offered 15 training sessions on general aspects of the Library, attended by 220 participants. With the migration to a new integrated library management system, which includes a 'discovery service', it is now possible to search across all the resources.

Through the IAEA Library, the Agency coordinated the International Nuclear Library Network — comprising 58 libraries and research institutes from 39 Member States — by facilitating the sharing of knowledge, resources and best practices.

Nuclear Science

Objective

To increase Member State capabilities in the development and application of nuclear science as a tool for their technological and economic development. To assist Member States in the management and effective utilization of research reactors.

Nuclear Data

The Agency worked with nuclear physics experts from national nuclear data evaluation projects to deliver high quality isotopic evaluations of actinides and structural materials to three major nuclear data libraries released in 2017: ENDF/B-VIII (United States of America), JEFF-3.3 (OECD/Nuclear Energy Agency) and TENDL-2017 (Europe). As part of the process, Agency and external experts performed integral validation with criticality benchmarks.

In November, the Agency held a Technical Meeting of the International Atomic and Molecular Code Centre Network on Molecular Dynamics Data of Collisional Cascades after Irradiation. At the meeting, 13 scientists from 11 Member States planned a database of computational simulations of neutron damage in materials. They also discussed various crowdsourcing initiatives that might be launched in connection with the database, including one on distributed computing.

A Technical Meeting on Nuclear Data Processing was held in Vienna in December, with 14 participants from 9 Member States. At the meeting, processing code developers discussed ways to ensure that reactor physics and fuel cycle software can continue to use well validated nuclear data libraries in the future. Participants also agreed to support an Agency activity, launched in 2017, to validate new codes under development in several Member States.

Research Reactors

Utilization and applications of research reactors

During the year, the Agency supported 28 neutron activation analysis laboratories from 23 Member States in validating their measurement results by providing proficiency testing through an interlaboratory comparison. Participants in a workshop held in November in cooperation with the Jožef Stefan Institute in Ljubljana, Slovenia, critically analysed the results of the proficiency testing to identify issues and discuss possible ways to improve results. In December, the Agency published *Proficiency Testing by Interlaboratory Comparison Performed in 2010–2015 for Neutron Activation Analysis and Other Analytical Techniques* (IAEA-TECDOC-1831), presenting the findings and lessons learned from tests performed

by 30 laboratories across the world. The Agency released its new on-line e-learning course on neutron activation analysis in October.

In August, the Agency conducted the third Training Workshop on Advanced Use of Neutron Imaging for Research and Applications, in cooperation with the Heinz Maier-Leibnitz Zentrum in Garching, Germany. During the workshop, 19 participants from 17 Member States delivered lectures and took part in practical exercises covering different neutron imaging methods, including applications in research and industry.

The Agency's Research Reactor Database (RRDB) continued to serve as the gateway to comprehensive technical information on over 770 research reactors built to date in 68 Member States, including information on their utilization. In 2017, information on 111 facilities was updated in the RRDB using input from Member States.

During the year, the Agency published *Strategic Planning for Research Reactors* (IAEA Nuclear Energy Series No. NG-T-3.16), providing guidance on and examples of how to prepare and implement strategic plans for existing and new research reactors. A new Agency brochure entitled *Research Reactors in Latin America and the Caribbean* provides a synopsis of the main research reactor activities in the region.

New research reactor projects, infrastructure development and capacity building

In 2017, the Agency carried out six fact-finding missions, provided guidance and supported the organization of national workshops in the following countries considering building research reactors: Azerbaijan, the Plurinational State of Bolivia (Fig. 1), Kenya, the Philippines, South Africa and Thailand. The Agency also worked with Nigeria on preparations for a new multipurpose research reactor. During the year, the Agency reviewed and provided recommendations to Nigeria on the feasibility study document and self-evaluation report on the status of its national nuclear infrastructure.

The Agency held two training workshops on various aspects of new research reactor projects at its Headquarters in Vienna during the year. In September, it hosted a Training

FIG. 1. One of several geological drills constructed as part of the site characterization for the new 200 kW research reactor in El Alto, Plurinational State of Bolivia.

Workshop on Assessment of the National Nuclear Infrastructure to Support a New Research Reactor Project, with 30 participants from 21 Member States. In October, it organized a Training Workshop on Preparation of a Feasibility Study for a New Research Reactor Project, with 30 participants from 24 Member States. The workshops provided practical information and a forum for sharing experience and lessons learned.

In 2017, the Agency's Internet Reactor Laboratory (IRL) project continued to provide nuclear engineering students and young specialists in Africa, Europe and Latin America with an opportunity to participate in live reactor experiments on-line. Two host facilities — Argentina's RA-6 research reactor and the French Alternative Energies and Atomic Energy Commission's ISIS reactor — provided live transmissions to participants in Belarus, Colombia, Cuba, Lithuania, Tunisia and the United Republic of Tanzania. In November, the Agency signed an agreement with Kyung Hee University in the Republic of Korea to initiate the broadcasting of the IRL in the Asia and the Pacific region in 2018. Morocco took steps to make its MA-R1 TRIGA research reactor at the National Centre for Nuclear Energy, Sciences and Technology the host research reactor for the IRL project in Africa.

The Agency provided support for the 13th Eastern European Research Reactor Initiative (EERRI) fellowship training course. The total number of professionals trained through EERRI grew to 105 in 2017.

The Agency organized the second Regional Research Reactor School, in cooperation with the Thailand Institute of Nuclear Technology in Thailand and the Dalat Nuclear Research Institute in Viet Nam. The School enabled 12 participants from 8 Member States to acquire on-site training experience at the two research reactors.

During the 61st regular session of the Agency's General Conference, the Belgian Nuclear Research Centre (SCK•CEN) and the United States Department of Energy's Idaho and Oak Ridge National Laboratories became IAEA-designated International Centres based on Research Reactors (ICERR). In December, the Agency established a network, ICERR-Net, to coordinate and optimize the services that ICERRs can offer to Member States.

Research reactor fuel cycle

The Agency hosted a Technical Meeting as part of the CRP entitled 'Benchmarks of Computational Tools against Experimental Data on Fuel Burnup and Material Activation for Utilization, Operation and Safety Analysis of Research Reactors', with 22 participants from 20 Member States. The purpose of the meeting was to enable Member States that are not involved in this CRP to contribute to the benchmarking exercise.

In November, the Agency, in cooperation with the International Centre for Theoretical Physics (ICTP), organized a joint workshop on 'Research Reactors for Development of Materials and Fuels for Innovative Nuclear Energy Systems'. The workshop provided 24 participants from 15 Member States with practical information and knowledge on the use of research reactors for R&D on the development and testing of materials and fuels for nuclear energy systems.

The Agency issued three publications related to the research reactor fuel cycle in 2017: *Use of Low Enriched Uranium Fuel in Accelerator Driven Subcritical Systems* (IAEA-TECDOC-1821), *Available Reprocessing and Recycling Services for Research Reactor Spent Nuclear Fuel* (IAEA Nuclear Energy Series No. NW-T-1.11) and *Research Reactors for the Development of Materials and Fuels for Innovative Nuclear Energy Systems* (IAEA Nuclear Energy Series No. NP-T-5.8).

The Agency continued to coordinate and provide technical support to the three year project to convert the Ghana Research Reactor-1 from high enriched uranium (HEU) to low enriched uranium (LEU) fuel. The project was successfully completed with the return in August of the irradiated HEU core to China (Fig. 2). Ghana is the first of the five countries operating a Chinese supplied miniature neutron source reactor outside of China to successfully convert and repatriate its irradiated HEU core.

FIG. 2. A three year project concluded in August with the successful repatriation to China of the HEU core of Ghana's miniature neutron source reactor.

The Agency's 11th Technical Meeting on Lessons Learned from High Enriched Uranium Take-back Programmes, held in Tbilisi, Georgia, in June, was attended by 83 participants from 18 Member States. The Technical Meeting on the Conversion of Miniature Neutron Source Reactors from HEU to LEU Fuel, held in Vienna in December, drew 25 participants from 7 Member States. Both meetings were aimed at sharing experience and lessons learned from the first conversion of a miniature neutron source reactor and the repatriation of its HEU fuel to China.

Research reactor operation and maintenance

In 2017, the Agency initiated several activities to help Member States address challenges related to ageing management and lifetime extension of research reactors, and optimization of their operational performance. In April, it launched a trial of a new database of properties of irradiated core structural materials for research reactors, containing 134 reports. The database resulted from the CRP entitled 'Establishment of a Material Properties Database for Irradiated Core Structural Components for Continued Safe Operation and Lifetime Extension of Ageing Research Reactors', which held its third and final Research Coordination Meeting in April.

In June, the Agency conducted a Pre-OMARR (Operation and Maintenance Assessment for Research Reactors) mission to the WWR-SM research reactor in Uzbekistan. The preparatory mission was used to finalize the plan for the main OMARR mission, which will assist the facility in preparing a plan for ageing management and continued operation with enhanced operational performance. In September, the Agency conducted a Pre-OMARR mission combined with in-service inspection to the RPI research reactor in Portugal. During the mission, the Agency provided a radiation resistant camera to examine the pool lining and core structural components, as well as technical support for detecting the source of a primary coolant leak.

In July, a Technical Meeting on Upgrades to Digital Instrumentation and Control Systems for Research Reactors was held in Vienna, with 29 participants from 21 Member States. Meeting participants exchanged knowledge and experience related to the installation of digital instrumentation and control systems in research reactors undergoing modernization. The Agency also published *On-line Monitoring of Instrumentation in Research Reactors*

(IAEA-TECDOC-1830), presenting fundamentals of on-line monitoring techniques such as data acquisition, qualification and analysis for improving research reactor performance, and providing the technical foundation and guidance for their use in research reactors.

In October, the Agency held a Technical Meeting on Research Reactor Ageing Management, Refurbishment and Modernization at its Headquarters in Vienna. The meeting's 34 participants from 29 Member States exchanged information on managing research reactor ageing, and shared experiences from ongoing projects aimed at modernizing and refurbishing research reactors. The Research Reactors Ageing Database was updated throughout the year with information provided by Member States.

Accelerator Applications

The Agency held the first Research Coordination Meeting of a new CRP entitled 'Accelerator Simulation and Theoretical Modelling of Radiation Effects — SMoRE-II'. The results of this CRP will be used to develop recommendations for best practices in the use of ion beam research for simulating in-reactor damage to materials used for advanced reactor concepts and life extension of existing reactors.

In September, the Agency held a Technical Meeting on Modern Neutron Detection, attended by 42 experts in dosimetry and standards, neutron scattering, fusion, regulatory activities and safeguards, from 20 Member States. The participants discussed state-of-the-art technologies and the outlook for promising near term technologies for specific applications.

In June, the Agency held a Technical Meeting on Developing Strategies for Safe Analysis of Paintings and Paint Materials at the Rijksmuseum in Amsterdam, the Netherlands. The meeting was attended by 37 curators, conservation scientists, radiation specialists, physicists, chemists, and materials and accelerator scientists from 14 Member States. Participants discussed current practices in analysing cultural heritage items (Fig. 3) and monitoring radiation induced modifications in real time and over the long term. They also defined best practices for documenting the irradiation history of individual paintings.

The first meeting of a new CRP entitled 'Enhancing Nuclear Analytical Techniques to Meet the Needs of Forensic Science', held in November in Vienna, was attended by 19 experts from 14 Member States. The project is aimed at determining the ways nuclear

FIG. 3. A painting by Frans Hals, displayed at the Rijksmuseum in Amsterdam, the Netherlands, being analysed by macroscopic X ray fluorescence. (Photograph courtesy of the Rijksmuseum.)

analytical techniques can complement existing forensic methods in areas such as crime investigation, food safety and health related issues, cultural heritage artefacts, and environmental samples.

In 2017, researchers from six Member States carried out nine experiments using the Agency's X ray fluorescence beamline at the Elettra synchrotron in Trieste. The experiments focused on environmental science, fundamental X ray physics, cultural heritage and industrial applications. Seven of the nine tests were supported by the CRP entitled 'Experiments with Synchrotron Radiation for Modern Environmental and Industrial Applications'.

At a Technical Meeting on Trends in Analytical Applications of Synchrotron Based X Ray Spectrometry Techniques and Developments in the Supporting Instrumentation, held in October in Vienna, 27 specialists from 23 Member States discussed the current need of Member States, in particular of developing countries, for access to synchrotron facilities. Participants in a consultants meeting held in December in Vienna discussed the latest developments in accelerator instrumentation and expansion of the network of regional resource centres to foster advanced research in developing countries.

Nuclear Instrumentation

The Agency supported Member State efforts to improve the quality of results obtained using nuclear analytical techniques through proficiency testing, meetings and training activities. In 2017, 47 laboratories from 36 Member States took part in an Agency proficiency test for the determination of trace elements in samples of environmental origin. In June, the Agency held a Training Workshop on Quality Assurance for Nuclear Spectrometry, with 25 participants from 25 Member States. The workshop addressed topics such as validation of nuclear analytic techniques and methods, internal and external quality control activities, and the need for quality management implementation and laboratory accreditation.

Eleven participants from 11 African countries attended a Regional Training Course on Validation of X ray Emission Techniques for the Analysis of Air Particulate Matter, held at the Agency's Laboratories in Seibersdorf in May. The Agency provided group fellowship training on X ray fluorescence, focusing on qualitative and quantitative analysis of environmental samples, involving four participants from two Member States. A national training course on nuclear instrumentation held in South Africa was attended by 48 participants.

The Agency organized two consultants meetings to discuss actions required to extend the use of mobile gamma spectrometry teams in Member States. The first meeting addressed the training needs and modalities for training workshops on in situ radiological characterization and production of maps. The second discussed past and future actions of the INSITU working group, established to support environmental remediation projects. In December, an Agency mobile gamma spectrometry team conducted a field mission to Indonesia to support the characterization of sites associated with tin mining; the mission included visits to two mining locations and a reprocessing site.

Nuclear Fusion

The Agency's Fusion Portal, launched in 2016, became fully functional in 2017. The new portal provides information on all fusion related events organized by the Agency, including planned events, as well as publications and other outputs.

The Agency issued *Investigations of Materials under High Repetition and Intense Fusion Pulses* (IAEA-TECDOC-1829), presenting experimental results of plasma–surface interaction phenomena under the extreme conditions expected in a fusion reactor. The publication is

a compilation of studies investigating the mechanism of material damage during transient heat loads, and addresses the performance and adequacy of tungsten as a plasma-facing material for next step fusion devices such as ITER and fusion demonstration power plants.

The Agency launched two new CRPs in the area of nuclear fusion in 2017: 'Development of Compact Steady-State Fusion Neutron Sources' and 'Network of Small and Medium Size Magnetic Confinement Fusion Devices for Fusion Research'.

Throughout the year, the Agency hosted seven Technical Meetings, one workshop and a number of consultants meetings with members of the world's fusion community, involving 460 researchers from 43 Member States. It also cooperated in the organization of three international events: the 13th International Reflectometry Workshop, the Eighth International Conference on the Frontiers of Plasma Physics and Technology, and the Tenth International Conference on Inertial Fusion Sciences and Applications. Conference materials from the 26th IAEA Fusion Energy Conference were made available via the Agency's Fusion Portal.

"the Agency hosted seven Technical Meetings, one workshop and a number of consultants meetings with members of the world's fusion community, involving 460 researchers from 43 Member States."

Support to the ICTP

In 2017, the Agency and the Abdus Salam International Centre for Theoretical Physics (ICTP) conducted 13 joint activities involving 681 participants from 100 Member States, of whom 345 were from developing Member States. Through the STEP (Sandwich Training Educational Programme) fellowship, the Agency supported 14 PhD students from developing countries, half of them women. Over the past 15 years, STEP fellowships have been awarded to 190 students from all over the world, enabling them to carry out research at advanced institutes. Through fellowships, the Agency funded the participation of 18 physicists in a two year Master of Advanced Studies in Medical Physics programme jointly conducted by the ICTP and the University of Trieste.

Food and Agriculture

Objective

To contribute to the sustainable intensification of agricultural production and the improvement of global food security by addressing the challenges of food production, food protection and food safety through capacity building and technology transfer to Member States. To increase resilience of livelihoods to threats and crises in agriculture by improving assessment and mitigation of threats and crises in agriculture, including impact of climate change and nuclear or radiological accidents on agriculture, as well as food safety risks. To improve efficient agricultural and food systems for sustainable management and conservation of natural resources, and to enhance the conservation and application of plant and animal biodiversity.

Animal and Zoonotic Disease Outbreaks: Diagnosis and Control

FIG. 1. Training is provided to veterinarians and technicians participating in the VETLAB Network of veterinary diagnostic laboratories.

The Veterinary Diagnostic Laboratory (VETLAB) Network continued to grow, expanding to 44 countries in Africa and 19 countries in Asia, with 4 Member State laboratories in Cambodia, the Philippines, Thailand and Viet Nam joining during the year. The Agency, in partnership with the Food and Agriculture Organization of the United Nations (FAO) through the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture, provided 35 national laboratories with diagnostic toolboxes containing equipment, reagents, consumables, protocols and guidelines for sampling in the field and for early detection of animal and zoonotic diseases under biosecurity conditions (Fig. 1).

In response to outbreaks of Middle East respiratory syndrome (MERS), the Agency, through the Joint FAO/IAEA Programme, provided training in the detection of the MERS pathogen in camels to 19 professionals from seven Member States on the Arabian Peninsula. The trainees learned about safety issues relating to zoonotic diseases in general and nuclear derived techniques for early rapid diagnosis of MERS outbreaks. The Agency also provided training in the detection of the highly pathogenic avian influenza (HPAI) virus to 23 experts from Member States in Europe. An Agency workshop involving 141 participants from 39 Member States focused on coordinating and strengthening 'One Health' initiatives in Africa aimed at addressing emerging and re-emerging zoonotic diseases. The Agency also provided enhanced capacity support, including equipment, standard

operating procedures and training, to Cameroon, the Democratic Republic of the Congo and Togo, enabling them to detect — and contain — HPAI outbreaks in birds at an early stage.

Improving Livestock Performance

In 2017, the Agency, through the Joint FAO/IAEA Division, assisted 23 Member States in their efforts to achieve sustainable growth of the livestock industry through fellowships and training activities. During the year, some 300 professionals received Agency training, including 115 trained in artificial insemination techniques, 143 trained in genetics and animal breeding, and 39 trained in animal nutrition. The Agency also developed a protocol and guidelines, distributed to eight Member States, on the application of stable isotope technology for better management of pastures and improved animal productivity. It also developed a protocol, currently being validated, for the application of radiolabelled amino acids to identify embryo-derived protein as a marker for early diagnosis of pregnancy in cows.

Regional Food Safety Networks

The Agency, through the Joint FAO/IAEA Division, continued to actively support the establishment and strengthening of food safety networks among laboratories and related institutions in 36 countries in Africa, 16 countries in the Asia and the Pacific region, and 21 countries in Latin America and the Caribbean. In 2017, through the Latin American and Caribbean Analytical Network (RALACA), it provided analytical training to 20 fellows. Eight analytical methods for food safety testing were developed, published and applied by the network. The Agency assisted the African Food Safety Network (AFoSaN) in initiating a new knowledge exchange mechanism enabling the exchange of scientists to benchmark analytical techniques and food safety programmes, and to share best practices. Through the Food Safety Asia Network, the Agency provided training in radioreceptor assay techniques to 70 participants in group training activities held in Singapore and Thailand (Fig. 2). A web based platform for knowledge exchange, hosted by Sri Lanka, was further strengthened by the network.

FIG. 2. Participants in an Agency training course on radioreceptor assay of food contaminants carried out through the Food Safety Asia Network.

Eradication of Mediterranean Fruit Fly from the Dominican Republic

The Agency successfully concluded a two year project supporting efforts to eradicate the Mediterranean fruit fly from the Dominican Republic. At the Member State's request, the Agency, in partnership with FAO through the Joint FAO/IAEA Division, provided training and technical guidance in the area-wide application of the sterile insect technique to control an outbreak of Mediterranean fruit fly, a major agricultural pest. Within two years the pest was officially declared eradicated from the country in July, having cost the agricultural sector more than US $42 million in lost export revenue in 2015. Through the project, the Dominican Republic successfully developed the capabilities for area-wide application of the sterile insect technique and has become a source of training and technology transfer for other countries in the region.

Climate-smart Agriculture

Fallout radionuclides have long been used to estimate soil erosion magnitudes in efforts to implement climate-smart agricultural practices. More than 70 Member States currently use such information to alleviate soil erosion, and hence improve soil quality and make it more resilient to climate variability. In 2017, the Agency, through the Joint FAO/IAEA Division, developed and began validating plutonium-239 and plutonium-240 radioisotopes as tracers for assessing soil erosion (Fig. 3). With their much lower rates of decay (half-lives of more than 6500 years) than currently used radioisotopes (caesium-137, beryllium-7 and lead-210), plutonium-239+240 will facilitate long term assessment of soil erosion and degradation.

FIG. 3. Testing of a new radioisotope tracer to assess soil erosion as part of climate-smart agriculture.

Human Health

Objective

To enhance capabilities in Member States to address needs related to the prevention, diagnosis and treatment of health problems through the development and application of nuclear and related techniques within a quality assurance framework.

Dosimetry of Small Static Fields Used in External Beam Radiotherapy

The use of small static fields in radiotherapy has grown rapidly over the past decade. To support consistent reference dosimetry traceable to metrological primary standards, the Agency, together with the American Association of Physicists in Medicine, issued *Dosimetry of Small Static Fields Used in External Beam Radiotherapy* (Technical Report Series No. 483), the first international code of practice dedicated to the dosimetry of small static fields used in radiotherapy. The publication provides a description of the physics of small field dosimetry and the underlying formalism and concepts, as well as recommendations on its practical implementation by medical physicists. The code of practice described ensures that reference dosimetry is traceable to the International System of Units and enables international harmonization of procedures to be followed by radiotherapy centres for the dosimetry of small static megavoltage photon fields.

Radiation Risk Assessments and Risk Perceptions in Medical Imaging

The rapid development of medical technology has expanded the spectrum of applications of radiation in medicine and has contributed to improved patient care. Medical imaging procedures for diagnosis or therapy involve exposure to a small amount of ionizing radiation for the patient, with a finite amount of risk. This risk depends on the amount of exposure, the number of exposures and the patient's age.

To inform health professionals and other interested parties about how to assess and communicate radiation risks, and to provide them with background information on risk perception in medical imaging, the Agency, together with the World Health Organization and the United Nations Scientific Committee on the Effects of Atomic Radiation, organized a joint side event during the 61st regular session of the Agency's General Conference. The event attracted more than 60 participants, who discussed the methodologies used for assessing radiation doses and associated risks; perceived magnitude and significance of dangers linked to medical exposures; and the importance of proper risk communication to patients.

Nuclear Techniques for Early Diagnosis of Alzheimer's Disease

An estimated 47 million people around the world have been diagnosed with dementia, two thirds of them in developing countries. Nuclear techniques can be instrumental in identifying the underlying disease process several years before symptoms appear and can thus improve treatment.

During the 61st regular session of the General Conference in September, on World Alzheimer's Day, the Agency arranged a side event entitled 'Neuropsychiatry: The Revolution of Molecular Imaging in Alzheimer's Disease'. The event highlighted the role of nuclear techniques in the evaluation of patients with dementia, including Alzheimer's disease, and other neurological diseases, and the Agency's activities and assistance to Member States in this area. It also covered aspects of living with a patient with dementia and the global burden of neuropsychiatric disorders.

"the Agency arranged a side event entitled 'Neuropsychiatry: The Revolution of Molecular Imaging in Alzheimer's Disease'…. [highlighting] the role of nuclear techniques in the evaluation of patients with dementia, including Alzheimer's disease and other neurological diseases"

During 2017, the Agency also developed new on-line educational materials for the Human Health Campus web site and provided training in the diagnosis of the Alzheimer's disease to over 120 medical professionals through three training courses held in Argentina, Brazil and Chile.

Addressing Malnutrition Using Stable Isotopes

The Agency, jointly with the World Health Organization and the United Nations Children's Fund, organized a workshop entitled 'Analysis of Biological Pathways to Better Understand the Double Burden of Malnutrition and to Inform Action Planning'. Held in Vienna in October, the workshop brought together some 50 researchers and public health professionals working in the fields of nutrition and diet related non-communicable diseases in 30 countries around the world.

Participants discussed the double burden of malnutrition, its epidemiology and the biological pathways that drive it, as well as nutrition related policies and programmes to address it. They emphasized the role of nuclear techniques in understanding the biological pathways and assessing the impact of nutrition interventions, and identified main areas of programmatic focus. The workshop underlined the growing importance of stable isotope techniques in providing accurate information for the design and evaluation of interventions, especially those related to feeding infants and young children in the first 1000 days — from conception to two years of age — and for the evaluation of diet quality.

Water Resources

Objective

To enable Member States to use isotope hydrology for the assessment and management of their water resources, including the characterization of climate change impacts on water availability.

Enhancing Groundwater Resources Availability

In 2017, the Agency successfully concluded a four year technical cooperation project, entitled 'Integrated and Sustainable Management of Shared Aquifer Systems and Basins of the Sahel Region', aimed at obtaining a broad overview of groundwater supplies in Africa's drought prone Sahel region. The Agency trained scientists from the 13 participating Member States in carrying out detailed examinations of groundwater using tritium, a naturally occurring radionuclide, to map shallow, recently recharged groundwater. By identifying the origin and composition of the water, the participating Member States are now in a position to develop strategies to protect the groundwater from anthropogenic sources of pollution. Among the findings of the technical cooperation project, published in May, was that there are significant reserves of good quality water in the region that are not yet threatened by pollution.

The Agency used the IAEA Water Availability Enhancement (IWAVE) Project methodology to design the second phase of the technical cooperation project in the Sahel region. Use of this methodology will help establish requirements for the routine use of isotope hydrology in groundwater assessments aimed at increasing water availability.

