IAEA ANNUAL REPORT 2014

IAEA
International Atomic Energy Agency

IAEA Annual Report 2014

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 2014.

GC(59)/7

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Member States of the International Atomic Energy Agency

(as of 31 December 2014)

AFGHANISTAN
ALBANIA
ALGERIA
ANGOLA
ARGENTINA
ARMENIA
AUSTRALIA
AUSTRIA
AZERBAIJAN
BAHAMAS
BAHRAIN
BANGLADESH
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
DOMINICA
DOMINICAN REPUBLIC
ECUADOR
EGYPT
EL SALVADOR
ERITREA
ESTONIA
ETHIOPIA
FIJI
FINLAND
FRANCE
GABON
GEORGIA
GERMANY
GHANA
GREECE
GUATEMALA
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
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
UGANDA
UKRAINE
UNITED ARAB EMIRATES
UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
UNITED REPUBLIC OF TANZANIA
UNITED STATES OF AMERICA
URUGUAY
UZBEKISTAN
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 2014)

162 Member States.

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

57 years of international service.

2560 professional and support staff.

€342 million total Regular Budget for 2014.[1] Extrabudgetary expenditures in 2014 totalled **€68.3 million.**

€69.2 million target in 2014 for voluntary contributions to the Agency's Technical Cooperation Fund, supporting projects involving **3461** expert and lecturer assignments, **5285** meeting participants and other project personnel, **2830** participants in **187** regional and interregional training courses and **1677** fellows and scientific visitors.

131 Member States participating in the Agency's technical cooperation programme, including **33** least developed countries.

1092 active technical cooperation projects at the end of 2014.

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

8 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 agreements relating to nuclear science and technology.

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

125 active CRPs involving **1641** approved research, technical and doctoral contracts and research agreements. In addition, **73** Research Coordination Meetings were held.

18 national donors to the voluntary Nuclear Security Fund.

180 States in which safeguards agreements were being implemented,[2,3] of which **124** States had additional protocols in force, with **2114** safeguards inspections performed in 2014. Safeguards expenditures in 2014 amounted to **€124.4 million** in the operational portion of the Regular Budget and **€21.8 million** in extrabudgetary resources.

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

20 million pages read by nearly **6 million** people on the Agency's *iaea.org* site during 2014, and **192 000** subscribers to the Agency's social media channels on Twitter and Facebook.

3.7 million records in the International Nuclear Information System (INIS), the Agency's largest database, with over **492 000** full texts and **3.4 million** page views and **420 000** document downloads in 2014.

1.1 million documents, technical reports, standards, conference proceedings, journals and books in the IAEA Library and **14 000** visitors to the Library in 2014.

186 publications, including newsletters, issued in 2014 (in print and electronic formats).

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1 At the UN average rate of exchange of US $1.3316 to €1.00. The total Regular Budget was €352.7 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. Among its functions, the Board adopts the Agency's programme for the incoming biennium and makes recommendations on the Agency's budget to the General Conference.

In the area of nuclear technologies, the Board considered the *Nuclear Technology Review 2014*.

In the area of safety and security, the Board kept implementation of the IAEA Action Plan on Nuclear Safety, approved in 2011, under review throughout the year. The Board discussed the *Nuclear Safety Review 2014* and also debated the *Nuclear Security Report 2014*.

As regards verification, the Board considered the *Safeguards Implementation Report for 2013* and also considered the issue of the conceptualization and development of safeguards implementation at the State level. It approved a number of safeguards agreements and additional protocols. The Board kept under its consideration the implementation of the NPT Safeguards Agreement and relevant provisions of United Nations Security Council resolutions in the Islamic Republic of Iran, the implementation of the 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 2013* and approved the Agency's technical cooperation programme for 2015.

The Board approved the recommendations contained in the *Report of the Working Group on Financing the Agency's Activities, including to examine the ways and means to render resources for the Technical Cooperation Fund sufficient, assured and predictable*.

Composition of the Board of Governors (2014–2015)

Chair:

Ms. Marta ŽIAKOVÁ
Governor from Slovakia

Vice-Chairs:

HE Ms. Christine STIX-HACKL
Ambassador
Governor from Austria

HE Mr. Khaled ABDELRAHMAN SHAMAA
Ambassador
Governor from Egypt

Argentina
Australia
Austria
Bosnia and Herzegovina
Brazil
Canada
Chile
China
Egypt
Finland
France
Germany
India
Ireland
Japan
Kenya
Malaysia
Mexico
New Zealand
Nigeria
Peru
Qatar
Russian Federation
Saudi Arabia
Slovakia
South Africa
Spain
Sudan
Switzerland
The former Yugoslav Republic of Macedonia
United Arab Emirates
United Kingdom of Great Britain and Northern Ireland
United States of America
Venezuela, Bolivarian Republic of
Viet Nam

The General Conference

The General Conference comprises all Member States of the Agency and meets once a year. It debates the annual report of the Board of Governors on the Agency's activities during the previous year, approves the Agency's financial statements and budget, approves any applications for membership, and elects members to the Board of Governors. It also conducts a wide ranging general debate on the Agency's policies and programmes and passes resolutions directing the priorities of the Agency's work.