Water Resource Assessment

To develop more effective means of building Member State capacity in isotope hydrology, the Agency conducted a series of training courses at its Headquarters in Vienna throughout the year. In March and November, it held two interregional training courses, with 26 participants from 25 Member States, highlighting the latest developments in isotope data interpretation for hydrology and climate change studies (Fig. 1). It also provided training in the analysis of low levels of environmental tritium and stable isotope analyses through laser absorption spectroscopy to 26 scientists from 10 Member States.

In June, the Agency organized a Technical Meeting to review key public health issues resulting from water scarcity, water pollution and vector borne diseases in urban areas. The meeting assembled a team of experts from ten Member States working in health and various environmental fields to explore the synergies between health and water. The participants evaluated the use of environmental isotopes for assessing sources, pathways

FIG. 1. Field training using groundwater sampling for analysis of noble gas isotopes in Costa Rica.

and interactions between water bodies in urban environments as a way to better manage water resources used for domestic supply in cities.

In September, a Technical Meeting was held in Vienna to examine the current knowledge and gaps regarding nitrogen compounds in the atmosphere, practices for monitoring them, and their impact on water resources and aquatic systems. Experts from 11 Member States explored the use of isotopes to better understand nitrogen sources such as fertilizers, human waste and industrial discharges, as well as natural atmospheric deposition, to develop more effective policies aimed at preventing the degradation of water sources.

Understanding Climate Change

Climate change adaptation is driven by knowledge and technology; through its water resources management activities, the Agency seeks to advance both. During the year, the Agency completed a coordinated research project entitled 'Stable Isotopes in Precipitation and Paleoclimatic Archives in Tropical Areas to Improve Regional Hydrological and Climatic Impact Models'. Participants from 13 Member States used laser spectroscopic technology to collect precipitation isotope data, either daily or on an event basis. The data were then compared with isotope data obtained from various paleoclimate archives, and the results were used to improve predictive regional and global climate and water balance models.

Analytical Capacity and Services

The Agency published the results of the Water Isotope Interlaboratory Comparison (WICO) 2016 test, involving analysis of stable isotopes of hydrogen and oxygen in eight water samples. A record number of 235 laboratories participated in the test. The results showed that approximately 75% of the laboratories produced reliable isotope data suitable for use in water resource investigations; however, around 25% underperformed owing to systemic errors, mistakes and poorly performing instrumentation. Several strategies to improve and correct analytical problems were recommended, such as the use of new data evaluation strategies and screening runs for contamination, and the inclusion of additional control standards.

The Agency also completed laboratory trials with a new laser based system and sample preparation procedure for analysing the stable isotopes nitrogen-15 and oxygen-18 in nutrient contaminants such as nitrates, a common pollutant in surface and groundwater. The new system provides Member States with a lower cost analytical option for evaluating nitrate pollution of water sources, and is being used for training counterparts.

Environment

Objective

To identify environmental problems caused by radioactive and non-radioactive pollutants and climate change, using nuclear, isotopic and related techniques, and to propose mitigation/adaptation strategies and tools. To enhance the capability of Member States to develop strategies for the sustainable management of terrestrial, marine and atmospheric environments and their natural resources in order to address effectively and efficiently their environment related development priorities.

Strengthened Analytical Capacity for Rapid Response

The Agency continued to work with Member States to enhance their capacity to rapidly and reliably analyse samples during a nuclear or radiological emergency. In 2017, a new global strategic plan was developed and implemented, involving the development and validation of a method of analysis; training activities; the production and supply of tailored reference materials; and the use of specially designed proficiency tests.

FIG. 1. Laboratory testing of water samples containing radionuclides typically found in the environment after a nuclear accident during the ConvEx-3 in June.

In 2017, the Agency for the first time tested the performance of Member State analytical laboratories during a Convention Exercise (ConvEx-3), held in Hungary in June. The test was organized in collaboration with the Radioanalytical Reference Laboratory of Hungary's National Food Chain Safety Office, an IAEA Collaborating Centre.

During the exercise, water samples with known activities of radionuclides that are typically found in the environment after an event such as a nuclear accident and that can pose analytical challenges were distributed to participating Member State laboratories to evaluate the timeliness and accuracy of their analyses and the standardization of their reporting methods (Fig. 1). Almost 90 laboratories from 37 Member States participated in the measurement and reporting exercise, including a large majority of ALMERA network laboratories. Ninety per cent of the laboratories reported within the time frame of the exercise, and the results showed excellent analytical performance.

Proficiency Tests

In 2017, the Agency developed a novel proficiency test for short-lived radionuclides representing a hypothetical release from a nuclear accident. Such samples had not previously been developed owing to logistical challenges in creating samples containing such radionuclides. The proficiency test drew substantial interest from Member State laboratories, and the results are being used to develop guidance for future tests, methodological guidelines and training materials.

The Agency expanded the range of proficiency tests to include sample materials for testing contamination of food, feed and different surface materials and matrices. It also developed an innovative approach to calibrate, test and train for in situ measurements using 'mosaic samples', samples that simulate a larger, integrated contaminated surface. The Agency conducted a series of training sessions focused on rapid contamination assessment using a comprehensive suite of in situ measurements, rapid analytical methods and dose assessment. The training courses were developed and implemented in close partnership with, inter alia, three IAEA Collaborating Centres: the Spiez Laboratory in Switzerland, the Radioanalytical Reference Laboratory of Hungary's National Food Chain Safety Office and the Korea Institute of Nuclear Safety. The Institute of Radiation Safety and Ecology in Kazakhstan and Argonne National Laboratory in the United States of America also contributed to this effort.

Movement of Contaminants in the Marine Environment

The Agency developed new analytical methods and conducted environmental research to advance understanding of the movement and impact of toxic contaminants on coastal and marine ecosystems. These contaminants, such as mercury and lead, persistent organic pollutants (POPs), biotoxins from harmful algae, and natural and artificial radionuclides, can have serious negative impacts on commercially important marine organisms that are consumed around the world. In 2017, the Agency assisted Member States in building capacity to rapidly identify the presence of such contaminants and to track their biogeochemical incorporation into and transfer up the food chain. In this regard, it provided Member States with a range of new tools — including fine-tuned radiolabelled tracers, nuclear and isotopic techniques, and other analytical methods — to precisely track the movement of these contaminants and biotoxins through marine food webs and ecosystems.

Through a Peaceful Uses Initiative project entitled 'Marine Plastics: Tackling the Challenge Using Nuclear Applications', the Agency designed multi-stressor experiments using controlled aquariums to examine the effects of realistic concentrations of organic contaminants adsorbed onto plastic particles under varying environmental conditions, such as a subtle change in the dissolved oxygen concentration, in the pH or in the salinity (Fig. 2). Other experiments used radio- and POP-labelled microplastic pellets as tracers to evaluate the uptake and loss mechanisms in commercially important fish and bivalve species. The research is delivering quantitative data that will enable all seafood-producing Member States to strengthen their seafood safety programmes.

FIG. 2. The Agency began a new project to study the effects of plastic particles in the marine environment and how contaminants can be transferred to marine animals.

Radioisotope Production and Radiation Technology

Objective

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

Radioisotopes and Radiopharmaceuticals

The Agency continued to assist Member States in producing radioisotopes and radiopharmaceuticals through capacity building and the dissemination and transfer of knowledge. In 2017, it expanded the focus of these activities to include regulatory aspects of radioisotope production and use. In October, it held a Technical Meeting of regulators and researchers responsible for the safe preparation and use of radiopharmaceuticals from 15 Member States, the World Health Organization and several professional societies. The meeting provided a platform for evaluating the status of regulations in different countries and for exploring the possibility of harmonizing regulations, with Agency support.

The Agency continued its support to Member States for the production of technetium-99m (Tc-99m), the most widely used radioisotope in nuclear medicine. In September, it launched a new coordinated research project entitled 'New Ways of Producing Tc-99m and Tc-99m Generators', involving ten Member States and six observers. The project aims at producing low to medium specific activity molybdenum-99 (Mo-99) using the photo-neutron route (i.e. the (γ,n) reaction on Mo-100) and developing corresponding guidelines, and at developing Tc-99m generators using low to medium specific activity Mo-99 produced by several routes. At the first meeting, held in December at the Agency's Headquarters in Vienna, the participants developed a work plan for the three year project.

Industrial Applications of Radiation Technology

In April, the Agency held the first International Conference on Applications of Radiation Science and Technology (ICARST-2017) in Vienna, with more than 500 participants from 73 Member States (Fig. 1). The conference highlighted the latest developments in the application of radiation science and technology, and focused on new initiatives to employ radiation technologies to meet emerging challenges and on building capacity in Member States for industrial development. Representatives of 45 equipment manufacturers, national research laboratories, dosimetry system suppliers, and non-governmental and academic research organizations participated as exhibitors.

FIG. 1. Director General Amano speaks during the first International Conference on Applications of Radiation Science and Technology, held in April.

The qualification of professionals in radiotracer and sealed source applications has historically been largely informal, based on on-the-job training by experienced local professionals and Agency experts. Increasingly, however, training and certification are becoming mandatory for those using radiotracers. In response to demand for more formal training, the Agency held a training course on industrial applications of radiotracers and sealed sources at the IAEA Collaborating Centre at the National Institute for Nuclear Science and Technology in Saclay, France, with participants from Cameroon, Côte d'Ivoire, the Democratic Republic of the Congo, Gabon, Madagascar and Morocco. The Agency held a similar training course on industrial applications of radiotracers at the National Centre for Nuclear Energy, Sciences and Technology in Morocco, with participants from Egypt, Kenya, the Sudan and Zimbabwe. Both courses included an examination under the certification scheme of the International Society for Tracer and Radiation Applications.

Nuclear Safety and Security

Incident and Emergency Preparedness and Response

Objective

To maintain and further enhance efficient Agency, national and international emergency preparedness and response (EPR) capabilities and arrangements for effective response to nuclear/radiological emergencies independent of their cause. To improve provision/sharing of information on nuclear or radiological incidents and emergencies among Member States, international stakeholders and the general public/media in preparedness stage and during response.

Strengthening Emergency Preparedness Arrangements

The Agency assisted Member States in strengthening their emergency preparedness and response (EPR) arrangements and capabilities through its peer review services and EPR training events and workshops held throughout the year. In 2017, the Agency conducted an Emergency Preparedness Review (EPREV) mission to Slovenia. It also developed new guidelines that improve the EPREV process by streamlining the self-assessment, clarifying the steps during the initiation and preparation phases, and aligning terminology and actions with those of other peer review services, where appropriate. The Agency streamlined the Integrated Regulatory Review Service (IRRS) questions on EPR to better align their scope to the regulatory aspects of EPR. It held two webinars to train EPR reviewers in carrying out IRRS missions, with 14 participants from Member States in different regions.

The Agency organized 53 training events and workshops — 41 at the regional level and 12 at the national level — to assist Member States in implementing the requirements established in *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSR Part 7). This included 3 regional and 3 national workshops dedicated to the new concepts and approaches in EPR addressed in GSR Part 7, and involved 314 participants from 44 Member States. Two regional workshops for Member States in Southeast Asia covered different aspects of GSR Part 7 relevant to regional priorities. During the first workshop, held in Singapore, 21 participants from 10 Member States defined a plan for developing a regional strategy for coordinating public communication in an emergency. At the second workshop, held in Pattaya, Thailand, 22 participants from 10 Member States defined the basis for a regional protocol for assessment and decision making. Around 170 experts attended a webinar covering medical preparedness and response for a nuclear or radiological emergency held jointly by the Agency and the World Health Organization.

The Agency approved a Safety Guide entitled *Arrangements for the Termination of a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSG-11) for publication. The guide was jointly sponsored by ten international organizations. During the year, the Agency conducted a first interregional workshop on applying the guidance and recommendations in GSG-11 for preparing to terminate an emergency and transition either to an existing exposure situation or to a planned exposure situation. The workshop, held in December in

Vienna and attended by 27 participants from 27 Member States, included a series of case studies and working sessions.

The Agency conducted five Schools of Radiation Emergency Management to address Member State requests for comprehensive training on all relevant EPR topics. Two Schools were held in Austria (Fig. 1) and one each in Japan, the Republic of Korea and Mexico. A total of 146 participants from 68 Member States took part.

FIG. 1. The School of Radiation Emergency Management involved a technical visit to the Lower Austria Fire Brigade School (Niederösterreichische Landes-Feuerwehrschule) during the three week training course held in Traiskirchen, Austria, in October.

During 2017, 240 health professionals from 44 Member States participated in 4 national and 6 regional training activities related to medical preparedness and response to a nuclear or radiological emergency. The activities covered medical response and dose assessment for individuals involved in such emergencies.

Response Arrangements with Member States

During 2017, the Agency organized 13 Convention Exercises (ConvEx) with Member States and international organizations. The exercises were carried out under the framework of the Convention on Early Notification of a Nuclear Accident (the Early Notification Convention) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (the Assistance Convention), and were used to test emergency communication channels, assistance mechanisms and the Agency's assessment and prognosis process. Member State capabilities were also tested regarding: requesting assistance during a nuclear or radiological emergency and preparing for its receipt; exchanging emergency information on appropriate protective actions; and communicating with the public.

One of the exercises held was a 36 hour ConvEx-3 exercise organized within the framework of the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE) (Fig. 2). Hosted by Hungary and involving 82 other Member States and 11 international organizations, this was the largest ConvEx-3 exercise to date. The exercise was based on a simulated scenario of a severe accident at the Paks nuclear power plant. Lessons learned were discussed at a Technical Meeting to Evaluate the ConvEx-3 (2017) Exercise, held in December in Vienna and attended by 75 participants from 56 Member States and 4 international organizations. Meeting participants finalized the ConvEx-3 (2017)

FIG. 2. Agency staff participate in a ConvEx-3 exercise hosted by Hungary in June to test the global emergency response to a simulated accident at a nuclear power plant.

International Emergency Response Exercise Report detailing the preparation, conduct and evaluation of the exercise.

The Agency further improved its Unified System for Information Exchange in Incidents and Emergencies (USIE) web site, adding a range of new functions. The improved portal now enables organizations registered on USIE to update information on an event using short messages in free text fields associated with a category (e.g. public information, meteorology); to easily identify the appropriate form for reporting events; and to register public information officers of organizations. States registered in the Response and Assistance Network (RANET) can now use USIE to update or confirm details of their RANET registration. The upgraded USIE web site also supports the storage of encrypted information, which can be accessed only by authorized users.

In April, the Agency launched its Assessment and Prognosis Tools web site, accessible to all USIE users. The site promotes understanding of the Agency's assessment and prognosis process by giving Member States access to the same tools and procedures used by Secretariat staff during emergencies. In November, the Agency updated the web site, revising the existing tools and making available additional technical features. During the year it held four webinars, attended by more than 50 experts, to assist Member States in using the tools.

In 2017, the Agency included innovative virtual reality exercises as part of both the Technical Meeting to Review the Draft Safety Guide on Preparedness and Response for an Emergency during the Transport of Radioactive Material, held in Vienna in October, and the Regional Workshop on Assessment and Prognosis during a Nuclear or Radiological Emergency, held in Vienna in November. In total, more than 100 experts participated in over 200 emergency response exercises during these two events, including activities such as on-scene hazard assessment, radiological surveying techniques in high dose rate environments and application of strategies for monitoring in an emergency.

In October, the Agency held the first RANET Joint Assistance Team exercise at the RANET Capacity Building Centre in Fukushima Prefecture, Japan, involving 30 experts from 7 Member States registered in RANET. The exercise simulated an Agency assistance mission with a Joint Assistance Team comprising field assistance teams and experts from support organizations in various Member States registered in RANET, as well as representatives of the Agency. The participants managed and resolved administrative, logistical and technical matters, and issues involving the safety and security of personnel that can arise during an assistance mission.

Ten countries updated their RANET registration details in 2017: the Czech Republic, Egypt, Hungary, the Republic of Korea, Pakistan, Slovenia, Spain, Switzerland, Turkey and Ukraine. This included updates to National Assistance Capabilities (NAC), updates to NAC coordinator details and the addition of NAC expertise and resources.

In June, 24 experts from 6 Member States took part in a simulated tabletop exercise conducted by participants in the Dialogue between Coastal and Shipping States and facilitated by the Agency. Participants practised transboundary cooperation and communication in emergencies relating to nuclear materials transported by sea.

Since 2010, the Agency has routinely provided emergency contact points with comprehensive training in operational arrangements for implementation of the Early Notification Convention and the Assistance Convention. In 2017, the Agency organized three workshops on notification, reporting and requesting assistance, involving more than 100 participants from 75 Member States.

An analysis of the communications tests led the Agency to request emergency contact points to review the use of their emergency communications channels; those lacking USIE web site users were reminded to register new users. More than 300 changes of user accounts on the USIE system were implemented, and more than 200 new users were added to the web site. The Agency also contacted Member States that did not have contact points for emergency communications and encouraged the designation of contact points in line with the *Operations Manual for Incident and Emergency Communication* (EPR-IEComm 2012).

The Agency conducted a total of eight national, regional and interregional workshops on effective communication with the public in an emergency, including a 'train the trainers' workshop held in Vienna in August. A total of 190 participants from 78 Member States took part in the workshops.

Response to Events

In 2017, the Agency was informed by the competent authorities, or became aware through earthquake alerts or media reports, of 206 events involving or suspected to involve ionizing radiation (Fig. 3). It took response actions in 19 of these events. It made 7 offers

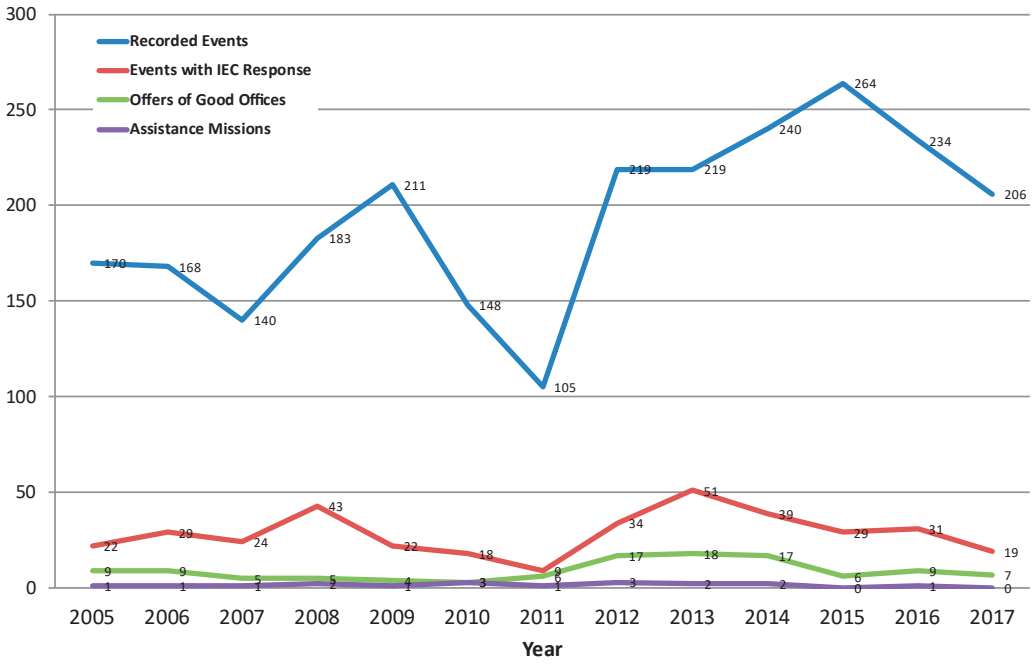

FIG. 3. Number of radiation events the Agency became aware of, and Agency responses, since 2005.

of good offices, including for events involving the loss of radioactive sources and those triggered by earthquakes. Since October 2017 the Agency collected, analysed and shared information and data with Member States and international organizations in response to elevated levels of Ru-106 in Europe.

Inter-Agency Coordination

The 26th Regular Meeting of the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE) was held in Brussels, Belgium, in November. Participants reviewed EPR activities in each organization, discussed lessons identified in the ConvEx-3 (2017) exercise, reviewed the exercise report and agreed on the IACRNE work programme for the next two years.

In-house Preparedness and Response

The Agency organized a comprehensive programme of training classes and exercises to enhance the skills and knowledge of Agency staff members serving as qualified responders in the Incident and Emergency System. The programme offered approximately 140 hours of training during the year, including 77 classes delivered to some 150 Agency staff responders. The Agency held four full response exercises during the year, including an exercise involving a radiological emergency triggered by a nuclear security event in December. In 2017, the Incident and Emergency Centre welcomed over 1000 visitors for presentations and tours of the operational area.

Safety of Nuclear Installations

Objective

To continuously improve the safety of nuclear installations during site evaluation, design, construction and operation through the availability of safety standards and their application. To support Member States in developing and implementing the appropriate safety infrastructure. To assist adherence to, and implementation of, the Convention on Nuclear Safety (CNS) and the Code of Conduct on the Safety of Research Reactors and to strengthen international cooperation.

Regulatory Infrastructure for Nuclear Safety

In 2017, the Agency conducted 32 expert missions, workshops and training activities to provide Member States with guidance and information on establishing an effective regulatory infrastructure on the basis of the Agency's safety standards, in particular the Safety Guide *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16). Expert missions addressed areas such as the development of safety regulations; human resource development; establishment of a management system at the regulatory body; and identification and planning of actions to strengthen national safety infrastructure. The Agency also held two Hands-on Regulatory Inspector Training Workshops to help Member States embarking on a nuclear power programme to prepare for inspections of plant construction sites. The workshops were held at the nuclear power plant in Zwentendorf, Austria, which was completed but never entered service.

The Agency assisted Member States in strengthening their national regulatory infrastructure for nuclear and radiation safety through its Integrated Regulatory Review Service (IRRS). During the year, it conducted follow-up IRRS missions to four Member States with operating nuclear power plants: Belgium, the Czech Republic, France and Romania. It also continued to promote and conduct IRRS missions to embarking countries. IRRS follow-up missions were conducted to Poland in June and to Jordan in October. In July, Nigeria hosted a full scope IRRS mission that included a module tailored to assist embarking countries in reviewing progress against actions set out in SSG-16.

The Agency organized the second International High Level Meeting on the Challenges Faced by Newcomer Countries Regarding the Establishment of an Effective Regulatory Framework and Infrastructure for Safety, held in Jakarta, Indonesia, in November. Fourteen high level representatives of nine countries took part. The meeting participants developed a report summarizing the challenges identified and the experience, information and recommendations shared during the meeting.

In 2017, the Regulatory Cooperation Forum (RCF) organized meetings with four of its active recipient countries — Belarus, Jordan, Poland and Viet Nam — to coordinate support plans for building regulatory capability. In June, Ghana and Morocco became active recipient countries of the RCF, bringing the total number to six. The RCF organized

a workshop, in collaboration with the Arab Network of Nuclear Regulators and the Forum of Nuclear Regulatory Bodies in Africa, on regulatory control for all recipient countries. The workshop, held in Rabat, Morocco, in November, was attended by 3 experts and 18 trainees from 10 countries.

Convention on Nuclear Safety

The Agency hosted the Seventh Review Meeting of the Contracting Parties to the Convention on Nuclear Safety at the Agency's Headquarters from 27 March to 7 April (Fig. 1). More than 900 participants from 77 Contracting Parties took part. For the first time, countries that have signed the CNS but that have not yet adhered to it were invited to attend the opening plenary, the part of the final plenary when the summary report was adopted and the concluding press conference. Representatives of the media were also invited to the same sessions, which were webcast for the first time. All National Reports were made publicly available on the Agency's web site after the Review Meeting.

FIG. 1. Opening of the plenary session of the Seventh Review Meeting of the Contracting Parties to the Convention on Nuclear Safety, held at the Agency's Headquarters in Vienna, Austria.

The Review Meeting included a peer review of the incorporation of appropriate technical criteria and standards used by Contracting Parties for addressing the principles of the Vienna Declaration on Nuclear Safety into national requirements and regulations. The peer review was carried out in accordance with a decision of the Contracting Parties to the CNS contained in the aforementioned Declaration adopted in 2015. A special session was held to discuss the challenges faced by countries not operating nuclear power plants and by embarking countries in meeting the obligations of the CNS. The Contracting Parties highlighted the need for the Agency to consider coordinating and hosting regional educational workshops for countries with no nuclear power reactors to encourage participation and provide information and assistance in meeting the obligations of the Convention.

Design Safety and Safety Assessment

In June, the Agency convened an International Conference on Topical Issues in Nuclear Installation Safety: Safety Demonstration of Advanced Water Cooled Nuclear Power Plants in Vienna, attended by over 300 participants from 48 Member States and 5 international

organizations. The participants discussed the latest approaches, advances and other matters regarding demonstration of the safety of nuclear power plants planned to be licensed and constructed in the near future. During the conference, the Agency conducted a workshop providing an introduction to and further explanation of design extension conditions, and another workshop on the Agency's technical safety review services.

The Agency supported Member States in sharing information and experience through Technical Meetings on: Challenges in the Application of the Design Safety Requirements for Nuclear Power Plants to Small and Medium Sized Reactors; the Development of the IAEA Technical Document on Developing Design Criteria for a Diverse Actuation System for Nuclear Power Plants; the Development of the Safety Report on Human Reliability Assessment for Nuclear Installations; and Implementation and Integration of Accident Management Guidelines and Interface with Emergency Preparedness and Response.

During the year, the Agency continued coordinating a study that reviewed Member States' application of the Agency's design related Safety Requirements to small and medium sized or modular reactor (SMR) designs and technologies intended for near term deployment. The study indicated that the requirements established in *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1 (Rev. 1)) are in principle applicable to water cooled SMR designs, with engineering judgement required for certain aspects. The Agency also supported a similar study conducted by the SMR Regulators' Forum by facilitating discussions on safety and licensing for regulators who are now, or will soon be, reviewing license applications for SMRs. To encourage sharing of information and experience related to nuclear regulation, the Agency organized two workshops for Member States embarking on a nuclear programme that includes SMRs.

Safety and Protection against External Hazards

The Agency provides independent reviews of the site evaluation and designed safety of nuclear installations through its Site and External Events Design (SEED) review service. In 2017, it conducted three preparatory missions for SEED reviews to the Republic of Korea, Thailand and Turkey, and five SEED review missions to Belarus, Indonesia, the Republic of Korea, Turkey and Uganda. It also conducted 13 expert missions, capacity building activities and training workshops under the framework of SEED.

Operational Safety of Nuclear Power Plants

The Operational Safety Review Team (OSART) programme has provided advice and assistance to Member States for 35 years to enhance the safety of nuclear power plants during construction, commissioning and operation. In 2017, the Agency conducted seven OSART missions to China, Finland, France, the Russian Federation, Slovenia, the United Arab Emirates and the United States of America. It also conducted seven follow-up OSART missions to Canada, France, Japan, the Netherlands, Pakistan, the Russian Federation and the United Kingdom.

Safety Aspects of Long Term Operation (SALTO) peer reviews specifically address safe long term operation of nuclear power plants. In 2017, the Agency conducted three SALTO missions to Belgium, China and Sweden, and one follow-up SALTO mission to Mexico. It also carried out one expert mission based on the SALTO methodology to Mexico. The large quantity of data collected during these missions was analysed by the Agency and recorded in a database that provides an overview of findings from SALTO and SALTO follow-up missions from 2005 to 2017. The database was made available to Member States during the year.

The Agency's Peer Review of Operational Safety Performance Experience (PROSPER) service aims at enhancing safety through improved use of operating experience. The Agency conducted two PROSPER missions to the Russian Federation in 2017. It also organized three Technical Meetings aimed at sharing good practices and lessons learned in the use of operating experience: in Argentina, with 35 participants from 6 Member States; in Austria, with 20 participants from 13 Member States; and in France, with 37 participants from 34 Member States.

Through peer review missions and related activities, the Agency assisted Member States, on request, in assessing and improving safety culture at all levels in nuclear regulatory bodies, at nuclear facilities and in other organizations. Leadership and management processes, and the interfaces between human, technological and organizational performance were assessed as part of the seven OSART missions conducted during the year. The Agency conducted an Independent Safety Culture Assessment mission to the research reactor and isotope facility in Petten, the Netherlands, as part of its services to assess leadership and management processes in nuclear facilities other than nuclear power plants. In October, the Agency, in cooperation with the World Association of Nuclear Operators, held a workshop aimed at developing guidance on applying a harmonized safety culture framework; and in November, it conducted a workshop for senior managers on the topic of leadership and safety culture, in Helsinki, Finland.

From 30 October to 3 November, the Agency held its first Pilot International School of Nuclear and Radiological Leadership for Safety, in Nice, France. Twenty junior and middle managers from operators and regulators took part in the School, which uses case studies, presentations, keynote addresses, exercises and discussions to illustrate nuclear and radiological safety leadership concepts in real-life situations (Fig. 2).

The Agency organized the Fourth International Conference on Nuclear Power Plant Life Management in Lyon, France, in October, hosted by France in cooperation with the European Commission's Joint Research Centre and the Electric Power Research Institute. Over 350 participants representing 32 Member States and 4 international organizations discussed the importance of plant life management programmes in ensuring safe and reliable operation of nuclear power plants; the role of configuration management in safety enhancement; and good practices related to the safety aspects of ageing management.

FIG. 2. Junior and mid-career professionals take part in the first Pilot International School of Nuclear and Radiological Leadership for Safety, held in Nice, France.

Safety of Research Reactors and Fuel Cycle Facilities

In 2017, the Agency conducted three Integrated Safety Assessment of Research Reactors (INSARR) missions to Jamaica (Fig. 3), Kazakhstan and Norway, and two follow-up INSARR missions to Poland and Turkey. These missions reviewed the facilities' operational safety and provided guidance and recommendations for safety improvements.

FIG. 3. The INSARR mission team at the JM-1 research reactor in Kingston, Jamaica, in June.

In May, the Agency held the fourth International Meeting on Application of the Code of Conduct on the Safety of Research Reactors, in Vienna. The meeting participants, from 40 Member States, reviewed Member States' self-assessments of the application of the Code to identify areas where it was being satisfactorily applied and areas where further improvements were necessary. They noted that Member States increasingly recognize the Code as a primary guidance document for the safe management of research reactors. They also provided recommendations for improvements in areas identified from safety reassessments, including regulatory supervision, ageing management, planning for decommissioning and implementation of safety upgrades.

The Agency held three workshops on the safety of nuclear fuel cycle facilities during the year: 'Operational Radiation Protection and Waste Management', held in March; 'Regulatory Supervision', held in July; and 'Safety Reassessment in the Light of the Fukushima Daiichi Accident', held in November. The workshops were attended by 72 experts from 29 Member States. Participants shared information, experience and good practices related to establishing and supervising safety and protection programmes based on the Agency's safety standards.

Radiation and Transport Safety

Objective

To achieve global harmonization of the development and application of the Agency's safety standards in this area, and to increase the safety of radiation sources and thereby raise the levels of protection of people against the harmful effects of radiation.

Radiation Safety and Monitoring

The Agency conducted Occupational Radiation Protection Appraisal Service (ORPAS) missions to Chile, Malaysia, Morocco and Paraguay, and preparatory ORPAS missions to Chile, Nicaragua and Panama (Fig. 1). The missions encouraged national regulatory authorities and end users to consider applying the graded approach in areas such as: licensing of radiation practices; safety assessment and inspection of facilities and activities; and review or development of radiation protection regulations for facilities and activities.

In 2017, the Agency's laboratory for radiation safety technical services earned re-accreditation under the ISO/IEC 17025 standard, affirming that it meets the highest quality and procedural standards and has the required competence to provide valid results. Throughout the year, the laboratory provided services such as assessment of occupational exposure for more than 800 staff and 2100 non-staff engaged in activities under Agency

FIG. 1. An ORPAS team member monitors the iodine-131 production process during a mission to the CCHEN Lo Aguirre Nuclear Research Centre in Chile.

control or supervision; workplace monitoring, including response to radiation incidents and emergencies; and calibration of equipment for radiation measurements. In 2017, the laboratory participated in five inter-laboratory comparison exercises in order to receive independent feedback on the quality of its analytical results. These exercises were organized by internationally recognized proficiency testing service providers such as the Association for the Promotion of Quality Control in Radiotoxicological Analysis (PROCORAD) and the European Radiation Dosimetry Group (EURADOS). In all the inter-laboratory comparison exercises, the laboratory ranked among the best performing participants. To support the radiation safety technical services, the Agency initiated procurement of a new radiophotoluminescence glass dosimeter system under the Major Capital Investment Fund project entitled 'Enhancing Radiation Safety through Efficient and Modern Dosimetry (RADSED)'.

The Agency conducted two Education and Training Appraisal (EduTA) missions: to Argentina, in November, and to the United Arab Emirates, in February. EduTA missions review the status of the legal and regulatory provisions for education and training in radiation protection and the safety of radiation sources. The Agency also carried out advisory missions on establishing a national strategy and policy for education and training in radiation protection and safety to the Democratic Republic of the Congo, in January, and to Uganda, in August.

Specialized training events in the field of radiation, transport and waste safety included a regional Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources held in Malaysia from May to November (Fig. 2), and three Schools for Drafting Regulations on Radiation Safety for the Caribbean (January), Europe (July), and Asia and the Pacific (August). The latter were prepared and implemented using the Control of Sources Network, under the International Regulatory Network and the Global Nuclear Safety and Security Network (GNSSN). During the year, more than 3000 people took part in e-learning activities offered on the Agency's Radiation Protection of Patients web site.

FIG. 2. Participants in the 14th regional Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources, held in Malaysia.

The International Conference on Radiation Protection in Medicine: Achieving Change in Practice was held in Vienna in December. The conference's 534 participants from 97 Member States and 16 international organizations discussed the implementation of the Bonn Call for Action to improve radiation protection in medicine, in particular the need for development of the Bonn Call for Action Implementation Toolkit. In addition, in the framework of the Practical Arrangements with Argentina's Nuclear Regulatory Authority,

the Agency supported the review and development of regulatory guidance on radiological protection in radiotherapy, addressing in particular the potential increase in the risk of secondary cancers.

The Agency continued to help Member States evaluate their need for a national action plan to control exposure due to radon. In November, it trained 20 architects and building professionals from 13 Member States in Europe in the use of technology and techniques for reducing radon concentrations in existing buildings at a regional training course held in cooperation with the University of Cantabria in Ciudad Rodrigo, Spain, at the university's radon test facility. It also provided support to Montenegro in upgrading its national system for reducing public exposure to radon indoors, through an Agency technical cooperation project.

"In November, [the Agency] trained 20 architects and building professionals from 13 Member States in Europe in the use of technology and techniques for reducing radon concentrations in existing buildings"

Regulatory Infrastructure

The Agency conducted six IRRS missions to Member States without operating nuclear power plants: Botswana, Cyprus, Ethiopia, Guatemala, Nigeria and the former Yugoslav Republic of Macedonia. It also carried out three follow-up IRRS missions to Member States without operating nuclear power plants: Greece, Jordan and Poland.

The Agency, through its Programme of Action for Cancer Therapy (PACT), continued to support assessment and enhancement of radiation safety infrastructure in Member States having a particular interest in establishing or enhancing their cancer control capacity. Four imPACT (integrated missions of PACT) Review missions were conducted during the year: to Burundi, in March; to the Republic of the Congo, in June; to Swaziland, in August; and to Togo, in September.

In June, the Agency organized an Open-ended Meeting of Legal and Technical Experts on the Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources, in Vienna, Austria. One hundred eighty experts from 101 Member States exchanged information and shared experiences on the establishment and implementation of financial provisions to ensure safe management and secure protection of radioactive sources once they have become disused. Participants also discussed the associated challenges faced by regulatory bodies and other stakeholders. The Agency finalized the development of the Guidance on the Management of Disused Radioactive Sources, supplementary to the Code of Conduct on the Safety and Security of Radioactive Sources. The Guidance was approved by the Board of Governors and endorsed by the General Conference in September.

The Agency organized two international workshops in Vienna in March, attended by a total of 95 experts from 73 Member States. The first workshop, on 'Implementation of a National Cradle-to-Grave Control System for Radioactive Sources', addressed all the steps necessary for the safe and secure management of radioactive sources, from their production or import into a country to their disposal or export to another country. The second workshop, on the 'National Registers of Radiation Sources', looked at the experience of and lessons learned by regulatory bodies in establishing and maintaining a national register of radiation sources.

Transport Safety

The Agency supported capacity building for regulatory oversight of transport of radioactive material in over 80 Member States through workshops involving more than 190 delegates from the Africa, Asia and the Pacific, Latin America and Europe regions. The workshops were held in Vienna in January, August and September; Bangkok, Thailand, in May; Auckland, New Zealand, in June (Fig. 3); San Jose, Costa Rica, in August; Madrid, Spain, in September; Sliema, Malta, in October; Accra, Ghana, in October; and Montevideo,

FIG. 3. Participants in a decontamination exercise for the Pacific Islands, held in New Zealand in June.

Uruguay, in November. These workshops included a drafting school for transport safety regulations, a 'train the trainers' course, and workshops on transport safety compliance inspections and emergency response for transport accidents.

Radiation Safety Information Management System

The Agency's Radiation Safety Information Management System (RASIMS) helps Member States that receive technical support from the Agency to assess progress made in their implementation of the Agency's radiation safety standards. The Agency organized a workshop in Vienna in May for RASIMS national coordinators from 15 Member States in the Asia and the Pacific region to assist them in updating the information in RASIMS on their national radiation safety infrastructure. Experts from nine Member States participated in two consultants meetings, held in Vienna in June and November, that tested and evaluated the new version of the RASIMS platform.

Radioactive Waste Management and Environmental Safety

Objective

To achieve harmonization in policies and standards governing waste safety and public and environmental protection, together with provisions for their application, including sound technologies and good practices.

Radioactive Waste and Spent Fuel Management

The Agency carried out the first Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) mission to Italy in July (Fig. 1). It also conducted an ARTEMIS review of Poland's National Plan of Radioactive Waste and Spent Nuclear Fuel Management, in October.

The Agency continued to assist Member States actively pursuing borehole configurations as one option for disposal of disused sealed radioactive sources. It held an Interregional Workshop on Regulatory Review of the Post-Closure Safety of Disposal of Disused Sealed Radioactive Sources, in Buenos Aires, Argentina, in June, with 29 participants from 23 Member States, and issued a publication entitled *Generic Post-closure Safety Assessment for Disposal of Disused Sealed Radioactive Sources in Narrow Diameter Boreholes* (IAEA-TECDOC-1824), covering all the steps required in such an assessment.

FIG. 1. Members of the ARTEMIS team and staff of Italy's State-owned company SOGIN visit the Caorso nuclear power plant in northern Italy as part of the Agency's first ARTEMIS review.

The Agency helped Member States build capacity and strengthen radioactive waste management infrastructure through five hands-on training courses on the management of radioactive waste and disused sealed radioactive sources, held in the Asia and the Pacific region. In total, 116 participants were equipped with practical skills to solve problems related to categorization of waste, technical procedures for conditioning of waste, and predisposal considerations in their home countries (Fig. 2).

Fig. 2. Staff of Indonesia's National Nuclear Energy Agency (BATAN) receive hands-on training during an Agency course on management of radioactive waste and disused sealed radioactive sources. (Photograph courtesy of Suriantoro/BATAN.)

Assessment and Management of Environmental Releases

As part of the second phase of the Modelling and Data for Radiological Impact Assessments (MODARIA II) programme, the Agency held a Technical Meeting in Vienna, from 30 October to 3 November, that brought together 150 regulators, operators, modellers and radiation protection experts from technical support organizations in 47 Member States. The meeting participants shared their experiences in assessing radiation exposures of the public and of flora and fauna from radionuclides present in the environment as a result of accidents or authorized practices.

In February, the Agency published the final report of the *International Peer Review of the Environmental Impact Assessment Performed for the Licence Application of the Baltic-1 Nuclear Power Plant, Kaliningrad, Russian Federation*.

Decommissioning and Remediation Safety

As part of the International Project on Managing the Decommissioning and Remediation of Damaged Nuclear Facilities, the Agency organized an international workshop in Penrith, United Kingdom, in October. The meeting was attended by 40 experts from 21 Member States who visited the Sellafield site and provided input to a new Agency report that will address challenges related to decommissioning and remediation of legacy sites and severely damaged nuclear installations.

The Agency's Coordination Group for Uranium Legacy Sites (CGULS) continued to play a central role in coordinating the many organizations working toward sustainable remediation of uranium legacy sites in Central Asia. The annual meeting of CGULS, held in Almaty, Kazakhstan, in June, was attended by 37 representatives of 12 Member States and 6 international organizations. The Agency finalized the *Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia*, providing a framework for remediation activities in the region. During the 61st regular session of the General Conference, parties collaborating on the development of the plan signed a Preface to the document, stating their support for a coordinated approach to remediation of the uranium legacy sites in Central Asia.

Joint Convention

The Third Extraordinary Meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was held in May, with the participation of 57 Contracting Parties. The Contracting Parties agreed to amend the Joint Convention Guidelines regarding the Review Process so that the Secretariat makes publicly available each National Report within 90 days after the Review Meeting, unless the Contracting Party concerned notifies the Secretariat otherwise. The Contracting Parties agreed to introduce 'Areas of Good Performance' on a trial basis at the Sixth Review Meeting of the Contracting Parties to the Joint Convention. This follows the approach used during the Seventh Review Meeting of Contracting Parties to the CNS.

The Organizational Meeting for the Sixth Review Meeting of the Contracting Parties to the Joint Convention, also held in May, was attended by 57 Contracting Parties. The Contracting Parties decided inter alia to organize two sequential topical sessions at the Sixth Review Meeting: one focusing on disused sealed sources and one addressing general safety issues, challenges and public acceptance aspects associated with the long term storage of higher level radioactive waste.

The Agency organized a side event during the 61st regular session of the General Conference to celebrate the 20th anniversary of the adoption of the Joint Convention. Representatives of five Contracting Parties shared experiences from past review meetings and highlighted the role of the Convention as the only legally binding international instrument to address the safe management of spent fuel and radioactive waste.

The Agency undertook activities to further encourage adherence to the Joint Convention and active participation in the peer review process, and to increase the effectiveness of the review process. In November, it held a Regional Workshop in Vienna to promote the Convention on Nuclear Safety and the Joint Convention in Latin American and Asian countries, and conducted a Regional Workshop for the Promotion of the Joint Convention in African Countries in Rabat, Morocco, in December.

Nuclear Security

Objective

To contribute to global efforts to achieve effective nuclear security, by establishing comprehensive nuclear security guidance and providing for its use through peer reviews and advisory services and capacity building, including education and training. To assist in adherence to, and implementation of, relevant international legal instruments, and to strengthen the international cooperation and coordination of assistance in a way that underpins the use of nuclear energy and applications. To play the central role and enhance international cooperation in nuclear security, in response to General Conference resolutions and Board of Governors directions.

Nuclear Security Plan 2018–2021

At its September meeting, the Board of Governors approved the Nuclear Security Plan 2018–2021. The Plan provides details of proposed Agency nuclear security activities for the period 2018–2021. It corresponds to the priorities of Member States expressed through the decisions and resolutions of the Agency's Policy-Making Organs, as well as priority setting for IAEA Nuclear Security Series guidance recommended by the Nuclear Security Guidance Committee.

International Conference on Physical Protection of Nuclear Material and Nuclear Facilities

The Agency organized the International Conference on Physical Protection of Nuclear Material and Nuclear Facilities, held at its Headquarters in November. The conference, comprising six main panel sessions and 39 technical sessions, was attended by some 700 participants. The topics addressed included, inter alia, universal adherence to the Convention on the Physical Protection of Nuclear Material and its Amendment; protection against unauthorized removal of nuclear material during use, storage and transport; protection against sabotage of nuclear material and facilities; legislative and regulatory requirements; nuclear security culture; physical protection regimes; design basis threat; training and capacity building; and nuclear security during transport.

Nuclear Security Guidance

The Agency continued to develop comprehensive guidance on nuclear security. The Nuclear Security Guidance Committee, comprising representatives of 69 Member States, met twice during 2017. A working group was convened to update the roadmap for the

IAEA Nuclear Security Series publications by identifying further priorities for guidance development and review. The November meeting concluded the Committee's second three year term.

Needs Assessment

In 2017, the Agency introduced a revised Integrated Nuclear Security Support Plan (INSSP) template that resulted in more comprehensive and better structured reports and helped States improve their needs assessments. The Agency also made more systematic use of the Nuclear Security Information Management System (NUSIMS) self-assessment questionnaires in combination with the new template in order to ensure the consistency and complementarity of the two assessment tools.

Capacity Building in Regulatory Frameworks for Nuclear Security

The Agency, on request, provided assistance in establishing and enhancing regulatory frameworks for nuclear security. It also conducted training to enable States to build capacity in drafting nuclear security regulations and carried out expert missions to review States' nuclear security regulations. During 2017, the Agency launched a project to enhance national regulatory frameworks for nuclear security in African States. In this context, it held a regional workshop, in Morocco in April, and two regional training workshops, which focused on the development and drafting of regulations to support national nuclear security regimes, in the Niger (May) and Zambia (October). The workshops were attended by 143 participants from 39 States.

Risk Reduction

The Agency continued to support States in their efforts to protect radioactive sources during and at the end of their useful life (Fig. 1). Physical protection upgrades to existing and new facilities using high activity radioactive sources were initiated in five countries, upon their request, in Asia and Latin America, and the Agency removed Category 1 and 2 disused sealed sources from two countries in Latin America.

FIG. 1. The Agency conducted a training course on physical protection at Japan's Nuclear Security Support Centre in June. Participants gained hands-on experience at the Centre's physical protection exercise field and mock facility.

In support of risk reduction activities, a pilot project for implementation of the borehole disposal concept for disused sealed sources in Ghana and Malaysia neared its final stages. In 2017, the safety cases and security plans were finalized for evaluation and approved by the respective regulatory bodies.

Tool for Radiation Alarm and Commodity Evaluation (TRACE)

The Agency launched a mobile application called Tool for Radiation Alarm and Commodity Evaluation (TRACE) in June. The application helps customs and other front line officers to quickly determine whether radiation alarms at border crossings are caused by naturally occurring radioactive material in goods or whether they could indicate nuclear or other radioactive material out of regulatory control. The application provides accurate, detailed information on commodities and their radiological characteristics and is available for both Apple and Android devices. It was developed as part of a coordinated research project involving experts from 20 Member States.

Advisory Services

In 2017, the Agency conducted International Physical Protection Advisory Service (IPPAS) missions to China, the Democratic Republic of the Congo, Germany and Lithuania, and follow-up IPPAS missions to Australia and Hungary, bringing to 81 the total number of IPPAS and IPPAS follow-up missions conducted to date. In October, the Agency held its third International Workshop on the International Physical Protection Advisory Service to expand the pool of experts for IPPAS missions. The workshop, held in Vienna, was attended by 54 experts from 29 Member States.

Major Public Events

In 2017, the Agency provided assistance in implementing nuclear security systems and measures for major public events to Gabon, Indonesia, Kazakhstan (Fig. 2), Malaysia, Mali,

FIG. 2. A participant in an Agency training event on the use of radiation detection instruments in Kazakhstan, in May. The training event was part of efforts to ensure that nuclear security measures and systems were in place for Expo 2017.

Morocco, Panama, the Philippines, Romania, Ukraine and Uzbekistan. This included five coordination meetings with counterparts to agree on the types of assistance to be provided by the Agency, and 11 international, regional and national training events. The Agency also loaned a total of 370 radiation detection instruments for use related to major public events and, prior to five major public events, provided analysis reports addressing recent Incident and Trafficking Database data related to the country and region of the event.

The Agency finalized a new training curriculum to provide assistance to States hosting major public events (MPEs). A Regional Workshop on Developing and Implementing Nuclear Security Systems and Measures for MPEs was held in Tokai, Japan, in August.

The Agency procured 161 additional radiation detection instruments, expanding the equipment available for loan to Member States.

Incident and Trafficking Database

In 2017, El Salvador and Liechtenstein joined the Incident and Trafficking Database (ITDB) programme. During the year, States confirmed 166 incidents to the ITDB; 139 involved radioactive sources and radioactively contaminated material and 27 incidents involved nuclear material. Five reported incidents involved acts of trafficking or malicious use. A new on-line system for reporting incidents and a new on-line tool for querying the database were released to ITDB Points of Contact. The Agency also launched a project to improve the quality of legacy data in the ITDB by standardizing the data collected from all available incident reports since the inception of the ITDB, and by aligning the contents of the database and the incident notification form.

Nuclear Security Fund

In 2017, financial pledges to the Nuclear Security Fund amounting to €44.1 million were accepted by the Agency. These pledges included financial contributions from 16 Member States and the European Commission.

Nuclear Verification

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. To remain ready to assist with verification tasks, in accordance with the Agency's Statute, in connection with nuclear disarmament or arms control agreements, as requested by States and approved by the Board of Governors.

Implementation of Safeguards in 2017

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

With regard to States with comprehensive safeguards agreements (CSAs), the Agency seeks to conclude that all nuclear material has remained in peaceful activities. To draw such a conclusion, the Agency must ascertain, first, that there are no indications of diversion of declared nuclear material from peaceful activities (including no misuse of declared facilities or other declared locations to produce undeclared nuclear material) and, second, that there are no indications of undeclared nuclear material or activities in the State as a whole.

To ascertain that there are no indications of undeclared nuclear material or activities in a State, and ultimately to be able to draw the broader conclusion that *all* nuclear material has remained in peaceful activities in that State, the Agency assesses the results of its verification and evaluation activities under the State's CSA and additional protocol (AP). Thus, for the Agency to draw such a broader conclusion, both a CSA and an AP must be in force for the State, and the Agency must have completed all necessary verification and evaluation activities and found no indication that, in its judgement, would give rise to a proliferation concern.

For a State that has a CSA but not an AP in force, the Agency draws a conclusion only with respect to whether *declared* nuclear material remained in peaceful activities, as the Agency does not have sufficient tools to provide credible assurances regarding the absence of undeclared nuclear material and activities in the State.

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

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

In 2017, safeguards were applied for 181 States[3,4] with safeguards agreements in force with the Agency. Of the 127 States that had both a CSA and an AP in force[5] the Agency drew the broader conclusion that *all* nuclear material remained in peaceful activities for 70 States[6]; for the remaining 57 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. For 46 States with a CSA but with no AP in force, the Agency concluded only that *declared* nuclear material remained in peaceful activities.

For those States for which the broader conclusion has been drawn, the Agency is able to implement integrated safeguards: an optimized combination of measures available under CSAs and APs to maximize effectiveness and efficiency in fulfilling the Agency's safeguards obligations. During 2017, integrated safeguards were implemented for 65 States[7,8].

Safeguards were also implemented with regard to nuclear material in selected facilities in the five nuclear-weapon States party 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 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 the three States for which the Agency implemented safeguards pursuant to item-specific safeguards agreements based on INFCIRC/66/Rev.2, the Agency concluded that nuclear material, facilities or other items to which safeguards had been applied remained in peaceful activities.

As of 31 December 2017, 12 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 (Fig. 1), and the amendment or rescission of small quantities protocols (SQPs)[9]. The status of safeguards agreements and APs as of 31 December 2017 is shown in Table A6 in the

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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 Or an additional protocol being provisionally applied, pending its entry into force.

6 And Taiwan, China.

7 Albania, Andorra, Armenia, Australia, Austria, Bangladesh, Belgium, Botswana, Bulgaria, Burkina Faso, Canada, Chile, Croatia, Cuba, Czech Republic, Denmark, Ecuador, Estonia, Finland, Germany, Ghana, Greece, Holy See, Hungary, Iceland, Indonesia, Ireland, Italy, Jamaica, Japan, Kazakhstan, Republic of Korea, Latvia, Libya, Lithuania, Luxembourg, Madagascar, Mali, Malta, Mauritius, Monaco, Montenegro, Netherlands, New Zealand, Norway, Palau, Peru, Philippines, Poland, Portugal, Romania, Seychelles, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Tajikistan, the former Yugoslav Republic of Macedonia, Ukraine, United Republic of Tanzania, Uruguay, Uzbekistan and Viet Nam.