In 2014, the Conference — upon the recommendation of the Board — approved the Co-operative Republic of Guyana, the Republic of Djibouti, the Republic of Vanuatu and the Union of the Comoros for membership of the Agency. At the end of 2014, the Agency's membership was 162.

Notes

- The *IAEA Annual Report 2014* aims to summarize only the significant activities of the Agency during the year in question. The main part of the report, starting on page 25, generally follows the programme structure as given in *The Agency's Programme and Budget 2014–2015* (GC(57)/2).
- 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 for 2014 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 8 June 2015, the Board of Governors approved the Annual Report for 2014 for transmission to the General Conference.

Abbreviations

ABACC	Brazilian–Argentine Agency for Accounting and Control of Nuclear Materials
AFRA	African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
AFRA-NEST	AFRA Network for Education in Science and Technology
AGaRT	Advisory Group on Increasing Access to Radiotherapy 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
CNS	Convention on Nuclear Safety
COP20	20th session of the Conference of the Parties (UNFCCC)
CPPNM	Convention on the Physical Protection of Nuclear Material
CRP	coordinated research project
CSA	comprehensive safeguards agreement
DSRS	disused sealed radioactive source
ECAS	Enhancing Capabilities of the Safeguards Analytical Services
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
ICTP	Abdus Salam International Centre for Theoretical Physics
IEC	Incident and Emergency Centre (IAEA)
IEM	international experts meeting
INFCIRC	Information Circular (IAEA)
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
INTERPOL	International Criminal Police Organization – INTERPOL
IPCC	Intergovernmental Panel on Climate Change
IRRS	Integrated Regulatory Review Service

ITDB	Incident and Trafficking Database (IAEA)
Joint Division	Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture
JPA	Joint Plan of Action
JPLAN	Joint Radiation Emergency Management Plan of the International Organizations
LANENT	Latin American Network for Education in Nuclear Technology
LEU	low enriched uranium
NCD	non-communicable disease
NEMS	Nuclear Energy Management School
NESA	Nuclear Energy System Assessment
NGSS	next generation surveillance system
NKMS	Nuclear Knowledge Management School
NPCs	National Participation Costs
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
OA-ICC	Ocean Acidification International Coordination Centre
OECD	Organisation for Economic Co-operation and Development
OECD/NEA	OECD Nuclear Energy Agency
OIC	Organisation of Islamic Cooperation
PACT	Programme of Action for Cancer Therapy (IAEA)
PUI	Peaceful Uses Initiative
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
SDG	sustainable development goal
SQP	small quantities protocol
SSAC	State system of accounting for and control of nuclear material
SSDL	secondary standards dosimetry laboratory
TCF	Technical Cooperation Fund
UNCT	United Nations Country Team
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WHO	World Health Organization

Overview

Since its creation almost sixty years ago, the International Atomic Energy Agency has continuously pursued and adapted its programme of work — within the framework of its Statute — to meet the changing needs and goals of its Member States. The Agency's range of activities in 2014 focused, in a balanced manner, on promoting peaceful applications of nuclear science and technology, enhancing nuclear safety and security, helping to strengthen global nuclear verification and non-proliferation efforts, and, through its technical cooperation programme, ensuring that the benefits of nuclear science and technology are shared by all of its Member States for their economic and social development.

The following is a survey of worldwide nuclear related developments and highlights in 2014 and how they were addressed through the work of the Agency.

NUCLEAR TECHNOLOGY

Nuclear Power

Status and trends

"With 438 reactors in operation around the world, the total generating capacity of nuclear energy reached 376.2 gigawatts (electrical) (GW(e)) at the end of 2014."

With 438 reactors in operation around the world, the total generating capacity of nuclear energy reached 376.2 gigawatts (electrical) (GW(e)) at the end of 2014. During the year, five reactors were connected to the grid, one was permanently shut down and construction started on three reactors. Asia remained the centre of near and long term growth prospects, accounting for 46 of the 70 reactors under construction.

The Agency's projections for 2030 showed an increase in global nuclear power capacity of 8% in the low case and 88% in the high case scenario. These projections were lower than those of 2013, mainly due to earlier than anticipated retirements of plants and a reduction in the number of planned new plants in some countries. Nevertheless, interest in nuclear power remains strong in some regions, particularly in countries with fast growing energy needs.

Major conferences

In May, the International Conference on Human Resource Development for Nuclear Power Programmes: Building and Sustaining Capacity, held at the Agency's Headquarters in Vienna, attracted over 300 participants from 65 Member States and five international organizations. The conference noted that more systematic training approaches were being used globally in the nuclear field and that development across the skills pyramid was improving. Countries were encouraged to join existing networks and to undertake capacity building self-assessments.

In October, the 25th IAEA Fusion Energy Conference (FEC 2014) was held in St Petersburg, Russian Federation. Participants reviewed the recent advances and achievements in physics and technology required for the demonstration of electricity production from fusion, as well as the substantial progress in the construction of the International Thermonuclear Experimental Reactor (ITER), a project to demonstrate self-sustained fusion energy generation in excess of 500 megawatts. The conference identified the following key areas for focus in the future: blanket and radiochemistry technologies; systems integration; technologies for the steady-state operation of fusion systems; and technologies for fusion–fission hybrid systems.

New developments in uranium exploration, mining and processing were highlighted in some 90 presentations given at the International Symposium on Uranium Raw Material for the Nuclear Fuel Cycle: Exploration, Mining, Production, Supply and Demand, Economics and Environmental Issues (URAM-2014). Held at the Agency's Headquarters in June, the symposium attracted over 250 experts from 60 countries. Among the new initiatives presented were innovative financing, the use of advanced technologies in 'smart mines', integrated exploration and 'wealth from wastes'. Issues emerging from the symposium included: the need for priority attention to social licensing and stakeholder engagement; the rollout of new technologies across the mining life cycle; and the focus on sustainable recovery and replacement of low cost resources.

Climate change and sustainable development

The 20th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP20), held in December in Lima, Peru, adopted the Lima Call for Climate Action as an important step towards the 2015 agreement on climate change. The Agency publication *Climate Change and Nuclear Power 2014*, launched at COP20, presented new evidence from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report on the urgency of mitigating anthropogenic climate change. The publication also reiterated that, on a life cycle basis, hydropower, nuclear power and wind emit the smallest amounts of greenhouse gases per kilowatt-hour of electricity produced. The book emphasized the importance of nuclear power in providing energy supply security and other environmental and macroeconomic benefits.

Energy assessment services

The Agency continued to assist Member States, upon request, in conducting energy planning studies to evaluate the potential contribution of different energy technologies, including nuclear power, to meeting future needs. In 2014, pre-feasibility studies for introducing nuclear power in Egypt and Jordan were completed. Capacity building efforts continued for conducting Nuclear Energy System Assessments (NESAs) according to the methodology developed by the Agency's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO). In 2014, NESAs were under way in Indonesia, Romania and Ukraine.

Support to operating nuclear power plants

One of the main challenges for long term operation of nuclear power plants is to develop and implement ageing management programmes to assess the integrity of essential structures and systems, and the remaining lifetime of critical components. The Agency has developed programmatic as well as component specific guidelines on ageing management, maintenance optimization and outage management programmes. In October, in Charlotte, United States of America, the Agency held a Technical Meeting on Ageing Management of

Buried and Underground Piping and Tanks at Nuclear Power Plants. Thirty-six participants reviewed draft guidelines on buried and underground piping and tanks.

Launching nuclear power programmes

Over 30 countries are considering, planning or starting a nuclear power programme. During the year, Bangladesh, Jordan, Turkey and Viet Nam made progress on their first nuclear power plant projects. The Agency supported these and other countries in preparing the infrastructure necessary for introducing nuclear power through services such as Integrated Nuclear Infrastructure Review (INIR) missions. An INIR mission to Jordan and a follow-up INIR mission to Viet Nam were conducted in 2014. Belarus and the United Arab Emirates continued constructing their first nuclear power plants during the year, with construction starting on Unit 2 at Ostrovets and on Unit 3 at Barakah, respectively.

Management of nuclear power programmes

The Agency continued to provide support to both newcomer countries and countries with established nuclear power programmes in human resource development, training, stakeholder involvement and management systems. New guidance materials were published and four new e-learning modules on the 'Milestones' approach were launched, bringing to 11 the number of modules available on the Agency's web site. Two Safety Aspects of Long Term Operation (SALTO) missions, the first to the Ringhals nuclear power plant in Sweden in February and the second to the Dukovany nuclear power plant in the Czech Republic in November, looked into the human resource aspects of safe operation.

"The Agency continued to provide support… in human resource development, training, stakeholder involvement and management systems."

Assurance of supply

In 2014, further progress was made on the financial, legal and technical arrangements for establishing the IAEA LEU [low enriched uranium] Bank in Kazakhstan. This included a comprehensive technical assessment of the facility proposed for the IAEA LEU Bank. In 2014, an assessment of the programmatic impact of seismic safety on the overall IAEA LEU Bank project was undertaken to determine whether a geological fault that exists in close proximity to the proposed site has the potential to affect the safety of the IAEA LEU Bank. Based on the outcome of this programmatic risk assessment, the Agency and Kazakhstan concluded with confidence that the IAEA LEU Bank can be established at the Ulba Metallurgical Plant (UMZ) site. Throughout the year, progress continued to be made on the Host State Agreement (HSA) for the IAEA LEU Bank and, separately, with the Russian Federation on a draft transit agreement for the IAEA LEU Bank, as well as on the completion of several technical agreements subsidiary to the HSA and other arrangements needed for the IAEA LEU Bank.