8 And Taiwan, China.

9 Many States with minimal or no nuclear activities have concluded an SQP to their CSA. Under an SQP, the implementation of most of the safeguards procedures in Part II of a CSA is held in abeyance as long as certain criteria are met. In 2005, the Board of Governors took the decision to revise the standardized text of the SQP and change the eligibility criteria for an SQP, making it unavailable to a State with an existing or planned facility and reducing the number of measures held in abeyance (GOV/INF/276/Mod.1 and Corr.1). The Agency initiated exchanges of letters with all States concerned in order to give effect to the revised SQP text and the change in the criteria for an SQP.

Annex to this report. During 2017, a CSA with an SQP and an AP were signed for one State[10]. In addition, three States[11] brought an AP into force. One State[12] acceded to the safeguards agreement between the non-nuclear-weapon States of Euratom, Euratom and the Agency, and to the protocol additional thereto. An INFCIRC/66/Rev.2-type agreement was signed and entered into force for one State[13]. By the end of 2017, safeguards agreements were in force with 182 States and APs were in force with 132 States. An AP continued to be provisionally applied pending its entry into force for one State[14].

The Agency continued to implement the *Plan of Action to Promote the Conclusion of Safeguards Agreements and Additional Protocols*[15], which was updated in September 2017. The Agency organized a regional event for Sub-Saharan African States, held in Lusaka, Zambia, in August and national events for the Sudan, held in Khartoum in April, and for Ethiopia, held in Addis Ababa in April, at which the Agency encouraged the participating States to conclude CSAs and APs, and to amend their SQPs. In addition, the Agency held consultations with representatives of a number of Member and non-Member States in Dakar, Geneva, Lusaka and Vienna at various times throughout the year.

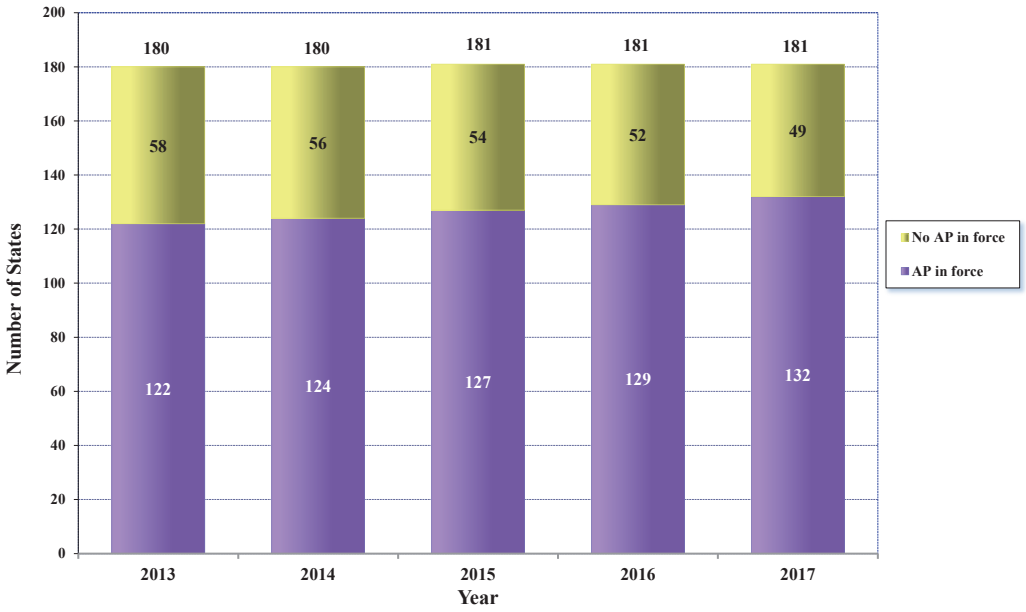


FIG. 1. Number of APs for States with safeguards agreements in force, 2013–2017 (the Democratic People's Republic of Korea is not included).

The Agency continued to communicate with States in order to implement the Board of Governors' 2005 decision regarding SQPs, with a view to rescinding such protocols or amending them to reflect the revised standard text. During 2017, an SQP became non-operative for one State[16]. By the end of 2017, 62 States had accepted the revised SQP text (which was in force for 55 of these States) and 7 States had rescinded their SQPs.

10 Liberia.

11 Honduras, Senegal and Thailand.

12 Croatia.

13 Pakistan.

14 Islamic Republic of Iran.

15 Available at: *https://www.iaea.org/sites/default/files/sg-plan-of-action-2016-2017.pdf.*

16 United Arab Emirates.

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

Throughout 2017, the Agency continued to verify and monitor the nuclear-related commitments of the Islamic Republic of Iran (Iran) under the Joint Comprehensive Plan of Action (JCPOA). During the year, the Director General submitted four reports to the Board of Governors and in parallel to the United Nations Security Council entitled *Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015)* (GOV/2017/10, GOV/2017/24, GOV/2017/35 and GOV/2017/48).

Syrian Arab Republic (Syria)

In August 2017, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic* (GOV/2017/37) covering relevant developments since the previous report in August 2016 (GOV/2016/44). 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.[17] In 2017, the Director General renewed his call on Syria to cooperate fully with the Agency in connection with unresolved issues related to the Dair Alzour site and other locations. Syria has yet to respond to these calls.

On the basis of the evaluation of information provided by Syria and all other safeguards relevant information available to it, the Agency found no indication of the diversion of declared nuclear material from peaceful activities. For 2017, the Agency concluded for Syria that declared nuclear material remained in peaceful activities.

Democratic People's Republic of Korea (DPRK)

In August 2017, the Director General submitted a report to the Board of Governors and General Conference entitled *Application of Safeguards in the Democratic People's Republic of Korea* (GOV/2017/36–GC(61)/21), which provided an update of developments since the Director General's report of August 2016 (GOV/2016/45–GC(60)/16).

Since 1994, the Agency has not been able to conduct all necessary safeguards activities provided for in the DPRK's NPT Safeguards Agreement. From the end of 2002 until July 2007, the Agency was not able — and, since April 2009, has not been able — to implement any verification measures in the DPRK, and, therefore, the Agency could not draw any safeguards conclusion regarding the DPRK.

On 3 September 2017, the DPRK announced that it had conducted a nuclear test.

In 2017, no verification activities were implemented in the field but the Agency continued to monitor the DPRK's nuclear activities by using open source information, including satellite imagery and trade information. In June 2017, the Director General indicated his intention to enhance the Agency's readiness to play an essential role in verifying the DPRK's nuclear programme. To this end, in August 2017, a DPRK Team was formed within the

[17] The Board of Governors, in its resolution GOV/2011/41 of June 2011 (adopted by a vote), had, inter alia, called on Syria to urgently remedy its non-compliance with its NPT Safeguards Agreement and, in particular, to provide the Agency with updated reporting under its Safeguards Agreement and access to all information, sites, material and persons necessary for the Agency to verify such reporting and resolve all outstanding questions so that the Agency could provide the necessary assurance as to the exclusively peaceful nature of Syria's nuclear programme.

Department of Safeguards to enhance the monitoring of the DPRK's nuclear programme; maintain updated verification approaches and procedures for the nuclear facilities known to exist within the DPRK; prepare for the Agency's return to the DPRK; and ensure the availability of appropriate verification technologies and equipment. An Executive Group was also formed within the Secretariat to consider procedural, managerial and legal matters.

During 2017, the Agency continued to observe indications that were consistent with the operation of the Yongbyon Experimental Nuclear Power Plant (5 MW(e)) which commenced the current operational cycle in early December 2015. The Agency did not observe indications of reprocessing operations at the Radiochemical Laboratory during 2017. At the Yongbyon Nuclear Fuel Rod Fabrication Plant there were indications consistent with the use of the reported centrifuge enrichment facility located within the plant. Construction work was undertaken on a building that adjoins the reported centrifuge enrichment facility. There were indications in the light water reactor construction yard of an increase in activities consistent with the fabrication of certain reactor components. The Agency has not observed indications of the delivery or introduction of major reactor components into the reactor containment building.

The Agency has not had access to the Yongbyon site. Without access to the site, the Agency cannot confirm the operational status of the facilities on the site, or the nature and purpose of the activities observed.

The continuation and further development of the DPRK's nuclear programme are a cause for grave concern. The DPRK's nuclear activities are deeply regrettable and clear violations of relevant United Nations Security Council resolutions, including resolutions 2371 (2017), 2375 (2017) and 2397 (2017). The DPRK's sixth nuclear test, announced on 3 September 2017, was also in clear violation of United Nations Security Council resolutions and is extremely regrettable.

Enhancing Safeguards

Evolving safeguards implementation

During 2017, the Agency developed new State-level safeguards approaches as described in the Director General's reports GOV/2013/38 and GOV/2014/41 and Corr.1. It developed State-level safeguards approaches for five States with a comprehensive safeguards agreement and an additional protocol in force and a broader conclusion; 29 States with a comprehensive safeguards agreement and an additional protocol in force for which the broader conclusion has yet to be drawn; and 28 States with a comprehensive safeguards agreement but no additional protocol in force[18]. This resulted in new State-level safeguards approaches for 62 States, bringing the total number of States for which State-level safeguards approaches were developed to 126. Of these 62 State-level safeguards approaches, 49 were for States with a small quantities protocol (SQP). In developing and implementing a State-level safeguards approach, consultations were held with the relevant State and/or regional authority, particularly on the implementation of in-field safeguards measures. The State-level safeguards approaches were developed and implemented for the above States within the scope of their respective safeguards agreements.

A State-level safeguards approach is developed in accordance with a State's safeguards agreement, through the conduct of acquisition or diversion path analysis, identification and prioritization of technical objectives, and selection of safeguards measures to address them. For those States where State-level safeguards approaches are not implemented,

[18] The State-level safeguards approaches developed for these States do not include the measures available under additional protocols which are only implemented in those States that have an additional protocol in force.

in-field safeguards activities are conducted at declared facilities and locations outside facilities where nuclear material is customarily used (LOFs) based on Safeguards Criteria. New techniques and technologies are implemented, as applicable and in accordance with the States' safeguards agreements, to strengthen effectiveness and improve efficiency.

To continue to ensure consistency and non-discrimination in the implementation of safeguards for States with the same type of safeguards agreements, the Agency continued in 2017 to improve internal work practices, including the better integration of the results of safeguards activities conducted in the field with those carried out at Headquarters, and introduced further advances in the handling of safeguards-relevant information to facilitate its evaluation. The Agency also continued to revise and update its guidance documentation for safeguards implementation, including guidance on consultations with States and/or regional authorities during development or updating and implementation of State-level safeguards approaches.

Cooperation with State and regional authorities

To assist States in building capacity for implementing their safeguards obligations, the Agency conducted seven international, regional and national training courses for those responsible for overseeing and implementing the State and regional systems of accounting for and control of nuclear material, and participated in nine other training activities organized by Member States on a bilateral basis. In total, more than 180 participants from some 40 countries were trained on safeguards related topics. The majority of these activities were supported financially or in-kind through Member State Support Programmes.

In 2017, the Agency published Arabic versions of the *Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols* (IAEA Services Series 21) and the *Safeguards Implementation Guide for States with Small Quantities Protocols* (IAEA Services Series 22). The Agency conducted, upon request, an IAEA State System of Accounting for and Control of Nuclear Material Advisory Service (ISSAS) mission to Jordan and participated in an Integrated Nuclear Infrastructure Review (INIR) mission to Ghana. Both missions included, inter alia, the provision of advice to the host countries on how to systematically enhance the capabilities necessary for the application of safeguards while embarking on a nuclear power programme.

Safeguards equipment and tools

Throughout 2017, the Agency ensured that the instrumentation and monitoring equipment installed in nuclear facilities around the world, which is vital to effective safeguards implementation, continued to function as required. During the year, 1150 portable and resident non-destructive assay systems comprising 2359 separate pieces of equipment were prepared and assembled for inspection use. The Agency installed seven new unattended monitoring systems, implemented major upgrades to 15 others and dismantled four, bringing the total number of such systems installed by the end of the year to 167 in 24 States. The Agency also had 1541 cameras operating at 277 facilities in 37 States[19]. The Agency is also responsible for maintaining approximately 120 cameras used jointly with regional or State authorities. By the end of 2017, remote data transmission infrastructure ensured the collection of 932 unattended safeguards data streams from 130 facilities in 29 States[20]. Of these, 311 data streams were produced by surveillance systems, 111 by unattended monitoring systems and 510 by electronic seals (Fig. 2).

"By the end of 2017, remote data transmission infrastructure ensured the collection of 932 unattended safeguards data streams from 130 facilities….[including] 311 data streams…produced by surveillance systems, 111 by unattended monitoring systems and 510 by electronic seals"

19 And Taiwan, China.

20 And Taiwan, China.

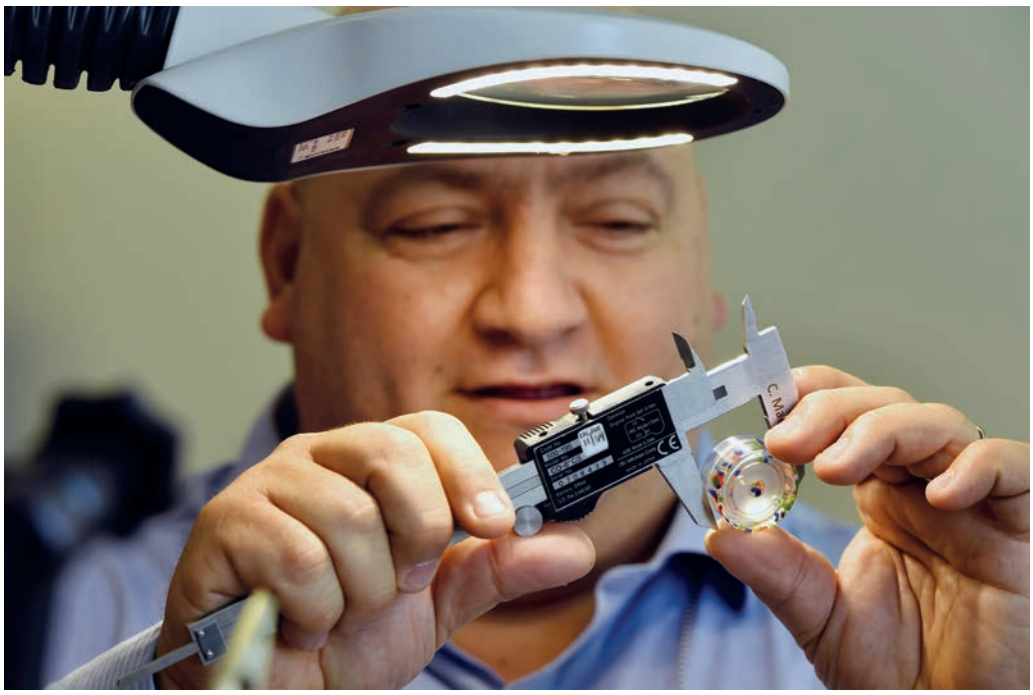


FIG. 2. An Agency engineer designs a glass seal for use by safeguards inspectors as part of IAEA verification measures.

The Agency continued to implement the next generation surveillance system, replacing outdated surveillance units (DCM-14 based technology). By the end of 2017, 750 next generation surveillance system cameras had been installed in 29 States[21]. The Passive Gamma Emission Tomography (PGET) system was successfully tested at three nuclear power plants during 2017 and subsequently officially authorized for use in inspections. PGET is able to detect missing or replaced rods in spent fuel assemblies, thus providing the Agency with an unprecedented verification capability of irradiated items.

In 2017, the Agency continued cooperative efforts with Member States, the Brazilian–Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) and the European Commission. These focused on procurement, acceptance testing, installation and maintenance of safeguards equipment designated for joint use, and staff training.

The Agency continued to undertake activities aimed at identifying and evaluating emerging instrumentation technologies that could lead to the deployment of new instruments in support of safeguards implementation. These activities were performed in close cooperation with Member State Support Programmes.

Safeguards analytical services

The Agency's Network of Analytical Laboratories consists of the Agency's Safeguards Analytical Laboratory and 22 other qualified laboratories in Australia, Brazil, China, France, Hungary, Japan, the Republic of Korea, the Russian Federation, the United Kingdom, the United States of America and the European Commission. Additional laboratories in the areas of environmental and/or nuclear material sample analysis were in the process of qualification in Argentina, Belgium, Canada, Germany, Hungary and the Netherlands.

21 And Taiwan, China.

FIG. 3. An analytical chemist at the Nuclear Material Laboratory analyses material collected by safeguards inspectors.

In 2017, the Agency collected 599 nuclear material samples that were analysed by the Agency's Nuclear Material Laboratory. The Agency also collected 483 environmental samples, which resulted in analysis of 1050 subsamples. Two hundred and three of these subsamples were analysed at the Agency's Environmental Sample Laboratory and the Nuclear Material Laboratory (Fig. 3), with the remainder analysed by other laboratories in the Network of Analytical Laboratories.

Support

Developing the safeguards workforce

In 2017, the Agency conducted 173 safeguards training courses to provide safeguards inspectors and analysts with the necessary technical and behavioural competencies. These included two sessions of the Introductory Course on Agency Safeguards held at the Agency for 24 newly recruited inspectors. To enhance their practical competencies for safeguards implementation in the field, several of the courses were held at nuclear facilities (Fig. 4). Holding the courses on-site serves to train safeguards staff in a realistic, effective, consistent and integrated manner in how to prepare, conduct and report on inspections, design information verification activities and 'complementary' access. Other courses were held at Headquarters, with the aim of developing skills for processing safeguards relevant data, for example, by developing analytical skills relevant to the effective use of collaborative analysis tools. During the year, the Agency developed a new training course on planning, performing and analysing efficient and effective verification measurements and activities at facilities handling unirradiated direct use material. The Agency continued to engage with Member State Support Programmes in the development of tools for training and in the conduct of courses at nuclear facilities.

FIG. 4. Agency safeguards inspectors undergo on-site training in hot cell and glovebox sampling in reprocessing facilities.

Significant Safeguards Projects

Information technology: MOSAIC

By the end of 2017, the Modernization of Safeguards Information Technology (MOSAIC) project had delivered 17 newly developed or refurbished software applications or systems, while continuing to strengthen the protection of safeguards data. The new Safeguards Authorization Management System, introduced in 2017, streamlines the process for requesting and granting access to safeguards information, while ensuring that such requests comply with Agency policies and procedures. The new State Declarations Portal, also released during the year, provides a new, more efficient way for State and regional authorities to submit declarations and exchange related communications with the Secretariat. The portal keeps track of such communications, aiding institutional memory and knowledge management, and reduces paper-based processes and manual data entry, thereby saving time and effort. Overall, MOSAIC has continued to make steady progress towards its planned completion by May 2018.

Preparing for the Future

As part of its strategic planning, the Agency held a workshop on emerging technologies in February, which fostered the update of the *Research and Development Plan (R&D)* and the biennial *Development and Implementation Support Programme for Nuclear Verification 2018–2019*. These two documents inform Member States on required support to improve the Agency's technical capabilities. The Development and Implementation Support Programme for Nuclear Verification comprises 314 support programme tasks in 24 projects. At the end of 2017, 20 States[22] and the European Commission had formal support programmes with the Agency.

[22] Argentina, Australia, Belgium, Brazil, Canada, China, Czech Republic, Finland, France, Germany, Hungary, Japan, Republic of Korea, Netherlands, Russian Federation, South Africa, Spain, Sweden, United Kingdom and United States of America.

Technical Cooperation

Management of Technical Cooperation for Development

Objective

To enhance the relevance, socioeconomic impact and efficiency of technical cooperation support to Member States by planning and implementing a needs based, responsive and sustainable technical cooperation programme (TCP) and by seeking continuously increasing effectiveness.

The Technical Cooperation Programme

The technical cooperation programme is the Agency's primary mechanism for transferring nuclear technology to Member States, helping them to address key development priorities in areas such as health and nutrition, food and agriculture, water and the environment, industrial applications, and nuclear knowledge development and management. The programme also helps Member States to identify and meet future energy needs, and assists in improving radiation safety and nuclear security worldwide, including through the provision of legislative assistance. The technical cooperation programme aims at achieving tangible socioeconomic impact by contributing directly in a cost effective manner to the achievement of the major sustainable development priorities of each country, including relevant nationally identified targets under the Sustainable Development Goals (SDGs). It also facilitates regional and interregional cooperation among Member States and partners.

Country Programme Frameworks and Revised Supplementary Agreements

Country Programme Frameworks (CPFs) provide a frame of reference for technical cooperation between a Member State and the Agency. They define national development needs and priorities that can be supported through the technical cooperation programme.

In 2017, 20 Member States signed CPFs: Albania, Algeria, Benin, Cambodia, Central African Republic, Cuba, Honduras, Hungary, Iraq, Israel, Jordan, Kenya, Mexico, Philippines, Rwanda, Saudi Arabia, Thailand, Uruguay, Vanuatu and Zimbabwe. In total there were 95 valid CPFs by the end of the year.

Revised Supplementary Agreements Concerning the Provision of Technical Assistance by the International Atomic Energy Agency (RSAs) govern the provision of technical assistance by the Agency. Two Member States, Congo and Swaziland, signed an RSA in 2017. As of 31 December 2017, 134 Member States had signed an RSA.

United Nations Development Assistance Frameworks

The United Nations Development Assistance Framework (UNDAF) is a structure for coordinating United Nations system actions in support of national development goals. In 2017, the Agency continued to focus on greater involvement in the development and implementation of UNDAFs in relevant countries. UNDAF participation enables the Agency to raise awareness about its work and facilitates access to the main national development coordination and planning bodies. In addition, it assists coordination and collaboration with the United Nations and other partners.

In 2017, the Agency co-signed a total of 12 UNDAFs, for Bahrain, the Plurinational State of Bolivia, Botswana, Costa Rica, the Dominican Republic, Gabon, Kyrgyzstan, Morocco, Nepal, the Republic of Moldova, Serbia and Viet Nam. At the end of 2017, the Agency was a co-signatory of 54 valid UNDAFs.

Partnerships and Cooperation with the United Nations System and Other International Organizations

The Agency held the first International Conference on the IAEA Technical Cooperation Programme: Sixty Years and Beyond — Contributing to Development, at its Headquarters in Vienna from 30 May to 1 June (Fig. 1). One of the objectives was to provide a forum for Member States, United Nations agencies and other partners to explore ways of working together to make the benefits of nuclear science and technology more accessible. The conference highlighted how the programme helps Member States to establish effective strategic partnerships with countries and development organizations, and examined how collaborative procedures might evolve in the new development context of Agenda 2030. High level speakers and panellists discussed appropriate approaches and measures to help countries maximize their use of nuclear science and technology in pursuit of the SDGs and associated targets.

FIG. 1. Director General Amano opening the first International Conference on the IAEA Technical Cooperation Programme on 30 May 2017.

In July, the Agency highlighted the benefits and the importance of nuclear science and technology and their contribution to the attainment of the SDGs at the United Nations High-level Political Forum on Sustainable Development. With the Permanent Missions of Botswana and Malaysia to the United Nations, it co-hosted a side event entitled ‘Science with Impact: Sustainable Development through Nuclear Technology’ to introduce the Agency’s technical cooperation programme and to showcase how nuclear science and technology can contribute to the achievement of the SDGs and key development objectives in areas such as human health, agriculture and food safety and security, animal health, and industry.

In its activities at the national and regional levels, the Agency promotes close cooperation with other United Nations agencies, multilateral agencies and international organizations. In 2017, the Agency participated in the meetings of regional directors of United Nations agencies in Europe, strengthening collaboration with the United Nations Development Programme, the Food and Agriculture Organization of the United Nations, the United Nations Economic Commission for Europe, the World Health Organization and others.

Partnership Agreements and Practical Arrangements

In 2017, the Agency continued its engagement with the European Commission on projects addressing the development needs of Member States in the field of nuclear safety. The work has been conducted through several agreements under the auspices of the European Union's Instrument for Nuclear Safety Cooperation.

In April, a cooperation arrangement was signed between the AFRA Network for Education in Science and Technology (AFRA-NEST), the Asian Network for Education in Nuclear Technology (ANENT), the European Nuclear Education Network (ENEN) and the Latin American Network for Education in Nuclear Technology (LANENT). The arrangement aims at enhancing collaboration between regional educational networks through the exchange of experiences, best practices and training materials.

Africa

In September, the Agency signed Practical Arrangements with the National Centre for Nuclear Energy, Sciences and Technology (CNESTEN) of Morocco, establishing a framework to enhance technical cooperation among developing countries. Under the arrangement, CNESTEN will provide training in human health (including radiation medicine, nuclear medicine and nutrition), radiation safety, isotope hydrology and nondestructive testing, through fellowships, the hosting of meetings, scientific visitors and training course participants, and the provision of local experts and lecturers. It will also provide laboratory analytical services, especially for water samples.

In November, the Agency began collaborating with the World Academy of Sciences and the African Academy of Sciences on a first of its kind sandwich fellowship programme. The programme is intended to train graduates and postgraduates in relevant fields of nuclear science and technology, to contribute to the scientific and technological development of the African region.

Asia and the Pacific

The Agency further strengthened its partnership with the OPEC Fund for International Development, leading to a funding commitment of US $600 000. This funding will be used to implement activities under two regional technical cooperation projects for Asia and the Pacific: one on the diagnosis and control of transboundary animal diseases, and one on the promotion of sustainable climate proofing of rice production systems with an emphasis on strengthening soil and water management using isotopic techniques.

Practical Arrangements between the Agency and the RCA Regional Office on cooperation in the performance of Secretariat duties under the 2017 Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) for the Asia and the Pacific region were signed in September. Practical Arrangements between the Agency and the China Atomic Energy Authority on cooperation for education and training in the area of nuclear energy, nuclear safety and security, and nuclear science and applications were signed to enhance cooperation between the two organizations.

The Practical Arrangements with the United States National Oceanic and Atmospheric Administration on early detection of harmful algal blooms were extended for five years.

In June, the Agency signed an agreement with the Secretariat of the Pacific Community — the principal scientific and technical organization in the Pacific region — to work together for the attainment of the SDGs in the region. The agreement is aimed at promoting science, technical expertise, research and innovation; addressing development challenges; and supporting economic and social progress in the future.

Europe

The Agency is helping countries in Europe and Central Asia to apply the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009) for the uranium production cycle. In November, the Agency and the United Nations Economic Commission for Europe conducted an interregional training course on the theme 'Unconventional Uranium Resource Assessment, UNFC Classification and Reporting with Particular Emphasis on Uranium as Co- or By-Product' in Salta, Argentina. Around 100 participants from over 30 countries discussed how the UNFC-2009 could be used to discover 'new economic resources' associated with uranium mining, and opportunities for the uranium industry to produce co- and by-products, including rare earth elements, niobium and tantalum and other key elements, together with uranium in an integrated manner.

Latin America and the Caribbean

In June, the Agency signed Practical Arrangements with the Caribbean Disaster Emergency Management Agency for the provision of technical cooperation in the area of nuclear and radiological emergency preparedness and response, and with the Caribbean Public Health Agency, focusing on the use of nuclear science and technology for disease prevention. It also participated in the Ninth Caribbean Community–United Nations General Meeting, held in New York in July, and hosted the first meeting between the Agency and the Caribbean Community Climate Change Centre at the Agency's Headquarters in November.

The Practical Arrangements with the Pan American Health Organization and the World Health Organization were extended for four years in 2017, enabling continued cooperation between the three organizations to assist countries in the region through training and capacity building, stronger research efforts, and the exchange and dissemination of information. The Agency also participated in the IAEA–PAHO follow-up meeting on 'Emergency Preparedness and Response for Radiological Emergencies in the Caribbean Sub-region', held in June in Miami, United States of America.

The Agency contributed to implementation of the first United Nations Multi-Country Sustainable Development Framework in the Caribbean, covering the years 2017–2021, through national technical cooperation projects. The framework supports the realization of the SDGs, the Small Island Developing States Accelerated Modalities of Action (SAMOA) Pathway and other international development aspirations, as well as the national development plans of the individual countries in the Caribbean.

As part of a visit to Austria in February, the Vice President of Panama and Agency officials held meetings involving discussions on strengthening the country's national regulatory body for radiation safety (Fig. 2).

Programme of Action for Cancer Therapy

In March, the Agency, in collaboration with the Organisation of Islamic Cooperation and the Islamic Development Bank, organized a meeting in Khartoum, Sudan, to review

FIG. 2. The Vice President of Panama and Agency officials during meetings held in February.

funding gaps and mobilize resources to support the national cancer control programmes of their Member States in common. The Agency worked with the 16 countries attending the meeting to develop funding proposals to present to potential donors. Following the meeting, consultations were continued to support Member State efforts to secure concessional loans and grants from the Islamic Development Bank and other donors. Country-specific donor mapping exercises helped identify additional potential funding partners, including non-traditional partners.

The Agency signed Practical Arrangements with the International Federation of Pharmaceutical Manufacturers and Associations to strengthen cancer control education and training capacity in low and middle income countries. The Federation will assist in improving engagement with the private sector to mobilize resources to address funding gaps for cancer diagnosis and treatment services.

Regional Agreements and Programming

The African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) continues to be the principal framework for promoting technical cooperation among developing countries in Africa and for enhancing regional cooperation among its State Parties. The 28th AFRA Technical Working Group Meeting took place in July in Kampala, Uganda. The meeting was opened by the Prime Minister of Uganda and was attended by the country's Minister for Energy and Mineral Development and national coordinators from 32 AFRA State Parties. The meeting participants deliberated on several AFRA policy and programme issues, and adopted concrete recommendations to further enhance regional cooperation in Africa. The recommendations were endorsed by the 28th Meeting of AFRA Representatives, held in September on the margins of the 61st regular session of the Agency's General Conference.

In September, following the signature of the instrument of acceptance of AFRA by the Minister for Foreign Affairs and its subsequent deposit with the Agency, the Congo became a State Party to AFRA.

The AFRA State Parties submitted nine regional projects for the 2018–2019 technical cooperation cycle aligned with the major themes of the AFRA Regional Strategic Cooperative Framework (RCF) for 2014–2018. The newly approved AFRA programme prioritizes enhanced human resource development and the strengthening of existing infrastructure in

the region. The AFRA Chair led a Review and Critical Assessment Brainstorming Meeting in October in preparation of a new RCF. The meeting brought together members of the AFRA Programme Management Committee to assess achievements, success stories and best practices relating to the implementation of the RCF. Participants reviewed the AFRA mid-term strategy for 2016–2018 and developed an executive document and terms of reference for use in formulating the new RCF for 2019–2023.

AFRA regional designated centres provided useful services in different nuclear related areas in the region throughout 2017, including hosting fellowship training and meetings and training courses. Expert services were also provided by qualified staff from these centres, and the centres contributed to strengthened relationships and improved the exchange of information between nuclear institutions in the region through technical cooperation among developing countries. AFRA launched a triangular cooperation modality to promote self-reliance and the effective use of the region's human resources and infrastructure. It also launched a process to recognize regional designated centres in the fields of academic and clinical training in nuclear medicine and medical physics; Member State applications have been received and were reviewed during the year.

In April, with Agency support, the AFRA Chair held a series of meetings with Resident Representatives of the Vienna-based African Group and donor countries in Vienna to share information on AFRA project related achievements and success stories, and to seek further support for the implementation of the unfunded portion of the programme. The meetings resulted in pledges for extrabudgetary contributions to upgrade unfunded AFRA project activities. During the year, 17 countries contributed approximately €300 000, demonstrating their continued commitment to the AFRA Fund and their willingness to further enhance regional ownership of the programme. These contributions have been allotted to AFRA projects to support the implementation of unfunded activities.

Under the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) for Asia and the Pacific, a comprehensive, detailed roadmap was established, ensuring the quality of RCA project designs for the 2018–2019 technical cooperation cycle. During the year, the RCA State Parties explored possibilities to mobilize more financial resources and promoted technical cooperation among developing countries and south–south cooperation under the RCA framework. The RCA Regional Office launched a research programme to promote research and development on air pollution in the region.

The Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA) continues to promote technical cooperation among its States Parties. The 2017 designation of ARASIA regional resource centres in several thematic areas (in particular nuclear medicine) within ARASIA States Parties is expected to strengthen the programme's sustainability and build self-reliance and areas of common interest.

Member States in Europe and Central Asia identified, designed and assessed new national and regional projects based on priorities established in the CPFs and the Europe Regional Profile. The Regional Profile, the main reference document and planning tool for regional technical cooperation projects, was updated to reflect the main priority thematic areas of human health, radioactive waste management and environment restoration, nuclear power, and nuclear and radiation safety, and to provide links to relevant SDGs.

The Regional Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) programme takes into account the needs and priorities identified in the Regional Strategic Profile for 2016–2021 adopted by ARCAL States Parties, and country priorities regarding the attainment of the SDGs.

ARCAL States Parties presented 12 projects in several thematic fields for the 2018–2019 technical cooperation cycle, in line with the Regional Strategic Profile. Belize joined ARCAL in 2017.

The 18th Meeting of the ARCAL Technical Co-ordination Board took place in Mexico in May. National ARCAL Representatives approved the ARCAL programme for the 2018–2019 technical cooperation cycle, established a working group to enhance the ARCAL communication strategy and evaluated ongoing projects in several fields of activity.

Latin America's second IAEA-supported School of Emergency Management took place in Mexico City in May. The School, designed by the Agency's Incident and Emergency Centre, was conducted in close cooperation with the Government of Mexico through the National Commission of Nuclear Safety and Safeguards. During the three week course, more than 30 participants from 15 Latin American countries received training in effective implementation and coordination of emergency preparedness and response.

The Quadripartite Forum meeting of the four regional/cooperative agreements (AFRA, ARASIA, ARCAL, RCA) was held in September. Participants shared their experiences under relevant agreements and explored opportunities for future collaboration among regions.

Programme of Action for Cancer Therapy (PACT)

"Throughout 2017, the Agency continued to support low and middle income countries in improving their cancer control capacities, and promoted the integration of radiation medicine in sustainable, comprehensive national cancer control strategies."

Throughout 2017, the Agency continued to support low and middle income countries in improving their cancer control capacities, and promoted the integration of radiation medicine in sustainable, comprehensive national cancer control strategies. The Agency highlighted its role in the global fight against cancer in the World Health Assembly and the World Health Summit. It also contributed to the activities of the United Nations Interagency Task Force on the Prevention and Control of Non-communicable Diseases, an initiative tailored to scale up joint efforts by United Nations agencies and partners to address the growing burden of non-communicable diseases.

The Agency conducted imPACT ('integrated missions of PACT') Review missions to four Member States (Burundi, the Congo, Swaziland and Togo), providing recommendations on strengthening national cancer control services to support evidence based decision making and facilitate the identification of priority interventions and investments in cancer control. imPACT review missions also form the basis for dedicated follow-up support by the Agency, in cooperation with partners. In 2017, Costa Rica, Lesotho, Mozambique, Nicaragua and Rwanda received expert advisory support in the development of their national cancer control plans. Fiji received expert assistance in developing a roadmap to implement its national plan and in conducting a detailed costing exercise to establish a radiotherapy facility.

The Agency and partners continued to support Member States in building human capacity for cancer control. For example, the Korea Institute of Radiological and Medical Sciences (KIRAMS) provided intensive, hands-on training in advanced radiotherapy techniques to cancer specialists from Mongolia, Sri Lanka and Viet Nam through a series of multidisciplinary courses aligned to their respective national priorities in radiotherapy. This brings the total number of fellows trained by KIRAMS since 2013 to 35.

In January, the Agency convened a meeting of international cancer experts to identify key challenges and propose solutions to improve access to affordable, quality and sustainable radiotherapy technology and services for low and middle income Member States. Priority activities identified included addressing key challenges in workforce development, financing, appropriate technology and knowledge management.

Managing the Agency's Technical Cooperation Programme

Member State priorities in 2017, as reflected in programme disbursements, were safety and security, health and nutrition, and food and agriculture (Fig. 3), with some variations in emphasis across regions. By the end of the year, 807 projects were active. During the course of the year, 240 projects were closed, of which one was cancelled in consultation with the relevant Member State, and an additional 337 projects were in the process of being closed. No Programme Reserve projects were requested.

Financial Highlights

Payments to the 2017 Technical Cooperation Fund (TCF) totalled €83 million (not including National Participation Costs (NPCs) and assessed programme cost (APC) arrears), against the target of €84.9 million, with the rate of attainment on payments at the end of 2017 standing at 97.7% (Fig. 4). The use of these resources resulted in a TCF implementation rate of 86.3%.

Improving the Quality of the Technical Cooperation Programme

In 2017, quality assurance activities were undertaken at every phase of the technical cooperation programme cycle, aimed at increasing the efficiency, effectiveness and results orientation of programmes and projects during planning, implementation and review. The Agency provided support to Member States throughout the year to further improve the quality of project designs developed for the 2018–2019 technical cooperation cycle.

Twenty-four workshops, training events and programme briefings were organized for some 554 technical cooperation stakeholders, both within the Secretariat and in Member States. These events included Technical Cooperation Orientation Workshops, training in the use of the logical framework approach (LFA) for the design of new projects, country and regional project design workshops, specific discussion groups on relevant issues, and targeted training in monitoring and evaluation. The on-line LFA training module (e-LFA) was updated and made available to all stakeholders.

The quality assurance process for the design phase of the 2018–2019 technical cooperation programme included a two step mechanism that applied the guidelines for quality assessment of project designs and built on experience and lessons learned from past quality reviews. During the design process, the Agency gave feedback to project teams to improve adherence of project documents to programme quality criteria. A review of the quality of the final project designs then enabled comparison with previous cycles, and highlighted areas for improvement and lessons learned. Overall, project designs improved significantly compared with the previous cycle.

The technical cooperation programme for 2018–2019 was approved by the Board of Governors in November, with €79.2 million for new and ongoing projects in 2018. The programme reflects the evolving priorities of Member States. Based on the budget for 2018 and future years, health and nutrition represented 26.8% of the core budget, followed by safety and security at 21.9% and food and agriculture at 19.7%. A total of 68% of 2018 core resources for new projects was planned for delivery under the various human resource components, reflecting an emphasis on support to human capacity building.

When developing their CPF and projects for the 2018–2019 technical cooperation programme cycle, Member States were encouraged to align priority development areas to be addressed through the technical cooperation programme with the SDGs, where appropriate. Such linkages between national technical cooperation programmes and the SDGs can help the Agency better deliver its mandate — deploying specialized competencies

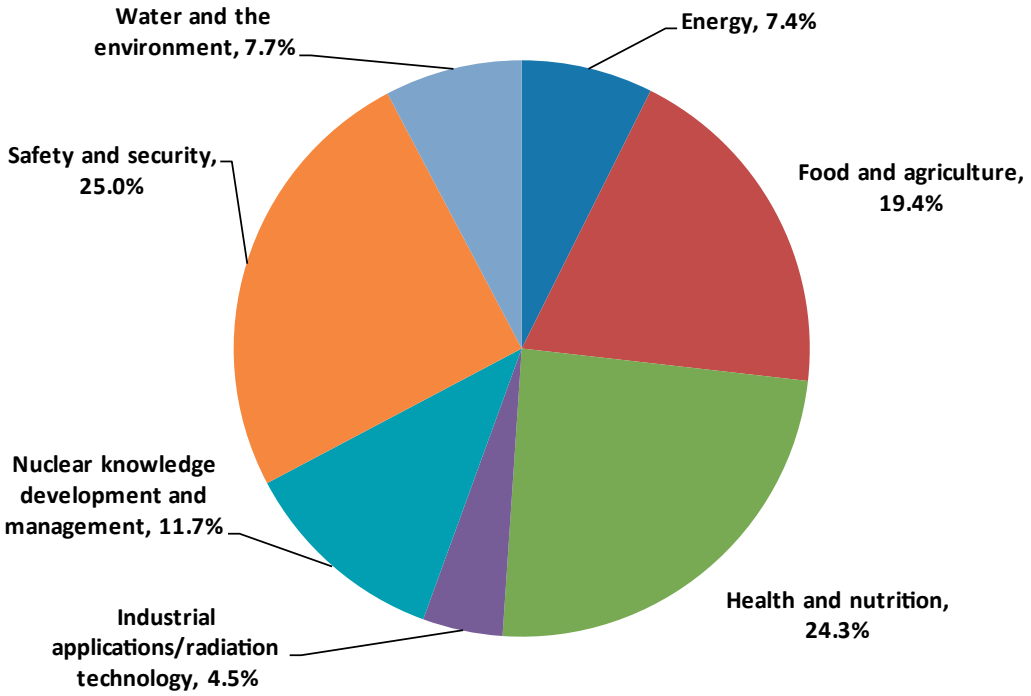


FIG. 3. Actuals by technical field for 2017. (Percentages do not add up to 100% owing to rounding.)

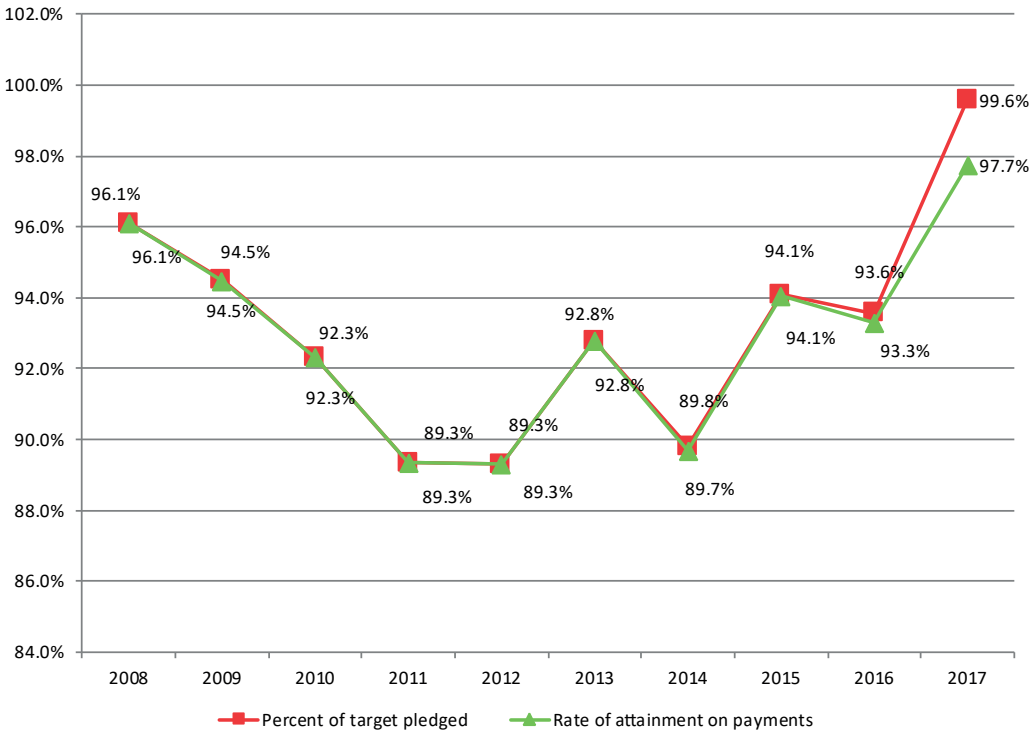


FIG. 4. Trends in the rate of attainment, 2008–2017.

and expertise in the field of nuclear science and technology for the benefit of its Member States — and support the strengthening of partnerships with relevant United Nations organizations and other institutions.

In preparation for the launch of the next planning cycle, the guidelines for the 2020–2021 technical cooperation cycle were reviewed and strengthened, taking into account experience gained during the 2017 quality assurance cycle, which consisted of training, quality reviews at design, project monitoring during implementation, and evaluation recommendation follow-up.

Monitoring and Evaluating Technical Cooperation Projects

The Agency successfully piloted and rolled out an electronic platform for submission of mandatory annual Project Progress Assessment Reports (PPARs). The new system enables quicker and more relevant reporting by Member States and feedback by the Secretariat, and significantly facilitates the aggregation and interpretation of PPAR data. This will improve communication and early identification of any factors that may support or hinder effective implementation.

The improved PPARs are part of a range of complementary monitoring instruments, including Field Monitoring Methodology and Self-Assessments, which are being reviewed as part of the drive for more effective monitoring and reporting of results in the technical cooperation programme. The aim is to strengthen the capacity of national technical cooperation programme stakeholders to effectively apply results oriented monitoring and evaluation tools, and to monitor the progress of ongoing projects using participatory assessments, in order to ensure that expected results are achieved and lead to planned outcomes.

Outreach and Communication

Outreach to Member States, current and potential partners, donors and the international development community remains an essential area of activity for the Agency. In 2017, the Agency promoted the first International Conference on the IAEA Technical Cooperation Programme through a series of web articles, a dedicated issue of the *IAEA Bulletin*, and multiple social media campaigns using the official hashtag #Atoms4Dev2017. The Agency also produced a video on the technical cooperation programme, and several exhibitions were installed for the duration of the conference.

An exhibition focusing on technical cooperation activities was organized at the Sixth Congress of the Ibero-Latin American Association for Radiation Oncology, held in the Dominican Republic in November. At the 61st regular session of the Agency's General Conference, a side event showcased a technical cooperation project on the climate proofing of rice production systems, and a second event provided information on the InTouch+ platform. The technical cooperation programme was also presented at a side event on the margins of the first session of the 2017 Preparatory Committee for the 2020 Nuclear Non-Proliferation Treaty Review Conference, held in Vienna in May.

More than 50 diplomats from 40 Permanent Missions attended the annual Seminar on Technical Cooperation for Diplomats in October. The seminar provided participants with a comprehensive overview of the technical cooperation programme.

Throughout the year, the Agency posted targeted outreach material of relevance to specific United Nations international days using social media and the Web to promote relevant technical cooperation activities.

In 2017, 228 news items on technical cooperation were posted online, including 14 photo essays and 24 videos.

During the year, more than 920 tweets were sent out from the @IAEATC Twitter account, which now has over 3750 followers. The LinkedIn TC Alumni Group now has over 1670 members.

Legislative Assistance

In 2017, the Agency continued to provide legislative assistance to its Member States through the technical cooperation programme. Country specific bilateral legislative assistance was provided to 20 Member States through written comments and advice on

drafting national nuclear legislation. The Agency also reviewed the legislative framework of newcomer countries as part of Integrated Nuclear Infrastructure Review missions. Short term scientific visits to Agency Headquarters were organized for a number of individuals, allowing fellows to gain further practical experience in nuclear law.

The Agency organized the seventh session of the Nuclear Law Institute in Baden, Austria, in October. The comprehensive two week course, which uses teaching methods based on interaction and practice, is designed to meet the increasing demand by Member States for legislative assistance and to enable participants to acquire a solid understanding of all aspects of nuclear law, as well as to draft, amend or review their national nuclear legislation. Sixty participants from Member States attended the training.

Four subregional workshops on nuclear law were conducted for Member States of Africa in Arusha, United Republic of Tanzania (13–17 March 2017) and in Vienna, Austria (31 July–4 August), Latin America and the Caribbean in San Ignacio, Belize (25–28 April) and Europe in Vienna, Austria (6–10 November). The workshops were attended by 111 participants from 63 Member States. National workshops and training courses on nuclear law were also organized in Bangladesh, Egypt, the Lao People's Democratic Republic, Montenegro and Peru. The workshops and courses addressed all aspects of nuclear law and created a forum for an exchange of views on topics relating to the international legal instruments.

Treaty Event

The Agency's seventh Treaty Event took place during the 61st regular session of the General Conference, providing Member States with a further opportunity to deposit their instruments of ratification, acceptance or approval of, or accession to, the treaties deposited with the Director General, notably those related to nuclear safety, security and civil liability for nuclear damage. Representatives of several Member States were also briefed on the conventions adopted under Agency auspices. This year's Treaty Event focused in particular on the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material, the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Annex

Note: Tables A31–A36(b) are available on the attached CD-ROM.

Table A1. Regular Budget allocation and utilization of resources in 2017 by Programme and Major Programme (in euros)

Major Programme (MP)/Programme	Original budget US $1/€1	Adjusted budget US $1/€0.891	Expenditure	Resource utilization	Balances
	a	b	c	d = c/b	e = b - c
MP1 — Nuclear Power, Fuel Cycle and Nuclear Science					
Overall management, coordination and common activities	3 300 581	3 248 950	3 248 896	100.0%	54
Nuclear Power	8 591 037	8 437 762	8 440 285	100.0%	(2 523)
Nuclear Fuel Cycle and Materials Technologies	6 896 576	6 780 215	6 746 000	99.5%	34 215
Capacity Building and Nuclear Knowledge for Sustainable Energy Development	10 300 660	10 138 805	10 128 014	99.9%	10 791
Nuclear Science	10 289 511	10 168 747	10 132 119	99.6%	36 628
Total Major Programme 1	**39 378 365**	**38 774 479**	**38 695 314**	**99.8%**	**79 165**
MP2 — Nuclear Techniques for Development and Environmental Protection					
Overall management, coordination and common activities	7 853 122	7 792 448	7 788 386	99.9%	4 062
Food and Agriculture	11 572 564	11 432 215	11 579 672	101.3%	(147 457)
Human Health	8 371 785	8 256 005	8 332 707	100.9%	(76 702)
Water Resources	3 510 039	3 463 315	3 305 698	95.4%	157 617
Environment	6 357 212	6 270 979	6 340 299	101.1%	(69 320)
Radioisotope Production and Radiation Technology	2 293 535	2 267 089	2 113 898	93.2%	153 191
Total Major Programme 2	**39 958 257**	**39 482 051**	**39 460 660**	**99.9%**	**21 391**
MP3 — Nuclear Safety and Security					
Overall management, coordination and common activities	3 981 785	3 917 715	3 908 361	99.8%	9 354
Incident and Emergency Preparedness and Response	4 298 741	4 234 182	4 234 132	100.0%	50
Safety of Nuclear Installations	10 391 724	10 189 878	10 184 731	99.9%	5 147
Radiation and Transport Safety	7 261 282	7 120 222	7 112 879	99.9%	7 343
Radioactive Waste Management and Environmental Safety	3 715 383	3 647 670	3 644 998	99.9%	2 672
Nuclear Security	5 513 932	5 404 369	5 168 753	95.6%	235 616
Total Major Programme 3	**35 162 847**	**34 514 036**	**34 253 854**	**99.2%**	**260 182**
MP4 — Nuclear Verification					
Overall management, coordination and common activities	14 492 940	14 324 291	13 161 817	91.9%	1 162 474
Safeguards Implementation	116 775 755	114 871 548	115 712 629	100.7%	(841 081)
Other Verification Activities	457 377	446 772	459 992	103.0%	(13 220)
Development	7 566 179	7 398 111	7 682 767	103.8%	(284 656)
Total Major Programme 4	**139 292 251**	**137 040 722**	**137 017 205**	**100.0%**	**23 517**
MP5 — Policy, Management and Administration Services					
Policy, Management and Administration Services	79 557 324	78 719 979	78 641 214	99.9%	78 765
Total Major Programme 5	**79 557 324**	**78 719 979**	**78 641 214**	**99.9%**	**78 765**
MP6 — Management of Technical Cooperation for Development					
Management of Technical Cooperation for Development	24 873 650	24 471 823	24 438 823	99.9%	33 000
Total Major Programme 6	**24 873 650**	**24 471 823**	**24 438 823**	**99.9%**	**33 000**
Total Operational Regular Budget	**358 222 694**	**353 003 090**	**352 507 070**	**99.9%**	**496 020**
Major Capital Investment Funding Requirements					
MP1 — Nuclear Power, Fuel Cycle and Nuclear Science	–	–	–	–	–
MP2 — Nuclear Techniques for Development and Environmental Protection	2 511 084	2 511 084	91 513	3.6%	2 419 571
MP3 — Nuclear Safety and Security	304 072	304 072	265 261	87.2%	38 811
MP4 — Nuclear Verification	2 227 574	2 227 574	1 215 033	54.5%	1 012 541
MP5 — Policy, Management and Administration Services	3 057 853	3 057 853	2 115 147	69.2%	942 706
MP6 — Management of Technical Cooperation for Development	–	–	–	–	–
Total Capital Regular Budget	**8 100 583**	**8 100 583**	**3 686 954**	**45.5%**	**4 413 629**
Total Agency Programmes	**366 323 277**	**361 103 673**	**356 194 024**	**98.6%**	**4 909 649**
Reimbursable work for others	2 697 812	2 697 812	3 268 768	121.2%	(570 956)
Total Regular Budget	**369 021 089**	**363 801 485**	**359 462 792**	**98.8%**	**4 338 693**

Column a: General Conference resolution GC(60)/RES/5 of September 2016 original budget at US $1/€1.