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

Uranium resources

The Agency and the OECD Nuclear Energy Agency jointly published *Uranium 2014: Resources, Production and Demand*, also known as the 'Red Book'. The report estimates global identified conventional uranium resources recoverable at a cost of less than US$ 260 per kilogram of uranium to be about 7.6 million tonnes of uranium. Also in 2014, the Agency provided focused assistance to Burkina Faso, Cameroon and Niger through a Peaceful Uses Initiative (PUI) project to support sustainable uranium mining in areas with less developed technical capacity.

Technology development and innovation

Agency activities continued to address the potential challenges for near term deployment of advanced reactors. During the year, enhanced versions of the tools developed by the Agency for economic assessment of desalination and evaluation of hydrogen production were made available to Member States. Bangladesh joined INPRO as its 40th member. Two INPRO Dialogue Forums held during the year addressed sustainability in the areas of nuclear energy system economics, resource availability and institutional arrangements, as well as good practices in the development of international collaboration mechanisms supporting R&D and innovation in nuclear energy system technology.

Research reactors

Member States were supported in various aspects of construction, operation, and utilization of research reactors through networks and coalitions, outreach activities, and training, as well as through guidance provided in a number of Agency publications issued in 2014. The Agency continued to assist with the minimization of the civilian use of high enriched uranium (HEU) by supporting Member State requests to convert research and test reactors from the use of HEU fuel to LEU fuel and to repatriate the HEU to its country of origin. The 5th Technical Meeting on the Conversion of Miniature Neutron Source Reactors from High Enriched Uranium to Low Enriched Uranium Fuel, held at the Agency's Headquarters in December, was attended by 23 participants from eight Member States. During the year, 53 kg of HEU fuel from Poland and 10.2 kg of fresh HEU fuel and 37.3 kg of spent HEU fuel from Kazakhstan was repatriated to the Russian Federation.

Nuclear data

In 2014, the Agency marked 50 years of providing a wide range of nuclear, atomic and molecular databases essential for a large variety of power applications and non-power applications such as nuclear medicine and radioisotope production. Commemorative activities included an event held at Headquarters in June highlighting the work undertaken in nuclear data collection to support Member States in the peaceful use of nuclear technology. The anniversary event included an exhibition of photographs and equipment as well as presentations by current and former staff, who shared their memories and views of the past 50 years. The event preceded the 30th meeting of the International Nuclear Data Committee (INDC), composed of Member State experts who review and advise on the Agency's nuclear data related activities. Also in 2014, the Isotope Browser, introduced in 2013 as an Android app, was made available as an app for Apple devices, facilitating access to information.

Accelerator applications

Accelerator based technologies serve social and economic development, and have a wide variety of applications in the energy, health, agriculture, environment, materials, natural resources and education sectors. The Agency continued its efforts to build capacity in accelerator applications. In 2014, the new beam line at the Elettra synchrotron facility in Trieste, Italy, was inaugurated, enabling greater access for scientists from developing countries to carry out related research and measurements.

SCIENTIFIC FORUM 2014

Nuclear technologies provide many benefits for people worldwide; however, in the process they produce radioactive waste, which must be safely and securely managed and disposed of. More than 300 participants attended the Agency's Scientific Forum on Radioactive Waste: Meeting the Challenge — Science and Technology for Safe and Sustainable Solutions, held at Headquarters in September, during the 58th regular session of the Agency's General Conference. Experts and representatives of organizations from around the world discussed integrated approaches to radioactive waste management, highlighting that safe, sustainable and viable solutions are available for implementation.

Nuclear Sciences and Applications

Nuclear technologies and techniques make many contributions to the achievement of sustainable development goals (SDGs) in Member States. In 2014, the Agency continued to assist Member States in building, strengthening and maintaining capacities in the safe, peaceful and secure use of nuclear technology in their efforts to achieve the Millennium Development Goals.

The Renovation of the Nuclear Applications Laboratories (ReNuAL) project officially began on 1 January 2014. The project aims to modernize the Agency's Laboratories in Seibersdorf to ensure that they continue to provide essential services to meet the growing needs of Member States. A team of architects and engineers carried out a feasibility study to determine each laboratory's needs and the most efficient way to conduct the renovation. In February, a set of briefs describing the activities and requirements of each laboratory in Seibersdorf was presented to Member States. Based on the team's study, the Strategy for the Renovation of the Nuclear Sciences and Applications Laboratories in Seibersdorf was developed and presented to the Board of Governors at its June meeting.

A site development plan identifying land in Seibersdorf to accommodate the buildings to be constructed under ReNuAL was completed in October, and the conceptual designs for these buildings were completed in November. A donor package providing detailed information on the project and its requirements was made available to Member States in December.

In total, approximately €3 million was raised during the year, with several Member States providing extrabudgetary resources or making commitments to support project planning and the acquisition of urgently needed equipment.

Water resources

Water security is key to the post-2015 United Nations development agenda, and there is a proposal to include a specific goal for water in the SDGs to be finalized in 2015.

The role of nuclear techniques in water resource management is essential. Groundwater is used to meet nearly half the global freshwater demand for drinking and irrigation. The need for sound assessments of groundwater availability was highlighted again in 2014 by persistent drought in several parts of the world. The Agency developed a method to use the isotopes of helium gas for reliably estimating groundwater age. Throughout the year, it continued to assist Member States in using these and other isotope techniques for groundwater assessments — including the assessment of the Guaraní aquifer shared by Argentina, Brazil, Paraguay and Uruguay — both to meet the demand for freshwater resources and to mitigate the impacts of climate change.

Food and agriculture

In 2014, outbreaks of avian influenza H5N1 and H7N9, the spread of Africa swine fever from Africa to Europe, and the outbreaks of bluetongue in Central and Western Europe highlighted the threat to human and animal health posed by transboundary animal diseases. In response, the Agency continued its work developing diagnostic tools for the early detection of animal and zoonotic diseases. During the year, nucleic acid amplification platform technologies such as polymerase chain reaction were developed and validated at the Animal Production and Health Laboratory in Seibersdorf. These advanced and sensitive techniques are capable of detecting disease indicators in extremely small amounts and at very early stages of the disease. In 2014, the Agency made contributions based on these techniques to the global efforts to combat the Ebola virus disease, responding quickly and effectively to urgent Member State needs.

The development of food control laboratories assists in the efficient and sustainable transfer of know-how and nuclear related techniques, targeting research and development priorities to solve food and environmental protection issues encountered in Member States. The Latin American and Caribbean Analytical Network (RALACA), established in 2012 with six member countries, expanded to 49 laboratories in 19 countries in 2014. This network provides a unique means of assisting Member States in gaining access to knowledge and skills from laboratories in other countries. RALACA has enhanced the application of nuclear techniques in food safety control programmes, including the use of radioimmunoassay techniques, stable isotope measurements and radiotracer applications. The network is now being used as a template for extending the food control laboratory initiative to Africa.

"In 2014, the Agency made contributions… to the global efforts to combat the Ebola virus disease, responding quickly and effectively to urgent Member State needs."

Radioisotope production and radiation technology

The Agency addressed Member State concerns about possible future shortages of molybdenum-99 (^{99}Mo) in 2014. The decay product of ^{99}Mo is technetium-99m (^{99m}Tc), the most widely used medical isotope in the world. A side event held during the 58th General Conference entitled 'Medical Radioisotope Mo-99: Supply Challenges, Crisis Mitigation Efforts and Alternatives' highlighted the ^{99}Mo supply challenges as well as new alternatives, focusing on the role of Agency initiatives and support to Member States in efforts to overcome shortages of ^{99}Mo/^{99m}Tc.

Threats to human health and the environment resulting from increasing industrialization are global causes for concern. Radiation technologies contribute to mitigating some negative environmental impacts of industrial processes by providing novel, environmentally friendly materials and processes, and by treating polluted industrial effluents to render them harmless. A Technical Meeting on the Deployment of Green Radiation Technology for Environmental Remediation, held at the Agency's Headquarters in Vienna in June, addressed the need to create a forum for radiation technologists and stakeholders to discuss the technical and commercial feasibility of applying radiation technologies to help industries mitigate their environmental impact and meet new pollution discharge regulations. The meeting concluded that the potential of radiation technology for mitigating a variety of pollutants in solid, liquid and gas phases has now been well demonstrated and that suitable radiation sources are available to meet industrial requirements.

Environment

Environmental monitoring remained an area of focus during the year, particularly monitoring of the marine environment. To support Member States in studying marine pollution processes and assessing the state of the marine environment, the Agency further developed methods for determining long lived radionuclides and stable and radiogenic

lead isotopes in seawater and sediment. Two methodologies for precise quantification of uranium and uranium isotope ratios in seawater were developed. The methodologies were applied to seawater samples from different regions of the world, including the Antarctic region and the Mediterranean, Irish and Black Seas. The results obtained for uranium and uranium isotope ratios can be used to track the sources of marine pollution.

To assist Member States in improving the quality of their laboratory analyses of marine and terrestrial samples, seven new reference materials were prepared in 2014. During the year, more than 540 laboratories participated in proficiency tests for radionuclides in terrestrial and marine samples as quality control measures.

Experimental work to assess the impact of marine stressors such as climate change and ocean acidification on ecosystem services intensified in 2014 in parallel with increased capacity building activities. The Agency helped set up laboratories in several Member States for experimental work on ocean acidification and harmful algal bloom detection.