Column b: Original budget revalued at the United Nations operational average rate of exchange of €0.891 to US $1 in 2017.

Table A2. Extrabudgetary regular programme fund resource utilization in 2017 by Programme and Major Programme (in euros)

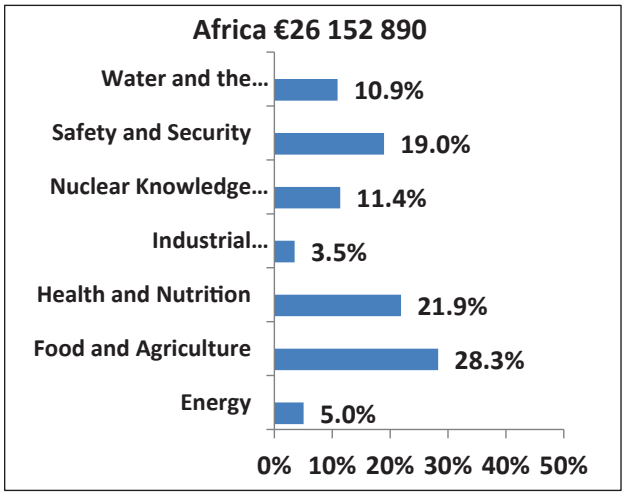
Major Programme (MP)/Programme	2017 expenditure
MP1 — Nuclear Power, Fuel Cycle and Nuclear Science	
Overall management, coordination and common activities	102 215
Nuclear Power	2 857 345
Nuclear Fuel Cycle and Materials Technologies	3 881 095
Capacity Building and Nuclear Knowledge for Sustainable Energy Development	541 320
Nuclear Science	3 786 918
Total Major Programme 1	**11 168 893**
MP2 — Nuclear Techniques for Development and Environmental Protection	
Overall management, coordination and common activities	14 860 107
Food and Agriculture	2 738 839
Human Health	234 476
Water Resources	158 113
Environment	1 305 556
Radioisotope Production and Radiation Technology	56 740
Total Major Programme 2	**19 353 831**
MP3 — Nuclear Safety and Security	
Overall management, coordination and common activities	4 203 875
Incident and Emergency Preparedness and Response	1 092 721
Safety of Nuclear Installations	4 811 586
Radiation and Transport Safety	2 486 122
Radioactive Waste Management and Environmental Safety	1 255 710
Nuclear Security	26 580 397
Total Major Programme 3	**40 430 411**
MP4 — Nuclear Verification	
Overall management, coordination and common activities	1 946 602
Safeguards Implementation	13 260 546
Other Verification Activities	6 271 013
Development	5 925 412
Total Major Programme 4	**27 403 573**
MP5 — Policy, Management and Administration Services	
Policy, Management and Administration Services	1 348 810
Total Major Programme 5	**1 348 810**
MP6 — Management of Technical Cooperation for Development	
Management of Technical Cooperation for Development	417 047
Total Major Programme 6	**417 047**
Total extrabudgetary programme funds	**100 122 565**

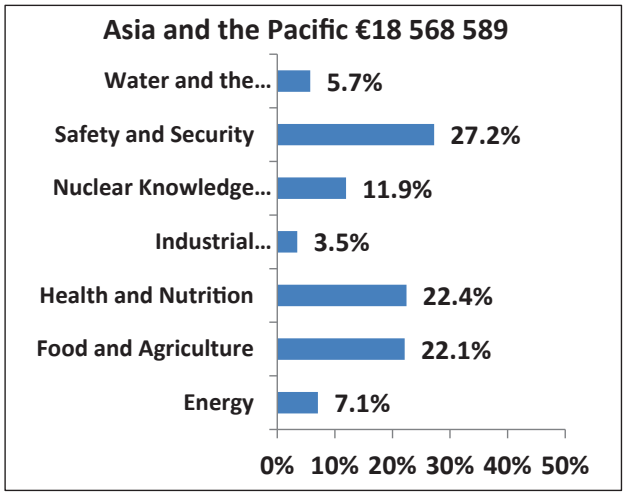
Table A3(a). Disbursements (actuals) of the Technical Cooperation Fund by technical field and region in 2017

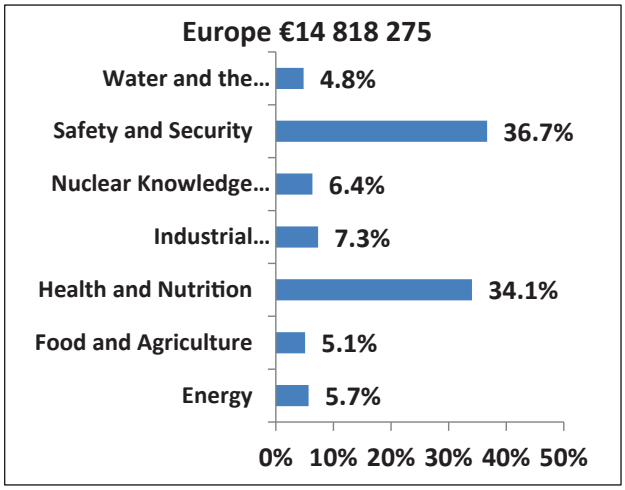
Summary of all regions (in euros)							
Technical field	**Africa**	**Asia and the Pacific**	**Europe**	**Latin America and the Caribbean**	**Global/ interregional**	**PACT [a]**	**Total**
Energy	1 320 075	1 310 134	844 197	559 903	2 247 111		**6 281 420**
Food and Agriculture	7 399 101	4 109 902	751 290	3 036 714	1 205 893		**16 502 900**
Health and Nutrition	5 725 222	4 168 622	5 048 131	4 153 066	796 424	740 532	**20 631 997**
Industrial Applications/ Radiation Technology	915 237	644 652	1 085 624	1 175 921			**3 821 434**
Nuclear Knowledge Development and Management	2 976 238	2 215 916	941 236	1 790 975	2 026 708		**9 951 073**
Safety and Security	4 958 454	5 056 705	5 434 997	3 967 474	1 852 641		**21 270 271**
Water and the Environment	2 858 563	1 062 658	712 800	1 824 674	105 655		**6 564 350**
Total	**26 152 890**	**18 568 589**	**14 818 275**	**16 508 727**	**8 234 432**	**740 532**	**85 023 445**

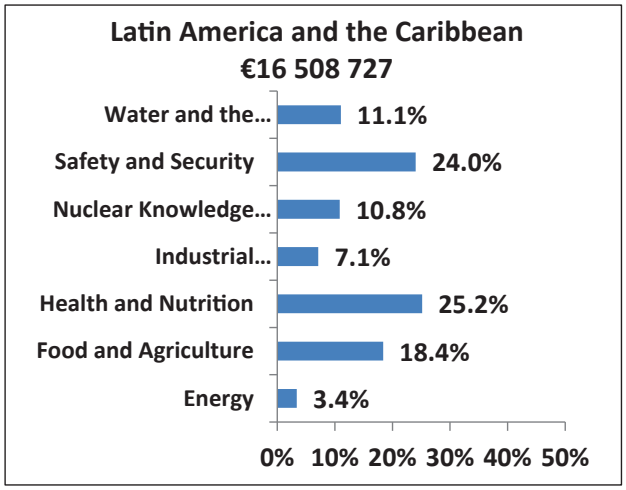
[a] PACT: Programme of Action for Cancer Therapy.

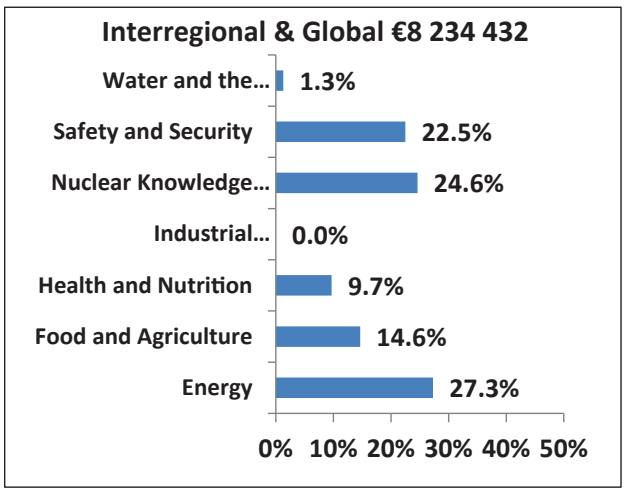
Table A3(b). Graphical representation of the information in Table A3(a)

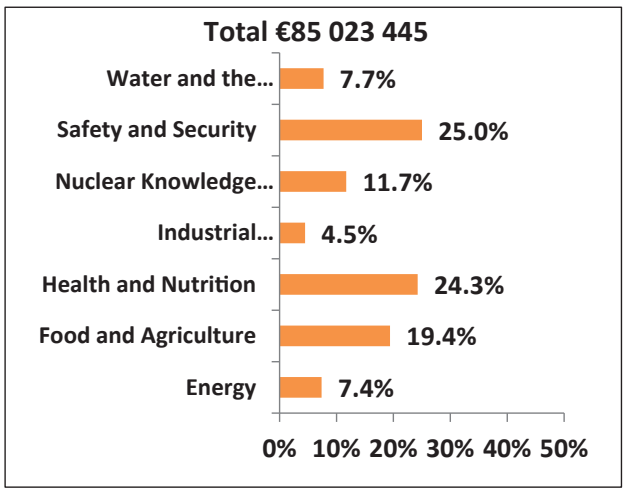












Note: See Table A3(a) for the full titles of the technical fields.

Table A4. Amount of nuclear material under Agency safeguards at the end of 2017 by type of agreement

Nuclear material	Comprehensive safeguards agreement [a]	INFCIRC/66-type agreement	Voluntary offer agreement	Quantity in significant quantities (SQs)
Plutonium[b] contained in irradiated fuel and in fuel elements in reactor cores	137 848	2 550	19 799	**160 197**
Separated plutonium outside reactor cores	1 441	5	10 735	**12 181**
High enriched uranium (equal to or greater than 20% U-235)	167	2	0	**169**
Low enriched uranium (less than 20% U-235)	19 357	317	1 541	**21 215**
Source material[c] (natural and depleted uranium and thorium)	11 192	879	3 038	**15 109**
U-233	18	0	0	**18**
Total SQs of nuclear material	**170 023**	**3 753**	**35 113**	**208 889**

Amount of heavy water under Agency safeguards at the end of 2017 by type of agreement

Non-nuclear material[d]	Comprehensive safeguards agreement	INFCIRC/66-type agreement	Voluntary offer agreement	Quantity in tonnes
Heavy water (tonnes)		**431.6**		**432.3**[e]

[a] Includes nuclear material under Agency safeguards in Taiwan, China; excludes nuclear material in the Democratic People's Republic of Korea.

[b] The quantity includes an estimated amount (10 000 SQs) of plutonium in fuel elements loaded into reactor cores and plutonium in other irradiated fuel, which has not yet been reported to the Agency under agreed reporting procedures.

[c] This table does not include material within the terms of subparagraphs 34(a) and 34(b) of INFCIRC/153 (Corrected).

[d] Non-nuclear material subject to Agency safeguards under INFCIRC/66/Rev.2-type agreements.

[e] Includes 0.7 tonnes of heavy water under Agency safeguards in Taiwan, China.

Table A5. Number of facilities and material balance areas outside facilities under Agency safeguards during 2017

Type	Comprehensive safeguards agreement [a]	INFCIRC/66-type agreement [b]	Voluntary offer agreement	Total
Power reactors	241	14	2	257
Research reactors and critical assemblies	149	3	1	153
Conversion plants	18	0	0	18
Fuel fabrication plants	39	2	1	42
Reprocessing plants	9	0	1	10
Enrichment plants	16	0	3	19
Separate storage facilities	130	2	4	136
Other facilities	80	0	0	80
Facility subtotals	**682**	**21**	**12**	**715**
Material balance areas containing locations outside facilities [c]	582	1	0	583
Total	**1264**	**22**	**12**	**1298**

[a] Covering safeguards agreements pursuant to the Treaty on the Non-Proliferation of Nuclear Weapons and/or the Treaty of Tlatelolco and other comprehensive safeguards agreements; includes facilities in Taiwan, China.

[b] Covering facilities in India, Israel and Pakistan.

[c] Includes 55 material balance areas in States with amended small quantities protocols.

Table A6. Conclusion of safeguards agreements, additional protocols and small quantities protocols (as of 31 December 2017)

State[a]	Small quantities protocols[b]	Safeguards agreements[c]	INFCIRC	Additional protocols
Afghanistan	Amended: 28 Jan. 2016	In force: 20 Feb. 1978	257	In force: 19 July 2005
Albania[1]		In force: 25 March 1988	359	In force: 3 Nov. 2010
Algeria		In force: 7 Jan. 1997	531	Approved: 14 Sept. 2004
Andorra	Amended: 24 April 2013	In force: 18 Oct. 2010	808	In force: 19 Dec. 2011
Angola	In force: 28 April 2010	In force: 28 April 2010	800	In force: 28 April 2010
Antigua and Barbuda[2]	Amended: 5 March 2012	In force: 9 Sept. 1996	528	In force: 15 Nov. 2013
Argentina[3]		In force: 4 March 1994	435	
Armenia		In force: 5 May 1994	455	In force: 28 June 2004
Australia		In force: 10 July 1974	217	In force: 12 Dec. 1997
Austria[4]		Accession: 31 July 1996	193	In force: 30 April 2004
Azerbaijan		In force: 29 April 1999	580	In force: 29 Nov. 2000
Bahamas[2]	Amended: 25 July 2007	In force: 12 Sept. 1997	544	
Bahrain	In force: 10 May 2009	In force: 10 May 2009	767	In force: 20 July 2011
Bangladesh		In force: 11 June 1982	301	In force: 30 March 2001
Barbados[2]	X	In force: 14 Aug. 1996	527	
Belarus		In force: 2 Aug. 1995	495	Signed: 15 Nov. 2005
Belgium		In force: 21 Feb. 1977	193	In force: 30 April 2004
Belize[5]	X	In force: 21 Jan. 1997	532	
Benin	*Amended: 15 April 2008*	*Signed: 7 June 2005*		*Signed: 7 June 2005*
Bhutan	X	In force: 24 Oct. 1989	371	
Bolivia, Plurinational State of [2]	X	In force: 6 Feb. 1995	465	
Bosnia and Herzegovina		In force: 4 April 2013	851	In force: 3 July 2013
Botswana		In force: 24 Aug. 2006	694	In force: 24 Aug. 2006
Brazil[6]		In force: 4 March 1994	435	
Brunei Darussalam	X	In force: 4 Nov. 1987	365	
Bulgaria[7]		Accession: 1 May 2009	193	Accession: 1 May 2009
Burkina Faso	Amended: 18 Feb. 2008	In force: 17 April 2003	618	In force: 17 April 2003

State[a]	Small quantities protocols[b]	Safeguards agreements[c]	INFCIRC	Additional protocols
Burundi	In force: 27 Sept. 2007	In force: 27 Sept. 2007	719	In force: 27 Sept. 2007
Cabo Verde	*Amended: 27 March 2006*	*Signed: 28 June 2005*		*Signed: 28 June 2005*
Cambodia	Amended: 16 July 2014	In force: 17 Dec. 1999	586	In force: 24 April 2015
Cameroon	X	In force: 17 Dec. 2004	641	In force: 29 Sept. 2016
Canada		In force: 21 Feb. 1972	164	In force: 8 Sept. 2000
Central African Republic	In force: 7 Sept. 2009	In force: 7 Sept. 2009	777	In force: 7 Sept. 2009
Chad	In force: 13 May 2010	In force: 13 May 2010	802	In force: 13 May 2010
Chile[8]		In force: 5 April 1995	476	In force: 3 Nov. 2003
China		In force: 18 Sept. 1989	369*	In force: 28 March 2002
Colombia[8]		In force: 22 Dec. 1982	306	In force: 5 March 2009
Comoros	In force: 20 Jan. 2009	In force: 20 Jan. 2009	752	In force: 20 Jan. 2009
Congo	In force: 28 Oct. 2011	In force: 28 Oct. 2011	831	In force: 28 Oct. 2011
Costa Rica[2]	Amended: 12 Jan. 2007	In force: 22 Nov. 1979	278	In force: 17 June 2011
Côte d'Ivoire		In force: 8 Sept. 1983	309	In force: 5 May 2016
Croatia[9]		Accession: 1 Apr. 2017	193	Accession: 1 Apr. 2017
Cuba[2]		In force: 3 June 2004	633	In force: 3 June 2004
Cyprus[10]		Accession: 1 May 2008	193	Accession: 1 May 2008
Czech Republic[11]		Accession: 1 Oct. 2009	193	Accession: 1 Oct. 2009
Democratic Republic of the Congo		In force: 9 Nov. 1972	183	In force: 9 April 2003
Denmark[12]		In force: 1 March 1972 In force: 21 Feb. 1977	176 193	In force: 22 March 2013 In force: 30 April 2004
Djibouti	In force: 26 May 2015	In force: 26 May 2015	884	In force: 26 May 2015
Dominica[5]	X	In force: 3 May 1996	513	
Dominican Republic[2]	Amended: 11 Oct. 2006	In force: 11 Oct. 1973	201	In force: 5 May 2010
Democratic People's Republic of Korea		In force: 10 April 1992	403	
Ecuador[2]	Amended: 7 April 2006	In force: 10 March 1975	231	In force: 24 Oct. 2001
Egypt		In force: 30 June 1982	302	
El Salvador[2]	Amended: 10 June 2011	In force: 22 April 1975	232	In force: 24 May 2004
Equatorial Guinea	*Approved: 13 June 1986*	*Approved: 13 June 1986*		

State[a]	Small quantities protocols[b]	Safeguards agreements[c]	INFCIRC	Additional protocols
Eritrea				
Estonia[13]		Accession: 1 Dec. 2005	193	Accession: 1 Dec. 2005
Ethiopia	X	In force: 2 Dec. 1977	261	
Fiji	X	In force: 22 March 1973	192	In force: 14 July 2006
Finland[14]		Accession: 1 Oct. 1995	193	In force: 30 April 2004
France	X	In force: 12 Sept. 1981 In force: 26 Oct. 2007[15]	290* 718	In force: 30 April 2004
Gabon	Amended: 30 Oct. 2013	In force: 25 March 2010	792	In force: 25 March 2010
Gambia	Amended: 17 Oct. 2011	In force: 8 Aug. 1978	277	In force: 18 Oct. 2011
Georgia		In force: 3 June 2003	617	In force: 3 June 2003
Germany[16]		In force: 21 Feb. 1977	193	In force: 30 April 2004
Ghana		In force: 17 Feb. 1975	226	In force: 11 June 2004
Greece[17]		Accession: 17 Dec. 1981	193	In force: 30 April 2004
Grenada[2]	X	In force: 23 July 1996	525	
Guatemala[2]	Amended: 26 April 2011	In force: 1 Feb. 1982	299	In force: 28 May 2008
Guinea	*Signed: 13 Dec. 2011*	*Signed: 13 Dec. 2011*		*Signed: 13 Dec. 2011*
Guinea-Bissau	*Signed: 21 June 2013*	*Signed: 21 June 2013*		*Signed: 21 June 2013*
Guyana[2]	X	In force: 23 May 1997	543	
Haiti[2]	X	In force: 9 March 2006	681	In force: 9 March 2006
Holy See	Amended: 11 Sept. 2006	In force: 1 Aug. 1972	187	In force: 24 Sept. 1998
Honduras[2]	Amended: 20 Sept. 2007	In force: 18 April 1975	235	In force: 17 Nov. 2017
Hungary[18]		Accession: 1 July 2007	193	Accession: 1 July 2007
Iceland	Amended: 15 March 2010	In force: 16 Oct. 1974	215	In force: 12 Sept. 2003
India[19]		In force: 30 Sept. 1971 In force: 17 Nov. 1977 In force: 27 Sept. 1988 In force: 11 Oct. 1989 In force: 1 March 1994 In force: 11 May 2009	211 260 360 374 433 754	In force: 25 July 2014
Indonesia		In force: 14 July 1980	283	In force: 29 Sept. 1999
Iran, Islamic Republic of[20]		In force: 15 May 1974	214	Signed: 18 Dec. 2003
Iraq		In force: 29 Feb. 1972	172	In force: 10 Oct. 2012

State[a]	Small quantities protocols[b]	Safeguards agreements[c]	INFCIRC	Additional protocols
Ireland		In force: 21 Feb. 1977	193	In force: 30 April 2004
Israel		In force: 4 April 1975	249/Add.1	
Italy		In force: 21 Feb. 1977	193	In force: 30 April 2004
Jamaica[2]		In force: 6 Nov. 1978	265	In force: 19 March 2003
Japan		In force: 2 Dec. 1977	255	In force: 16 Dec. 1999
Jordan		In force: 21 Feb. 1978	258	In force: 28 July 1998
Kazakhstan		In force: 11 Aug. 1995	504	In force: 9 May 2007
Kenya	In force: 18 Sept. 2009	In force: 18 Sept. 2009	778	In force: 18 Sept. 2009
Kiribati	X	In force: 19 Dec. 1990	390	Signed: 9 Nov. 2004
Korea, Republic of		In force: 14 Nov. 1975	236	In force: 19 Feb. 2004
Kuwait	Amended: 26 July 2013	In force: 7 March 2002	607	In force: 2 June 2003
Kyrgyzstan	X	In force: 3 Feb. 2004	629	In force: 10 Nov. 2011
Lao People's Democratic Republic	X	In force: 5 April 2001	599	Signed: 5 Nov. 2014
Latvia[21]		Accession: 1 Oct. 2008	193	Accession: 1 Oct. 2008
Lebanon	Amended: 5 Sept. 2007	In force: 5 March 1973	191	
Lesotho	Amended: 8 Sept. 2009	In force: 12 June 1973	199	In force: 26 April 2010
Liberia	*Signed: 25 Sept. 2017*	*Signed: 25 Sept. 2017*		*Signed: 25 Sept. 2017*
Libya		In force: 8 July 1980	282	In force: 11 Aug. 2006
Liechtenstein		In force: 4 Oct. 1979	275	In force: 25 Nov. 2015
Lithuania[22]		Accession: 1 Jan. 2008	193	Accession: 1 Jan. 2008
Luxembourg		In force: 21 Feb. 1977	193	In force: 30 April 2004
Madagascar	Amended: 29 May 2008	In force: 14 June 1973	200	In force: 18 Sept. 2003
Malawi	Amended: 29 Feb. 2008	In force: 3 Aug. 1992	409	In force: 26 July 2007
Malaysia		In force: 29 Feb. 1972	182	Signed: 22 Nov. 2005
Maldives	X	In force: 2 Oct. 1977	253	
Mali	Amended: 18 April 2006	In force: 12 Sept. 2002	615	In force: 12 Sept. 2002
Malta[23]		Accession: 1 July 2007	193	Accession: 1 July 2007
Marshall Islands		In force: 3 May 2005	653	In force: 3 May 2005

State[a]	Small quantities protocols[b]	Safeguards agreements[c]	INFCIRC	Additional protocols
Mauritania	Amended: 20 March 2013	In force: 10 Dec. 2009	788	In force: 10 Dec. 2009
Mauritius	Amended: 26 Sept. 2008	In force: 31 Jan. 1973	190	In force: 17 Dec. 2007
Mexico[24]		In force: 14 Sept. 1973	197	In force: 4 March 2011
Micronesia, Federated States of	*Signed: 1 June 2015*	*Signed: 1 June 2015*		
Monaco	Amended: 27 Nov. 2008	In force: 13 June 1996	524	In force: 30 Sept. 1999
Mongolia	X	In force: 5 Sept. 1972	188	In force: 12 May 2003
Montenegro	In force: 4 March 2011	In force: 4 March 2011	814	In force: 4 March 2011
Morocco		In force: 18 Feb. 1975	228	In force: 21 April 2011
Mozambique	In force: 1 March 2011	In force: 1 March 2011	813	In force: 1 March 2011
Myanmar	X	In force: 20 April 1995	477	Signed: 17 Sept. 2013
Namibia	X	In force: 15 April 1998	551	In force: 20 Feb. 2012
Nauru	X	In force: 13 April 1984	317	
Nepal	X	In force: 22 June 1972	186	
Netherlands	X	In force: 5 June 1975[15] In force: 21 Feb. 1977	229 193	In force: 30 April 2004
New Zealand[25]	Amended: 24 Feb. 2014	In force: 29 Feb. 1972	185	In force: 24 Sept. 1998
Nicaragua[2]	Amended: 12 June 2009	In force: 29 Dec. 1976	246	In force: 18 Feb. 2005
Niger		In force: 16 Feb. 2005	664	In force: 2 May 2007
Nigeria		In force: 29 Feb. 1988	358	In force: 4 April 2007
Norway		In force: 1 March 1972	177	In force: 16 May 2000
Oman	X	In force: 5 Sept. 2006	691	
Pakistan		In force: 5 March 1962 In force: 17 June 1968 In force: 17 Oct. 1969 In force: 18 March 1976 In force: 2 March 1977 In force: 10 Sept. 1991 In force: 24 Feb. 1993 In force: 22 Feb. 2007 In force: 15 April 2011 In force: 3 May 2017	34 116 135 239 248 393 418 705 816 920	
Palau	Amended: 15 March 2006	In force: 13 May 2005	650	In force: 13 May 2005
Palestine				
Panama[8]	Amended: 4 March 2011	In force: 23 March 1984	316	In force: 11 Dec. 2001