Human health

Malnutrition in early life can lead to lifelong disadvantages such as diminished cognitive development and a higher risk of metabolic disorders and chronic diseases. The Agency is assisting Member States in evaluating programmes designed to prevent and treat malnutrition in early life using stable isotope techniques. These techniques are used to assess changes in body composition and the bioavailability of nutrients in foods used to prevent and treat malnutrition. In May, the Agency hosted an International Symposium on Understanding Moderate Malnutrition in Children for Effective Interventions. Held at Agency Headquarters and attracting over 350 participants from 63 countries, the symposium determined that better tools are required to evaluate interventions to prevent and treat moderate malnutrition and that the Agency is making an important contribution to capacity building in this area.

"In 2014, the main focus was on developing guidelines on quality control and on education and training of medical physicists for the safe and effective use of radiation technology."

The Agency also continued to make important contributions to expanding the use of radiation medicine for the diagnosis and treatment of disease. In 2014, the main focus was on developing guidelines on quality control and on education and training of medical physicists for the safe and effective use of radiation technology. The Agency published *Diagnostic Radiology Physics: A Handbook for Teachers and Students*, which was endorsed by the American Association of Physicists in Medicine, the Asia–Oceania Federation of Organizations for Medical Physics and the European Federation of Organisations for Medical Physics, and is expected to become a reference textbook for postgraduate medical physics education programmes.

The use of proton therapy to treat cancer is currently restricted owing to the high cost of the equipment. To investigate the relevance of this emerging technology for low and middle income countries, the Agency conducted a Consultants Meeting on Particle Therapy in the 21st Century: Relevance to Developing Countries. The meeting, held at Headquarters in November, brought together 11 world experts in the field of particle therapy.

The Agency has been assisting Member States in developing competencies and capabilities in the safe and efficient practice of nuclear medicine. This year, a harmonized, open access, web based learning programme to support continuing professional development of nuclear medicine professionals was made available through the Agency's Human Health Campus.

NUCLEAR SAFETY AND SECURITY

Nuclear Safety

The global nuclear community continued to make steady progress in strengthening nuclear safety throughout the world in 2014. The Agency and its Member States continued

to implement the IAEA Action Plan on Nuclear Safety, which was endorsed by the General Conference in 2011 after the accident at the Fukushima Daiichi nuclear power plant in March 2011.

Progress on the IAEA Action Plan on Nuclear Safety

As part of its efforts to disseminate the lessons learned from the Fukushima Daiichi accident through analysis of relevant technical aspects, the Agency organized two international experts meetings in 2014. The International Experts Meeting on Radiation Protection after the Fukushima Daiichi Accident: Promoting Confidence and Understanding was attended by over 220 experts from 68 Member States and ten international organizations. The discussions at the meeting covered a very wide spectrum of issues, many of which are interlinked, including the releases of radioactive material to the environment, managing the impact of these radioactive releases, international standards and communication. The International Experts Meeting on Severe Accident Management in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant was attended by around 170 participants from 40 Member States and four international organizations. The experts exchanged views on strengthening mitigation capabilities to deal with severe accidents, and considered the lessons learned and further actions to be taken to strengthen severe accident management arrangements. These actions included the approaches that could be taken by operating organizations, regulatory bodies and other organizations in responding to severe accidents.

During the year, the Agency published reports on *Human and Organizational Factors in Nuclear Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant*[1] and *Radiation Protection after the Fukushima Daiichi Accident: Promoting Confidence and Understanding*[2].

Progress continued to be made in the review and revision of the Agency's safety standards to take into account the lessons learned from the Fukushima Daiichi accident. These revisions are being effected through addenda to the Safety Requirements relating to the safety of nuclear power plants and the storage of spent nuclear fuel.[3] During 2014, the revisions were prepared for submission to the Board of Governors for establishment as Agency safety standards.

Progress continued to be made in the preparation of the report on *The Fukushima Daiichi Accident*. The Secretariat continued to assess and analyse new information related to data from radiation monitoring of the public and the environment, the results of technical analyses of the accident, and the transcripts made available by Japan of numerous interviews with individuals who played a role during the crisis phase.

Improving regulatory effectiveness

The Integrated Regulatory Review Service (IRRS) allows Member States to evaluate the effectiveness of their national safety regulatory bodies by self-assessment and peer review. This is done through consideration of regulatory, technical and policy practices by comparisons against Agency safety standards, and, where appropriate, good practices elsewhere. The Agency conducted six IRRS missions, to Cameroon, France, Jordan,

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1 Available at: *https://www.iaea.org/sites/default/files/humanfactors0914.pdf*.

2 Available at: *https://www.iaea.org/sites/default/files/radprotection0914.pdf*.

3 The following Safety Requirements publications underwent review and revision during the year: *Governmental, Legal and Regulatory Framework for Safety* (IAEA Safety Standards Series No. GSR Part 1); *Site Evaluation for Nuclear Installations* (IAEA Safety Standards Series No. NS-R-3); *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1); *Safety of Nuclear Power Plants: Commissioning and Operation* (IAEA Safety Standards Series No. SSR-2/2); and *Safety Assessment for Facilities and Activities* (IAEA Safety Standards Series No. GSR Part 4).

the Netherlands, Pakistan and Zimbabwe, and four IRRS follow-up missions, to the Republic of Korea, Slovenia, the United States of America and Viet Nam. To improve these missions, the Agency periodically convenes workshops where Member States that have hosted such a mission are invited to share their experience. In December, a fourth Workshop on Lessons Learned from IRRS Missions was held in the Russian Federation. For this workshop, the Agency also conducted an analysis of the recommendations and suggestions from previous missions to identify recurring issues concerning nuclear, radiation, transport and waste safety, and emergency preparedness.