State[a]	Small quantities protocols[b]	Safeguards agreements[c]	INFCIRC	Additional protocols
Papua New Guinea	X	In force: 13 Oct. 1983	312	
Paraguay[2]	X	In force: 20 March 1979	279	In force: 15 Sept. 2004
Peru[2]		In force: 1 Aug. 1979	273	In force: 23 July 2001
Philippines		In force: 16 Oct. 1974	216	In force: 26 Feb. 2010
Poland[26]		Accession: 1 March 2007	193	Accession: 1 March 2007
Portugal[27]		Accession: 1 July 1986	193	In force: 30 April 2004
Qatar	In force: 21 Jan. 2009	In force: 21 Jan. 2009	747	
Republic of Moldova	Amended: 1 Sept. 2011	In force: 17 May 2006	690	In force: 1 June 2012
Romania[28]		Accession: 1 May 2010	193	Accession: 1 May 2010
Russian Federation		In force: 10 June 1985	327*	In force: 16 Oct. 2007
Rwanda	In force: 17 May 2010	In force: 17 May 2010	801	In force: 17 May 2010
Saint Kitts and Nevis[5]	Amended: 19 Aug. 2016	In force: 7 May 1996	514	In force: 19 May 2014
Saint Lucia[5]	X	In force: 2 Feb. 1990	379	
St Vincent and the Grenadines[5]	X	In force: 8 Jan. 1992	400	
Samoa	X	In force: 22 Jan. 1979	268	
San Marino	Amended: 13 May 2011	In force: 21 Sept. 1998	575	
São Tomé and Príncipe				
Saudi Arabia	X	In force: 13 Jan. 2009	746	
Senegal	Amended: 6 Jan. 2010	In force: 14 Jan. 1980	276	In force: 24 July 2017
Serbia[29]		In force: 28 Dec. 1973	204	Signed: 3 July 2009
Seychelles	Amended: 31 Oct. 2006	In force: 19 July 2004	635	In force: 13 Oct. 2004
Sierra Leone	X	In force: 4 Dec. 2009	787	
Singapore	Amended: 31 March 2008	In force: 18 Oct. 1977	259	In force: 31 March 2008
Slovakia[30]		Accession: 1 Dec. 2005	193	Accession: 1 Dec. 2005
Slovenia[31]		Accession: 1 Sept. 2006	193	Accession: 1 Sept. 2006
Solomon Islands	X	In force: 17 June 1993	420	
Somalia				
South Africa		In force: 16 Sept. 1991	394	In force: 13 Sept. 2002
Spain		Accession: 5 April 1989	193	In force: 30 April 2004

State[a]	Small quantities protocols[b]	Safeguards agreements[c]	INFCIRC	Additional protocols
Sri Lanka		In force: 6 Aug. 1984	320	
Sudan	X	In force: 7 Jan. 1977	245	
Suriname[2]	X	In force: 2 Feb. 1979	269	
Swaziland	Amended: 23 July 2010	In force: 28 July 1975	227	In force: 8 Sept. 2010
Sweden[32]		Accession: 1 June 1995	193	In force: 30 April 2004
Switzerland		In force: 6 Sept. 1978	264	In force: 1 Feb. 2005
Syrian Arab Republic		In force: 18 May 1992	407	
Tajikistan		In force: 14 Dec. 2004	639	In force: 14 Dec. 2004
Thailand		In force: 16 May 1974	241	In force: 17 Nov. 2017
The former Yugoslav Republic of Macedonia	Amended: 9 July 2009	In force: 16 April 2002	610	In force: 11 May 2007
Timor-Leste	*Signed: 6 Oct. 2009*	*Signed: 6 Oct. 2009*		*Signed: 6 Oct. 2009*
Togo	Amended: 8 Oct. 2015	In force: 18 July 2012	840	In force: 18 July 2012
Tonga	X	In force: 18 Nov. 1993	426	
Trinidad and Tobago[2]	X	In force: 4 Nov. 1992	414	
Tunisia		In force: 13 March 1990	381	Signed: 24 May 2005
Turkey		In force: 1 Sept. 1981	295	In force: 17 July 2001
Turkmenistan		In force: 3 Jan. 2006	673	In force: 3 Jan. 2006
Tuvalu	X	In force: 15 March 1991	391	
Uganda	Amended: 24 June 2009	In force: 14 Feb. 2006	674	In force: 14 Feb. 2006
Ukraine		In force: 22 Jan. 1998	550	In force: 24 Jan. 2006
United Arab Emirates		In force: 9 Oct. 2003	622	In force: 20 Dec. 2010
United Kingdom	Signed: 6 Jan. 1993	In force: 14 Dec. 1972[33] In force: 14 Aug. 1978 Signed: 6 Jan. 1993[15]	175 263* 	In force: 30 April 2004
United Republic of Tanzania	Amended: 10 June 2009	In force: 7 Feb. 2005	643	In force: 7 Feb. 2005
United States of America	X	In force: 9 Dec. 1980 In force: 6 April 1989[15]	288* 366	In force: 6 Jan. 2009
Uruguay[2]		In force: 17 Sept. 1976	157	In force: 30 April 2004
Uzbekistan		In force: 8 Oct. 1994	508	In force: 21 Dec. 1998
Vanuatu	In force: 21 May 2013	In force: 21 May 2013	852	In force: 21 May 2013

State[a]	Small quantities protocols[b]	Safeguards agreements[c]	INFCIRC	Additional protocols
Venezuela, Bolivarian Republic of [2]		In force: 11 March 1982	300	
Viet Nam		In force: 23 Feb. 1990	376	In force: 17 Sept. 2012
Yemen	X	In force: 14 Aug. 2002	614	
Zambia	X	In force: 22 Sept. 1994	456	Signed: 13 May 2009
Zimbabwe	Amended: 31 Aug. 2011	In force: 26 June 1995	483	

Key

Bold States not party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) whose safeguards agreements are of INFCIRC/66-type.

Italics States Parties to the NPT that have not yet brought into force comprehensive safeguards agreements (CSAs) pursuant to Article III of the NPT.

* Voluntary offer safeguards agreement with NPT nuclear-weapon States.

X 'X' in the 'small quantities protocols' column indicates that the State has an operative small quantities protocol (SQP). 'Amended' indicates that the operative SQP is based on the revised standard SQP text.

NB: This table does not aim at listing all safeguards agreements that the Agency has concluded. Not included are agreements under which the application of safeguards has been suspended upon the entry into force of a CSA. Unless otherwise indicated, the safeguards agreements referred to are CSAs concluded pursuant to the NPT.

[a] An entry in this column does not imply the expression of any opinion whatsoever on the part of the Agency concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

[b] Provided that they meet certain eligibility criteria (including that the quantities of nuclear material do not exceed the limits set out in paragraph 37 of INFCIRC/153(Corrected)), countries have the option to conclude an SQP to their CSAs that holds in abeyance the implementation of most of the detailed provisions set out in Part II of the CSAs as long as eligibility criteria continue to apply. This column contains countries whose CSA with an SQP based on the original standard text has been approved by the Board of Governors and for which, as far as the Secretariat is aware, these eligibility criteria continue to apply. For those States that have accepted the revised standard SQP text (approved by the Board of Governors on 20 September 2005) the current status is reflected.

[c] The Agency also applies safeguards for Taiwan, China, under two agreements, which entered into force on 13 October 1969 (INFCIRC/133) and 6 December 1971 (INFCIRC/158), respectively.

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[1] *Sui generis* comprehensive safeguards agreement. On 28 November 2002, upon approval by the Board of Governors, an exchange of letters entered into force confirming that the safeguards agreement satisfies the requirement of Article III of the NPT.

[2] Safeguards agreement is pursuant to both the Treaty of Tlatelolco and the NPT.

[3] Date refers to the safeguards agreement concluded between Argentina, Brazil, ABACC and the Agency. On 18 March 1997, upon approval by the Board of Governors, an exchange of letters entered into force between Argentina and the Agency confirming that the safeguards agreement satisfies the requirements of Article 13 of the Treaty of Tlatelolco and Article III of the NPT to conclude a safeguards agreement with the Agency.

[4] The application of safeguards for Austria under the NPT bilateral safeguards agreement (INFCIRC/156), in force since 23 July 1972, was suspended on 31 July 1996, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Austria had acceded, entered into force for Austria.

[5] Date refers to a safeguards agreement pursuant to Article III of the NPT. Upon approval by the Board of Governors, an exchange of letters entered into force (for Saint Lucia on 12 June 1996 and for Belize, Dominica, Saint Kitts and Nevis and Saint Vincent and the Grenadines on 18 March 1997) confirming that the safeguards agreement satisfies the requirement of Article 13 of the Treaty of Tlatelolco.

[6] Date refers to the safeguards agreement concluded between Argentina, Brazil, ABACC and the Agency. On 10 June 1997, upon approval by the Board of Governors, an exchange of letters entered into force between Brazil and the Agency confirming that the safeguards agreement satisfies the requirement of Article 13 of the Treaty of Tlatelolco. On 20 September 1999, upon approval by the Board of Governors, an exchange of letters entered into force confirming that the safeguards agreement also satisfies the requirement of Article III of the NPT.

[7] The application of safeguards for Bulgaria under the NPT bilateral safeguards agreement (INFCIRC/178), in force since 29 February 1972, was suspended on 1 May 2009, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Bulgaria had acceded, entered into force for Bulgaria.

[8] Date refers to a safeguards agreement pursuant to Article 13 of the Treaty of Tlatelolco. Upon approval by the Board of Governors, an exchange of letters entered into force (for Chile on 9 September 1996; for Colombia on 13 June 2001; for Panama on 20 November 2003) confirming that the safeguards agreement satisfies the requirement of Article III of the NPT.

[9] The application of safeguards for Croatia under the NPT bilateral safeguards agreement (INFCIRC/463), in force since 19 January 1995, was suspended on 1 April 2017, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Croatia had acceded, entered into force for Croatia.

[10] The application of safeguards for Cyprus under the NPT bilateral safeguards agreement (INFCIRC/189), in force since 26 January 1973, was suspended on 1 May 2008, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Cyprus had acceded, entered into force for Cyprus.

[11] The application of safeguards for the Czech Republic under the NPT bilateral safeguards agreement (INFCIRC/541), in force since 11 September 1997, was suspended on 1 October 2009, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which the Czech Republic had acceded, entered into force for the Czech Republic.

[12] The application of safeguards for Denmark under the NPT bilateral safeguards agreement (INFCIRC/176), in force since 1 March 1972, was suspended on 21 February 1977, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193) entered into force for Denmark. Since 21 February 1977, INFCIRC/193 also applies to the Faroe Islands. Upon Greenland's secession from Euratom as of 31 January 1985, INFCIRC/176 re-entered into force for Greenland. The Additional Protocol for Greenland entered into force on 22 March 2013 (INFCIRC/176/Add.1).

[13] The application of safeguards for Estonia under the NPT bilateral safeguards agreement (INFCIRC/547), in force since 24 November 1997, was suspended on 1 December 2005, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Estonia had acceded, entered into force for Estonia.

[14] The application of safeguards for Finland under the NPT bilateral safeguards agreement (INFCIRC/155), in force since 9 February 1972, was suspended on 1 October 1995, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Finland had acceded, entered into force for Finland.

[15] The safeguards agreement is pursuant to Additional Protocol I to the Treaty of Tlatelolco.

[16] The NPT safeguards agreement of 7 March 1972 concluded with the German Democratic Republic (INFCIRC/181) is no longer in force with effect from 3 October 1990, on which date the German Democratic Republic acceded to the Federal Republic of Germany.

[17] The application of safeguards for Greece under the NPT bilateral safeguards agreement (INFCIRC/166), in force since 1 March 1972, was suspended on 17 December 1981, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Greece had acceded, entered into force for Greece.

[18] The application of safeguards for Hungary under the NPT bilateral safeguards agreement (INFCIRC/174), in force since 30 March 1972, was suspended on 1 July 2007, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Hungary had acceded, entered into force for Hungary.

[19] The application of safeguards for India under the safeguards agreement between the Agency, Canada and India (INFCIRC/211), in force since 30 September 1971, was suspended as of 20 March 2015. The application of safeguards for India under the following safeguards agreements between the Agency and India was suspended as of 30 June 2016: INFCIRC/260, in force since 17 November 1977; INFCIRC/360, in force since 27 September 1988; INFCIRC/374, in force since 11 October 1989; and INFCIRC/433, in force since 1 March 1994. Items subject to safeguards under the aforementioned safeguards agreements are subject to safeguards under the safeguards agreement between India and the Agency (INFCIRC/754), which entered into force on 11 May 2009.

[20] Pending entry into force, the additional protocol is being applied provisionally for the Islamic Republic of Iran as of 16 January 2016.

[21] The application of safeguards for Latvia under the NPT bilateral safeguards agreement (INFCIRC/434), in force since 21 December 1993, was suspended on 1 October 2008, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Latvia had acceded, entered into force for Latvia.

[22] The application of safeguards for Lithuania under the NPT bilateral safeguards agreement (INFCIRC/413), in force since 15 October 1992, was suspended on 1 January 2008, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Lithuania had acceded, entered into force for Lithuania.

[23] The application of safeguards for Malta under the NPT bilateral safeguards agreement (INFCIRC/387), in force since 13 November 1990, was suspended on 1 July 2007, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Malta had acceded, entered into force for Malta.

[24] The safeguards agreement was concluded pursuant to both the Treaty of Tlatelolco and the NPT. The application of safeguards under an earlier safeguards agreement pursuant to the Treaty of Tlatelolco, which entered into force on 6 September 1968 (INFCIRC/118), was suspended as of 14 September 1973.

[25] Whereas the NPT safeguards agreement and SQP with New Zealand (INFCIRC/185) also apply to Cook Islands and Niue, the additional protocol thereto (INFCIRC/185/Add.1) does not apply to those territories. Amendments to the SQP entered into force only for New Zealand on 24 February 2014 (INFCIRC/185/Mod.1).

[26] The application of safeguards for Poland under the NPT bilateral safeguards agreement (INFCIRC/179), in force since 11 October 1972, was suspended on 1 March 2007, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Poland had acceded, entered into force for Poland.

[27] The application of safeguards for Portugal under the NPT bilateral safeguards agreement (INFCIRC/272), in force since 14 June 1979, was suspended on 1 July 1986, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Portugal had acceded, entered into force for Portugal.

[28] The application of safeguards for Romania under the NPT bilateral safeguards agreement (INFCIRC/180), in force since 27 October 1972, was suspended on 1 May 2010, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Romania had acceded, entered into force for Romania.

[29] The NPT safeguards agreement concluded with the Socialist Federal Republic of Yugoslavia (INFCIRC/204), which entered into force on 28 December 1973, continues to be applied for Serbia to the extent relevant to the territory of Serbia.

[30] The application of safeguards for Slovakia under the NPT bilateral safeguards agreement with the Czechoslovak Socialist Republic (INFCIRC/173), in force since 3 March 1972, was suspended on 1 December 2005, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Slovakia had acceded, entered into force for Slovakia.

[31] The application of safeguards for Slovenia under the NPT bilateral safeguards agreement (INFCIRC/538), in force since 1 August 1997, was suspended on 1 September 2006, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Slovenia had acceded, entered into force for Slovenia.

[32] The application of safeguards for Sweden under the NPT bilateral safeguards agreement (INFCIRC/234), in force since 14 April 1975, was suspended on 1 June 1995, on which date the agreement of 5 April 1973 between the non-nuclear-weapon States of Euratom, Euratom and the Agency (INFCIRC/193), to which Sweden had acceded, entered into force for Sweden.

[33] Date refers to the INFCIRC/66-type safeguards agreement, concluded between the United Kingdom and the Agency, which remains in force.

Table A7. Participation in multilateral treaties for which the Director General is the depositary (status as of 31 December 2017)

	State/Organization	P&I	ENC	AC	CNS	JC	CPPNM	A-CPPNM	VC	A-VC	CSC	JP
*	Afghanistan						X					
*	Albania	X	X	X	X	X	X	X				
*	Algeria		X	X			X	X				
	Andorra						X					
*	Angola		X									
*	Antigua and Barbuda						X	X				
*	Argentina	X	X	X	X	X	X	X	X	X	X	
*	Armenia		X	X	X	X	X	X	X			
*	Australia	X	X	X	X	X	X	X				
*	Austria		X	X	X	X	X	X				
*	Azerbaijan						X	X				
*	Bahamas						X					
*	Bahrain		X		X		X	X				
*	Bangladesh		X	X	X		X	X				
*	Barbados											
*	Belarus	X	X	X	X	X	X		X	X		
*	Belgium	X	X	X	X	X	X	X				
*	Belize											
*	Benin	X										
	Bhutan											
*	Bolivia, Plurinational State of	X	X	X			X	X	X			
*	Bosnia and Herzegovina	X	X	X	X	X	X	X	X	X		
*	Botswana		X	X		X	X	X				
*	Brazil	X	X	X	X	X	X		X			
*	Brunei Darussalam											
*	Bulgaria	X	X	X	X	X	X	X	X			X

	State/Organization	P&I	ENC	AC	CNS	JC	CPPNM	A-CPPNM	VC	A-VC	CSC	JP
*	Burkina Faso		X	X			X	X				
*	Burundi											
	Cabo Verde						X					
*	Cambodia		X		X		X					
*	Cameroon	X	X	X			X	X	X			X
*	Canada	X	X	X	X	X	X	X			X	
*	Central African Republic						X					
*	Chad											
*	Chile	X	X	X	X	X	X	X	X			X
*	China	X	X	X	X	X	X	X				
*	Colombia	X	X	X			X	X				
	Comoros						X					
*	Congo											
*	Costa Rica		X	X			X	X				
*	Côte d'Ivoire						X	X				
*	Croatia	X	X	X	X	X	X	X	X			X
*	Cuba	X	X	X	X	X	X	X	X			
*	Cyprus	X	X	X	X	X	X	X				
*	Czech Republic	X	X	X	X	X	X	X	X			X
	Dem. People's Rep. of Korea											
*	Dem. Rep. of the Congo	X					X					
*	Denmark	X	X	X	X	X	X	X				X
*	Djibouti						X	X				
*	Dominica						X					
*	Dominican Republic		X				X	X				
*	Ecuador	X					X	X				
*	Egypt	X	X	X					X			X
*	El Salvador		X	X			X	X				

	State/Organization	P&I	ENC	AC	CNS	JC	CPPNM	A-CPPNM	VC	A-VC	CSC	JP
	Equatorial Guinea						X					
*	Eritrea											
*	Estonia	X	X	X	X	X	X	X	X			X
*	Ethiopia											
*	Fiji						X	X				
*	Finland	X	X	X	X	X	X	X				X
*	France		X	X	X	X	X	X				X
*	Gabon		X	X		X	X	X				
	Gambia											
*	Georgia		X			X	X	X				
*	Germany	X	X	X	X	X	X	X				X
*	Ghana	X	X	X	X	X	X	X			X	
*	Greece	X	X	X	X	X	X	X				X
	Grenada						X					
*	Guatemala		X	X			X					
	Guinea						X					
	Guinea-Bissau						X					
*	Guyana						X					
*	Haiti											
*	Holy See	X										
*	Honduras						X					
*	Hungary	X	X	X	X	X	X	X	X			X
*	Iceland	X	X	X	X	X	X	X				
*	India	X	X	X	X		X	X			X	
*	Indonesia	X	X	X	X	X	X	X				
*	Iran, Islamic Republic of	X	X	X								
*	Iraq	X	X	X			X					
*	Ireland	X	X	X	X	X	X	X				

	State/Organization	P&I	ENC	AC	CNS	JC	CPPNM	A-CPPNM	VC	A-VC	CSC	JP
*	Israel		X	X			X	X				
*	Italy	X	X	X	X	X	X	X				X
*	Jamaica	X					X	X				
*	Japan	X	X	X	X	X	X	X			X	
*	Jordan	X	X	X	X	X	X	X	X	X		
*	Kazakhstan	X	X	X	X	X	X	X	X	X		
*	Kenya						X	X				
	Kiribati											
*	Korea, Republic of	X	X	X	X	X	X	X				
*	Kuwait	X	X	X	X		X	X				
*	Kyrgyzstan					X	X	X				
*	Lao People's Dem. Rep.		X	X			X					
*	Latvia	X	X	X	X	X	X	X	X	X		X
*	Lebanon		X	X	X		X		X			
*	Lesotho		X	X		X	X	X				
*	Liberia											
*	Libya		X	X	X		X	X				
*	Liechtenstein		X	X			X	X				
*	Lithuania	X	X	X	X	X	X	X	X			X
*	Luxembourg	X	X	X	X	X	X	X				
*	Madagascar		X	X	X	X	X	X				
*	Malawi						X					
*	Malaysia		X	X								
	Maldives											
*	Mali		X	X	X		X	X				
*	Malta				X	X	X	X				
*	Marshall Islands						X	X				
*	Mauritania		X	X		X	X	X				

	State/Organization	P&I	ENC	AC	CNS	JC	CPPNM	A-CPPNM	VC	A-VC	CSC	JP
*	Mauritius	X	X	X		X			X			
*	Mexico	X	X	X	X		X	X	X			
	Micronesia, Federated States of											
*	Monaco		X	X			X	X				
*	Mongolia	X	X	X			X					
*	Montenegro	X	X	X	X	X	X	X	X	X	X	
*	Morocco	X	X	X		X	X	X		X	X	
*	Mozambique	X	X	X			X					
*	Myanmar		X		X		X	X				
*	Namibia						X	X				
	Nauru						X	X				
*	Nepal											
*	Netherlands	X	X	X	X	X	X	X				X
*	New Zealand	X	X	X			X	X				
*	Nicaragua	X	X	X			X	X				
*	Niger	X		X	X	X	X	X	X	X		
*	Nigeria	X	X	X	X	X	X	X	X			
	Niue						X					
*	Norway	X	X	X	X	X	X	X				X
*	Oman	X	X	X	X	X	X					
*	Pakistan	X	X	X	X		X	X				
*	Palau	X					X					
*	Panama		X	X			X					
*	Papua New Guinea											
*	Paraguay		X	X	X		X	X				
*	Peru		X	X	X	X	X	X	X			
*	Philippines	X	X	X			X		X			
*	Poland	X	X	X	X	X	X	X	X	X		X

	State/Organization	P&I	ENC	AC	CNS	JC	CPPNM	A-CPPNM	VC	A-VC	CSC	JP
*	Portugal	X	X	X	X	X	X	X				
*	Qatar		X	X			X	X				
*	Republic of Moldova	X	X	X	X	X	X	X	X			
*	Romania	X	X	X	X	X	X	X	X	X	X	X
*	Russian Federation	X	X	X	X	X	X	X	X			
*	Rwanda						X					
	Saint Kitts and Nevis						X					
	Saint Lucia						X	X				
*	St Vincent and the Grenadines		X	X					X			X
	Samoa											
*	San Marino						X	X				
	São Tomé and Príncipe											
*	Saudi Arabia		X	X	X	X	X	X	X	X		
*	Senegal	X	X	X	X	X	X	X	X			
*	Serbia	X	X	X			X	X	X			
*	Seychelles						X	X				
*	Sierra Leone											
*	Singapore	X	X	X	X		X	X				
*	Slovakia	X	X	X	X	X	X	X	X			X
*	Slovenia	X	X	X	X	X	X	X				X
	Solomon Islands											
	Somalia											
*	South Africa	X	X	X	X	X	X					
*	Spain	X	X	X	X	X	X	X				
*	Sri Lanka		X	X	X							
*	Sudan						X					
	Suriname											
*	Swaziland						X	X				

	State/Organization	P&I	ENC	AC	CNS	JC	CPPNM	A-CPPNM	VC	A-VC	CSC	JP
*	Sweden	X	X	X	X	X	X	X				X
*	Switzerland	X	X	X	X	X	X	X				
*	Syrian Arab Republic	X			X							
*	Tajikistan	X	X	X		X	X	X				
*	Thailand	X	X	X								
*	The former Yugoslav Republic of Macedonia		X	X	X	X	X	X	X			
	Timor Leste											
*	Togo						X					
	Tonga						X					
*	Trinidad and Tobago						X		X			
*	Tunisia	X	X	X	X		X	X				
*	Turkey	X	X	X	X		X	X				X
*	Turkmenistan						X	X				
	Tuvalu											
*	Uganda						X					
*	Ukraine	X	X	X	X	X	X	X	X			X
*	United Arab Emirates		X	X	X	X	X	X		X	X	X
*	United Kingdom	X	X	X	X	X	X	X				
*	United Republic of Tanzania		X	X			X					
*	United States of America		X	X	X	X	X	X			X	
*	Uruguay		X	X	X	X	X	X	X			X
*	Uzbekistan					X	X	X				
*	Vanuatu											
*	Venezuela, Bolivarian Republic of		X									
*	Viet Nam	X	X	X	X	X	X	X				
*	Yemen						X					
*	Zambia						X					
*	Zimbabwe											

	State/Organization	P&I	ENC	AC	CNS	JC	CPPNM	A-CPPNM	VC	A-VC	CSC	JP
	Euratom		X	X	X	X	X	X				
	FAO		X	X								
	WHO		X	X								
	WMO		X	X								