Operation of nuclear power plants and research reactors

Managing long term operation of both power reactors and research reactors continued to be a major focus of Member States in 2014. At the end of October, over 50% of the 438 nuclear power reactors operating in the world had been in operation for more than thirty years, and of these, 14% had been in operation for more than forty years. Regarding research reactors, more than 70% of the 247 operating research reactors had been in operation for over thirty years, with over half of these exceeding forty years of operation. Prolonged shutdown of these reactors has led to past, and could lead to future, shortages of radioisotopes used for medical applications.

During 2014, the Agency conducted two SALTO peer review service missions, to the Czech Republic and Sweden, and two follow-up missions, to the Republic of Korea and the Netherlands. Also during the year, phase two of the International Generic Ageing Lessons Learned (IGALL) project was launched, aimed at supporting Member States in implementing the guidance on ageing management programmes and time-limited ageing analysis developed during phase one of the project.

During the year, the Agency also carried out five Operational Safety Review Team (OSART) missions, to France, Hungary, the Netherlands, the Russian Federation and the United States of America; seven OSART follow-up missions, to Brazil, Bulgaria, the Czech Republic, France, India, Mexico and Switzerland; and one Corporate OSART mission to Électricité de France. The missions have observed significant improvements in a number of Member States in enhancing the ability of nuclear power plants to withstand severe accidents. The number of mission requests (including Corporate and Pre-OSART missions) has been increasing, with six to seven OSART missions scheduled per year for the coming years. Despite this positive trend, there are still a few Member States that have not requested an OSART mission in the past five to seven years, and some that have not had an OSART mission for nearly two decades.

Feedback from Agency research reactor activities in 2014, including safety missions and an International Meeting on Application of the Code of Conduct on the Safety of Research Reactors, showed that regulatory effectiveness continues to be an important safety issue in many Member States, particularly in the areas of establishing regulations specific to research reactors, reviewing and assessing safety documents for issuance of authorizations, and developing and implementing inspection programmes. This is especially important for those Member States without operating nuclear power plants that are facing difficulties in developing staff with the necessary competencies to fulfil the regulatory functions.

New and expanding nuclear power programmes

Nuclear safety is a precondition for the successful use of nuclear technology. It takes time and resources for countries embarking on a nuclear power programme to develop the necessary safety infrastructure. In 2014, reviews of current schedules of nuclear power plant and research reactor programmes in embarking countries, undertaken during peer review and advisory missions, showed a trend of project milestones (e.g. site licensing, bids, construction) outpacing the development of the necessary safety infrastructure

(legal, regulatory and technical). This places undue pressure on the relevant organizations to make sure that staff are recruited in time and trained in the requisite components of nuclear safety. The Agency continued to assist Member States embarking on a nuclear programme in improving their safety infrastructure through its Safety Assessment Advisory Programme (SAAP) missions. During the year, the Agency conducted SAAP missions to Bangladesh and Jordan. Similarly, two national workshops on safety review and assessment by the regulatory body were conducted for Indonesia and Turkey, and a regional workshop on the topic was held at the Korea Institute of Nuclear Safety for newcomer countries that are members of the Asian Nuclear Safety Network (ANSN).

International Conference on Occupational Radiation Protection

The International Conference on Occupational Radiation Protection: Enhancing the Protection of Workers — Gaps, Challenges and Developments, held in Vienna in December, was organized by the Agency and co-sponsored by the International Labour Organization, in cooperation with 15 other international organizations and associations. The 470 participants from 79 Member States and 21 international organizations exchanged information and experience; reviewed challenges, opportunities and advances since the first conference on this topic in 2002; and identified areas for future improvement. Among the recommendations for occupational radiation protection were those to implement existing international safety standards and to enhance occupational protection of workers through the development and implementation of new safety guidelines for occupational radiation protection in different exposure situations.

"During 2014, the Agency conducted six Convention Exercises (ConvEx), providing opportunities for Member States to work on developing harmonized messages appropriate for delivery to the public, technical audiences and the relevant authorities."

Radioactive waste challenges

The safe management of all types of radioactive waste continues to be an objective for all Member States. Safe disposal solutions for low and intermediate level waste are in place in many Member States. Progress is also being made in the disposal of high level waste, with a few Member States moving towards licensing such facilities and others progressing on the siting phase of geological disposal facilities. The Agency is working to further develop — and to assist in the application of — guidance for Member States on recovery from severe accidents, management of large amounts of radioactive waste following an accident and strategic planning for radioactive waste management in such situations. In 2014, the Agency launched the Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) to better deliver expert review missions that are based on the Agency's safety standards, technical guidance and international practice. ARTEMIS reviews are designed to assist Member State operators and regulatory and policy making bodies in improving organizational performance relating to issues under review, and to contribute to increased confidence in their activities.