P&I	Agreement on the Privileges and Immunities of the IAEA
ENC	Convention on Early Notification of a Nuclear Accident
AC	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
CNS	Convention on Nuclear Safety
JC	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
CPPNM	Convention on the Physical Protection of Nuclear Material
A-CPPNM	Amendment to the Convention on the Physical Protection of Nuclear Material
VC	Vienna Convention on Civil Liability for Nuclear Damage
A-VC	Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage
CSC	Convention on Supplementary Compensation for Nuclear Damage
JP	Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention
*	Agency Member State
X	Party

Table A8. Member States that have concluded a Revised Supplementary Agreement (status as of 31 December 2017)

Afghanistan
Albania
Algeria
Angola
Antigua and Barbuda
Argentina
Armenia
Azerbaijan
Bahrain
Bangladesh
Belarus
Belize
Benin
Bolivia, Plurinational State of
Bosnia and Herzegovina
Botswana
Brazil
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Central African Republic
Chad
Chile
China
Colombia
Congo
Costa Rica
Côte d'Ivoire
Croatia
Cuba
Cyprus
Czech Republic
Democratic Republic of the Congo
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Estonia
Ethiopia
Fiji
Gabon
Georgia
Ghana
Greece
Guatemala
Haiti
Honduras
Hungary
Iceland
Indonesia
Iran, Islamic Republic of
Iraq
Ireland
Israel
Jamaica
Jordan
Kazakhstan
Kenya
Korea, Republic of
Kuwait
Kyrgyzstan
Lao People's Democratic Republic
Latvia
Lebanon
Lesotho
Libya
Lithuania
Madagascar
Malawi
Malaysia
Mali
Malta
Marshall Islands
Mauritania
Mauritius
Mexico
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nepal
Nicaragua
Niger
Nigeria
Oman
Pakistan
Palau
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Republic of Moldova
Romania
Rwanda
Saudi Arabia
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Slovakia
Slovenia
South Africa
Spain
Sri Lanka
Sudan
Swaziland
Syrian Arab Republic
Tajikistan
Thailand
The former Yugoslav Republic of Macedonia
Togo
Tunisia
Turkey
Uganda
Ukraine
United Arab Emirates
United Republic of Tanzania
Uruguay
Uzbekistan
Vanuatu
Venezuela, Bolivarian Republic of
Viet Nam
Zambia
Zimbabwe

Table A9. Acceptance of Amendment to Article VI of the Agency's Statute (status as of 31 December 2017)

Afghanistan
Albania
Algeria
Argentina
Austria
Belarus
Bosnia and Herzegovina
Brazil
Bulgaria
Canada
Colombia
Croatia
Cyprus
Czech Republic
Denmark
El Salvador
Estonia
Ethiopia
Finland
France
Germany
Greece
Holy See
Hungary
Iceland
Ireland
Israel
Italy
Japan
Korea, Republic of
Latvia
Libya
Liechtenstein
Lithuania
Luxembourg
Malta
Mexico
Monaco
Morocco
Myanmar
Netherlands
Norway
Pakistan
Panama
Peru
Poland
Portugal
Republic of Moldova
Romania
Slovakia
Slovenia
South Africa
Spain
Sweden
Switzerland
Tunisia
Turkey
Ukraine
United Kingdom
Uruguay

Table A10. Acceptance of Amendment to Article XIV.A of the Agency's Statute (status as of 31 December 2017)

Albania
Algeria
Argentina
Australia
Austria
Belarus
Bosnia and Herzegovina
Brazil
Bulgaria
Canada
Colombia
Croatia
Cyprus
Czech Republic
Denmark
Ecuador
Estonia
Finland
France
Germany
Greece
Holy See
Hungary
Iceland
Iran, Islamic Republic of
Ireland
Italy
Japan
Kenya
Korea, Republic of
Latvia
Liechtenstein
Lithuania
Luxembourg
Malta
Mexico
Monaco
Myanmar
Netherlands
Norway
Pakistan
Peru
Poland
Portugal
Republic of Moldova
Romania
Seychelles
Slovakia
Slovenia
South Africa
Spain
Sweden
Switzerland
Syrian Arab Republic
Tunisia
Turkey
Ukraine
United Kingdom

Table A11. Conventions negotiated and adopted under the auspices of the Agency and/or for which the Director General is the depositary (status and relevant developments)

Agreement on the Privileges and Immunities of the IAEA (reproduced in INFCIRC/9/Rev.2). In 2017, the status of the Agreement remained unchanged with 84 Parties.

Convention on Early Notification of a Nuclear Accident (reproduced in INFCIRC/335). Entered into force on 27 October 1986. In 2017, 1 State became a Party to the Convention. By the end of the year, there were 121 Parties.

Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (reproduced in INFCIRC/336). Entered into force on 26 February 1987. In 2017, 2 States became Parties to the Convention. By the end of the year there were 115 Parties.

Convention on Nuclear Safety (reproduced in INFCIRC/449). Entered into force on 24 October 1996. In 2017, 5 States became Parties to the Convention. By the end of the year, there were 83 Parties.

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (reproduced in INFCIRC/546). Entered into force on 18 June 2001. In 2017, 3 States became Parties to the Convention. By the end of the year, there were 76 Parties.

Convention on the Physical Protection of Nuclear Material (reproduced in INFCIRC/274/Rev.1). Entered into force on 8 February 1987. In 2017, 1 State became a Party to the Convention. By the end of the year, there were 155 Parties.

Amendment to the Convention on the Physical Protection of Nuclear Material. Entered into force on 8 May 2016. In 2017, 9 States adhered to the Amendment. By the end of the year, there were 115 Parties.

Vienna Convention on Civil Liability for Nuclear Damage (reproduced in INFCIRC/500). Entered into force on 12 November 1977. In 2017, the status of the Convention remained unchanged with 40 Parties.

Optional Protocol Concerning the Compulsory Settlement of Disputes (reproduced in INFCIRC/500/Add.3). Entered into force on 13 May 1999. In 2017, the status of the Protocol remained unchanged with 2 Parties.

Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage (reproduced in INFCIRC/566). Entered into force on 4 October 2003. In 2017, the status of the Protocol remained unchanged with 13 Parties.

Convention on Supplementary Compensation for Nuclear Damage (reproduced in INFCIRC/567). Entered into force on 17 April 2015. In 2017, 1 State became a Party to the Convention. By the end of the year, there were 10 Parties.

Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (reproduced in INFCIRC/402). Entered into force on 27 April 1992. In 2017, the status of the Protocol remained unchanged with 28 Parties.

Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA). In 2017, 2 States concluded an RSA. By the end of the year, there were 134 States party to an RSA Agreement.

Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology, 2017 (2017 RCA) (reproduced in INFCIRC/919). Entered into force on 11 June 2017. In 2017, 15 States became Parties to the Agreement. By the end of the year, there were 15 Parties.

African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) (Fifth Extension) (reproduced in INFCIRC/377/Add.20). Entered into force on 4 April 2015. In 2017, 10 States became Parties to the Agreement. By the end of the year, there were 37 Parties.

Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) (First Extension) (reproduced in INFCIRC/582/Add.4). Entered into force on 5 September 2015. In 2017, 2 States became Parties to the Agreement. By the end of the year, there were 21 Parties.

Co-operative Agreement for Arab States in Asia for Research, Development and Training Related to Nuclear Science and Technology (ARASIA) (Second Extension) (reproduced in INFCIRC/613/Add.3). Entered into force on 29 July 2014. In 2017, the status of the Agreement remained unchanged with 9 Parties.

Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project (reproduced in INFCIRC/702). Entered into force on 24 October 2007. In 2017, the status of the Agreement remained unchanged with 7 Parties.

Agreement on the Privileges and Immunities of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project (reproduced in INFCIRC/703). Entered into force on 24 October 2007. In 2017, the status of the Agreement remained unchanged with 6 Parties.

Table A12. Nuclear power reactors in operation and under construction in the world (as of 31 December 2017)[a]

Country	Reactors in operation		Reactors under construction		Nuclear electricity supplied in 2017		Total operating experience through 2017	
	No. of units	Total MW(e)	No. of units	Total MW(e)	TW·h	% of total	Years	Months
Argentina	3	1 633	1	25	5.7	4.5	82	2
Armenia	1	375			2.4	32.5	43	8
Bangladesh			1	1 080				
Belarus			2	2 220				
Belgium	7	5 918			40.2	49.9	289	7
Brazil	2	1 884	1	1 340	14.9	2.7	53	3
Bulgaria	2	1 926			14.9	34.3	163	3
Canada	19	13 554			95.1	14.6	731	6
China	39	34 514	18	19 016	232.8	3.9	280	9
Czech Republic	6	3 930			26.8	33.1	158	10
Finland	4	2 769	1	1 600	21.6	33.2	155	4
France	58	63 130	1	1 630	381.8	71.6	2 164	4
Germany	7	9 515			72.2	11.6	832	7
Hungary	4	1 889			15.2	50.0	130	2
India	22	6 255	7	4 824	34.9[b]	3.2	482	11
Iran, Islamic Republic of	1	915			6.4	2.2	6	4
Japan	42	39 752	2	2 653	29.3	3.6	1 823	5
Korea, Republic of	24	22 494	4	5 360	141.3	27.1	523	5
Mexico	2	1 552			10.6	6.0	51	11
Netherlands	1	482			3.3	2.9	73	0
Pakistan	5	1 318	2	2 028	8.1	6.2	72	5
Romania	2	1 300			10.6	17.7	31	11
Russian Federation	35	26 142	7	5 520	190.1	17.8	1 261	9
Slovakia	4	1 814	2	880	14.0	54.0	164	7
Slovenia	1	688			6.0	39.1	36	3

Country	Reactors in operation		Reactors under construction		Nuclear electricity supplied in 2017		Total operating experience through 2017	
	No. of units	Total MW(e)	No. of units	Total MW(e)	TW·h	% of total	Years	Months
South Africa	2	1 860			15.1	6.7	66	3
Spain	7	7 121			55.6	21.2	329	1
Sweden	8	8 629			63.1	39.6	451	0
Switzerland	5	3 333			19.6	33.4	214	11
Ukraine	15	13 107	2	2 070	80.4	55.1	488	6
United Arab Emirates			4	5 380				
United Kingdom	15	8 918			63.9	19.3	1 589	7
United States of America	99	99 952	2	2 234	805.6	20.0	4 309	9
Total [c, d]	**448**	**391 721**	**59**	**60 460**	**2 503.1**		**17 430**	**6**

[a] Data are from the Agency's Power Reactor Information System (PRIS) (*http://www.iaea.org/pris*).

[b] Electricity data for India are based on the provided annual country level value, as data from some individual reactors were not available at the time this report was issued.

[c] The total figures include the following data from Taiwan, China: 6 units, 5052 MW(e) in operation; 2 units, 2600 MW(e) under construction; 30.5 TW·h of nuclear electricity generation, representing 13.7% of the total electricity generated.

[d] The total operating experience also includes shutdown plants in Italy (80 years, 8 months), Kazakhstan (25 years, 10 months), Lithuania (43 years, 6 months) and Taiwan, China (218 years, 1 month).

Table A13. Member State participation in selected Agency activities

Member State	No. of research contracts and agreements	No. of Collaborating Centres	Services provided to Member States					
			ALMERA [a]	Dosimetry audits for radiotherapy	Plant irradiation services	QUANUM [b]	QUAADRIL [c]	QUATRO [d]
Afghanistan								
Albania	1			3				
Algeria	4							
Angola	1			3				
Antigua and Barbuda				3				
Argentina	46		1					
Armenia	2							
Australia	41	1	3					
Austria	19		2		3			
Azerbaijan	1			3				
Bahamas				2				
Bahrain								
Bangladesh	25			14				
Barbados				1				
Belarus	4		1					
Belgium	22		2					
Belize								
Benin	1							
Bolivia, Plurinational State of								
Bosnia and Herzegovina			3	4				
Botswana	1							
Brazil	52	2	4			2		
Brunei Darussalam				3				
Bulgaria	7		2	30	1			
Burkina Faso	6	1			1			

Member State	No. of research contracts and agreements	No. of Collaborating Centres	Services provided to Member States					
			ALMERA [a]	Dosimetry audits for radiotherapy	Plant irradiation services	QUANUM [b]	QUAADRIL [c]	QUATRO [d]
Burundi					1			
Cambodia	1							
Cameroon	6				1			
Canada	35		3					
Central African Republic								
Chad								
Chile	18		1	8		1		
China	84		3	30				
Colombia	7			56				
Congo								
Costa Rica	4	1	1					
Côte d'Ivoire	1				1			
Croatia	13		2	14				
Cuba	13		3	11				
Cyprus			1	3				
Czech Republic	7		1					
Dem. Rep. of the Congo	1							
Denmark	3		1					
Djibouti	1							
Dominica								
Dominican Republic								
Ecuador	1		1	18				
Egypt	21		1			1		
El Salvador				5				
Eritrea								
Estonia	7		1	10				

Member State	No. of research contracts and agreements	No. of Collaborating Centres	Services provided to Member States					
			ALMERA [a]	Dosimetry audits for radiotherapy	Plant irradiation services	QUANUM [b]	QUAADRIL [c]	QUATRO [d]
Ethiopia	8		1					
Fiji								
Finland	8		1					
France	49	2	5					
Gabon								
Georgia	2			6				
Germany	47		3		6			
Ghana	12			2	1			
Greece	15		5					
Guatemala	7			2				
Guyana				1				
Haiti								
Holy See								
Honduras								
Hungary	17	2	2	19	1			
Iceland			1					
India	69	1	3	20				
Indonesia	21	2	1	2				
Iran, Islamic Republic of	13		1					
Iraq	1		1	8	3			
Ireland			1					
Israel	7		2	3		1		
Italy	51	1	8					
Jamaica	6		1	2				
Japan	48	2	1					
Jordan	6		1					

Member State	No. of research contracts and agreements	No. of Collaborating Centres	Services provided to Member States					
			ALMERA [a]	Dosimetry audits for radiotherapy	Plant irradiation services	QUANUM [b]	QUAADRIL [c]	QUATRO [d]
Kazakhstan	2		1	16				
Kenya	12		1	1				
Korea, Republic of	36	2	2					
Kuwait	5		1			1		
Kyrgyzstan								
Lao People's Dem. Rep.	1							
Latvia			1	5				
Lebanon	2		1	5		1		1
Lesotho					1			
Liberia								
Libya								
Liechtenstein								
Lithuania	5		3	6				
Luxembourg			1					
Madagascar	4		1					
Malawi					1			
Malaysia	24	2	1	16		1		
Mali	2				1			
Malta								
Marshall Islands								
Mauritania				2				
Mauritius	4					1		
Mexico	20	2	3	23				
Monaco								
Mongolia	3		1					
Montenegro	2		1	3				

Member State	No. of research contracts and agreements	No. of Collaborating Centres	Services provided to Member States					
			ALMERA [a]	Dosimetry audits for radiotherapy	Plant irradiation services	QUANUM [b]	QUAADRIL [c]	QUATRO [d]
Morocco	18	1	1	10				1
Mozambique								
Myanmar	2		1	3				
Namibia					1			
Nepal	1			2				
Netherlands	12	1	4		4			
New Zealand	3		1					
Nicaragua	1							
Niger								
Nigeria	5			3				
Norway	6		2					
Oman					1			
Pakistan	38		1					
Palau								
Panama	1		1	7				
Papua New Guinea	1							
Paraguay				4				
Peru	9		1	9				
Philippines	10	1	1	8				
Poland	23	1	5		1			
Portugal	9		1					
Qatar			1		2			
Republic of Moldova								
Romania	13		3	31	2			
Russian Federation	47		3	56				1
Rwanda								

Member State	No. of research contracts and agreements	No. of Collaborating Centres	Services provided to Member States					
			ALMERA [a]	Dosimetry audits for radiotherapy	Plant irradiation services	QUANUM [b]	QUAADRIL [c]	QUATRO [d]
Saint Vincent and the Grenadines								
San Marino								
Saudi Arabia	4	1	1	13				
Senegal	7				1			
Serbia	7		5	8				
Seychelles								
Sierra Leone					1			
Singapore	12		1					
Slovakia	5		3					
Slovenia	8		1	5				
South Africa	33		3	20		1		
Spain	38	1	2					
Sri Lanka	11		1	2				
Sudan	5			1	2			
Swaziland								
Sweden	9		2					
Switzerland	5	1	3					
Syrian Arab Republic	6		1					
Tajikistan	1		1					
Thailand	20		2	19		1	1	
The former Yugoslav Republic of Macedonia	5		1	5				
Togo								
Trinidad and Tobago								
Tunisia	6		1	5				

Member State	No. of research contracts and agreements	No. of Collaborating Centres	Services provided to Member States					
			ALMERA [a]	Dosimetry audits for radiotherapy	Plant irradiation services	QUANUM [b]	QUAADRIL [c]	QUATRO [d]
Turkey	17		2	42				
Turkmenistan								
Uganda	7							
Ukraine	23		1	39				
United Arab Emirates	1		2	1		1		
United Kingdom	47		4		3			
United Republic of Tanzania	2			3	1			
United States of America	114	1	7					
Uruguay	12		1					
Uzbekistan	2				2			
Vanuatu								
Venezuela, Bolivarian Republic of	2		2	1				
Viet Nam	21			1				
Yemen								
Zambia	5		1	3				
Zimbabwe				4	2			

[a] ALMERA: Analytical Laboratories for the Measurement of Environmental Radioactivity.

[b] QUANUM: Quality Management Audits in Nuclear Medicine Practices.

[c] QUAADRIL: Quality Assurance Audit for Diagnostic Radiology Improvement and Learning.

[d] QUATRO: Quality Assurance Team for Radiation Oncology.

Table A14. Advisory Missions on Regulatory Infrastructure for Radiation Safety (AMRAS) in 2017

Type	Country
AMRAS	Bahrain
AMRAS	Benin
AMRAS	Brunei Darussalam
AMRAS	Costa Rica
AMRAS	Honduras
AMRAS	Malawi
AMRAS	Panama
AMRAS	Papua New Guinea
AMRAS	Paraguay
AMRAS	Seychelles
AMRAS	Sudan
AMRAS	Vanuatu

Table A15. Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) missions in 2017

Type	Country
ARTEMIS	Italy
ARTEMIS	Poland

Table A16. Education and Training Appraisal (EduTA) missions in 2017

Type	Country
EduTA	Argentina
EduTA	United Arab Emirates

Table A17. Emergency Preparedness Review (EPREV) missions in 2017

Type	Country
EPREV	Slovenia

Table A18. Integrated missions of the Agency's Programme of Action for Cancer Therapy (imPACT) in 2017

Type	Country
imPACT	Burundi
imPACT	Democratic Republic of the Congo
imPACT	Swaziland
imPACT	Togo

Table A19. Integrated Nuclear Infrastructure Review (INIR) missions in 2017

Type	Country
INIR	Ghana

Table A20. Integrated Safety Assessment of Research Reactors (INSARR) missions in 2017

Type	Country
INSARR	Jamaica
INSARR	Kazakhstan
INSARR	Norway
INSARR follow-up	Poland
INSARR follow-up	Turkey

Table A21. International Physical Protection Advisory Service (IPPAS) missions in 2017

Type	Country
IPPAS	China
IPPAS	Democratic Republic of the Congo
IPPAS	Germany
IPPAS	Lithuania
IPPAS follow-up	Australia
IPPAS follow-up	Hungary

Table A22. Integrated Regulatory Review Service (IRRS) missions in 2017

Type	Country
IRRS	Botswana
IRRS	Cyprus
IRRS	Ethiopia
IRRS	Guatemala
IRRS	Nigeria
IRRS	The former Yugoslav Republic of Macedonia
IRRS follow-up	Belgium
IRRS follow-up	Czech Republic
IRRS follow-up	France
IRRS follow-up	Greece
IRRS follow-up	Jordan
IRRS follow-up	Poland
IRRS follow-up	Romania

Table A23. Independent Safety Culture Assessment (ISCA) missions in 2017

Type	Country
ISCA	Netherlands

Table A24. Knowledge Management Assist Visit (KMAV) missions in 2017

Type	Organization/nuclear power plant	Country
KMAV	Daya Bay nuclear power plant	China
KMAV	CEZ, a.s. and Temelin nuclear power plant	Czech Republic
KMAV	Ignalina nuclear power plant	Lithuania
KMAV	Joint-Stock Company Atomstroyexport	Russian Federation
KMAV	Slovenské Elektrárne and Mochovce nuclear power plant	Slovakia

Table A25. Occupational Radiation Protection Appraisal Service (ORPAS) missions in 2017

Type	Country
ORPAS	Chile
ORPAS	Malaysia
ORPAS	Morocco
ORPAS	Paraguay
ORPAS preparatory	Nicaragua
ORPAS preparatory	Panama

Table A26. Operational Safety Review Team (OSART) missions in 2017

Type	Country
OSART	China
OSART	Finland
OSART	France
OSART	Russian Federation
OSART	Slovenia
OSART	United Arab Emirates
OSART	United States of America
OSART follow-up	Canada
OSART follow-up	France
OSART follow-up	Japan
OSART follow-up	Netherlands
OSART follow-up	Pakistan
OSART follow-up	Russian Federation
OSART follow-up	United Kingdom

Table A27. Peer Review of Operational Safety Performance Experience (PROSPER) missions in 2017

Type	Country
PROSPER	Russian Federation (two missions)

Table A28. Safety Aspects of Long Term Operation (SALTO) missions in 2017

Type	Country
SALTO	Belgium
SALTO	China
SALTO	Sweden
SALTO follow-up	Mexico
SALTO preparatory	Brazil
SALTO preparatory	Sweden
SALTO preparatory	Ukraine

Table A29. Site and External Events Design (SEED) missions in 2017

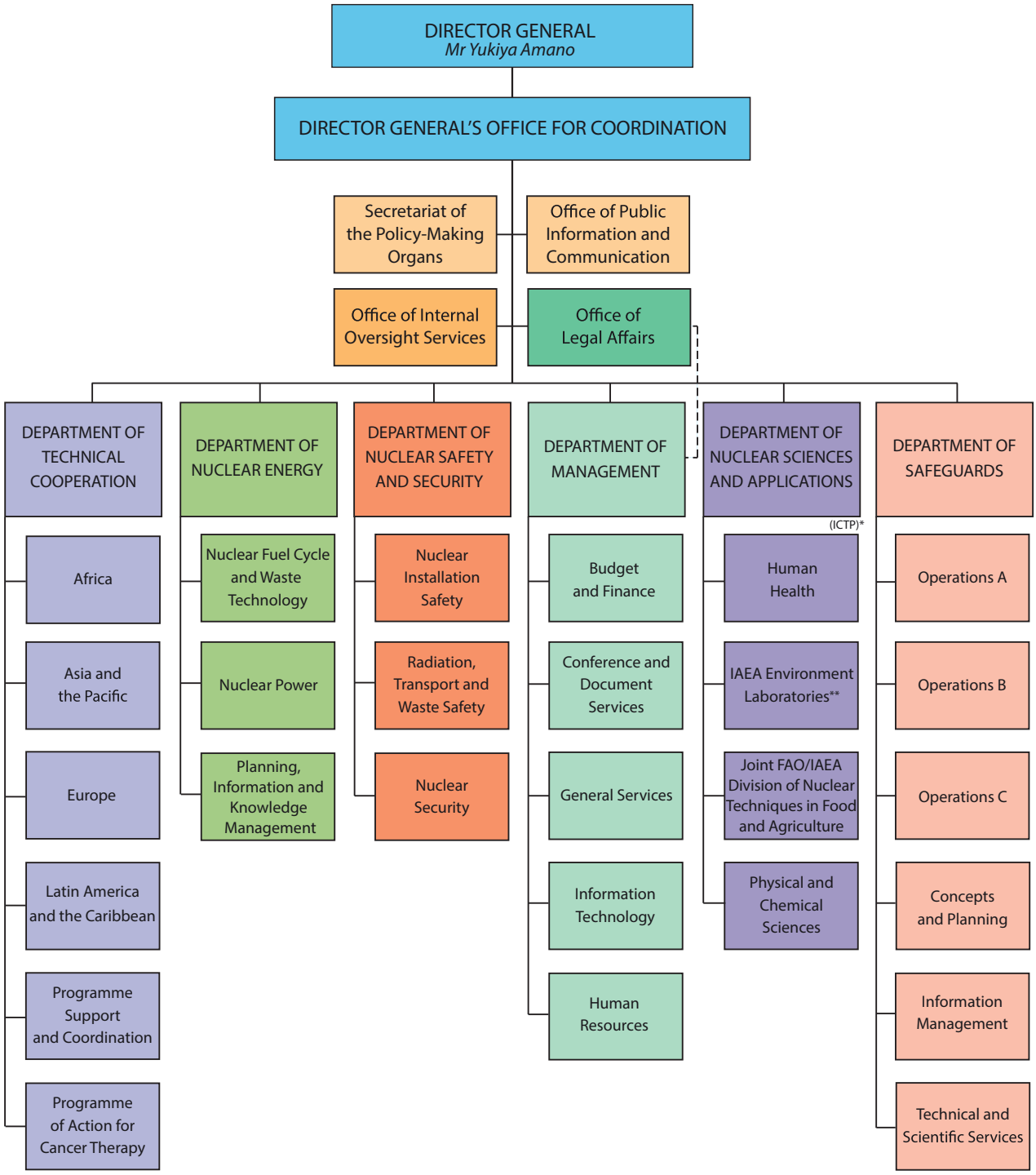
Type	Country
SEED	Belarus
SEED	Indonesia
SEED	Korea, Republic of
SEED	Turkey
SEED	Uganda
SEED preparatory	Korea, Republic of
SEED preparatory	Thailand
SEED preparatory	Turkey

Table A30. IAEA-designated International Centres based on Research Reactors (ICERR) added in 2017

Type	Organization/Research centre	Country
ICERR	Nuclear Research Centre SCK•CEN	Belgium
ICERR	Idaho and Oak Ridge National Laboratories of the US Department of Energy	United States of America

ORGANIZATIONAL CHART

(as of 31 December 2017)



* 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.

"The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world."

Article II of the IAEA Statute

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Atoms for Peace and Development

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GC(62)/3