Incident and emergency preparedness and response

Within its specific functions under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, the Agency continued to assist Member States in strengthening emergency preparedness and response (EPR) arrangements through the development of Agency safety standards and technical tools, delivery of training, and provision of expert and Emergency Preparedness Review (EPREV) services. In 2014, the Agency conducted three EPREV missions, to South Africa, Tajikistan and the United Republic of Tanzania.

During 2014, the Agency conducted six Convention Exercises (ConvEx), providing opportunities for Member States to work on developing harmonized messages appropriate for delivery to the public, technical audiences and the relevant authorities. During the

exercises the Agency, Member States and relevant international organizations practised arrangements within the international EPR framework for nuclear and radiological emergencies to identify shortcomings in emergency response systems. The outcomes of these exercises have reconfirmed the importance of harmonized EPR arrangements worldwide.

The development and testing of a new assessment and prognosis process continued during 2014. The process will enable the Agency to provide Member States, international organizations and the general public with timely, clear, factually correct, objective and easily understandable information during a nuclear emergency on its potential consequences.

Development of an Emergency Preparedness and Response Information Management System (EPRIMS) began in 2014. The aim of EPRIMS is to increase the availability of key information on Member States' EPR arrangements, improve Agency access to relevant EPR information during an emergency (in line with the Agency's expanded role in assessment and prognosis) and facilitate information exchange on national EPR arrangements among Member States.

In 2014, the International Radiation Monitoring Information System (IRMIS) was further developed and tested for use with Member States and the European Commission. IRMIS will provide Member States with a tool for reporting large volumes of radiological monitoring data during an emergency.

Strengthening global, regional and national networks

Knowledge networks provided by the Agency played an integral part in building nuclear safety capacity for Member States in 2014. The Agency's Global Nuclear Safety and Security Network (GNSSN) — a network operating at the global, regional and national levels, and supported by a strong web platform — continued to provide Member States with the ability to share information, expertise and knowledge. The GNSSN also added two new global networks, the Emergency Preparedness Network (EPnet) and the Global Nuclear Safety and Security Communications Network (GNSCOM), bringing the total to 18 networks.

The Agency organized the third International Conference on Challenges Faced by Technical and Scientific Support Organizations (TSOs) in Enhancing Nuclear Safety and Security: Strengthening Cooperation and Improving Capabilities, held in Beijing, China, in October. The conference was attended by more than 240 participants from 42 Member States and five organizations. The focus of the conference was on strengthening cooperation among TSOs and improving their capabilities to provide nuclear and radiation safety and security expertise to both regulators and operators. Important key outcomes focused on, inter alia, building capacity for Member States embarking on nuclear power development programmes; networking and knowledge sharing; and strengthening cooperative R&D programmes in areas such as decommissioning, remediation, human and organizational factors, safety analysis, and predicting severe accident progression.

In the area of transport safety, development of regional transport networks was a primary focus of Agency activities in 2014. Efforts were made to establish and enhance existing networks in Africa, Asia, the Caribbean, the Mediterranean, and the Pacific Islands.

International meetings

In June, the Agency held an International Meeting on Application of the Code of Conduct on the Safety of Research Reactors at its Headquarters in Vienna. The meeting drew 64 participants from 40 Member States, who exchanged experience on application of the Code of Conduct. The meeting participants concluded that, while there had been improvement in the application of many of the Code's provisions by Member States — notably in the areas of ageing management and regulatory supervision, and consideration

of human factors — there was a need for further improvement in these areas, as well as in the areas of operational radiation protection, emergency preparedness and response, periodic safety reviews and decommissioning planning.

In September, the Agency held its biennial meeting for national coordinators on the operation of the Fuel Incident Notification and Analysis System (FINAS). Held at Agency Headquarters, the meeting attracted 25 participants from 19 Member States, who discussed operating experience feedback on the safety of fuel cycle facilities and the events reported to FINAS, including their root causes and actions taken to prevent recurrences of such events. The meeting also provided recommendations for further enhancing the effectiveness of FINAS.

Conventions

During the Sixth Review Meeting of the Contracting Parties to the Convention on Nuclear Safety (CNS), held at Agency Headquarters from 24 March to 4 April 2014, the Contracting Parties agreed by consensus on a number of amendments to the CNS guidance documents. They also agreed on recommendations for action to the Secretariat, Contracting Parties and other organizations based on the work of the Working Group on Effectiveness and Transparency established during the Second Extraordinary Meeting of the Contracting Parties to the CNS, held in August 2012. The Contracting Parties at the Review Meeting also decided by a two-thirds majority to convene a diplomatic conference within one year to consider a proposal by Switzerland to amend Article 18 of the CNS addressing the design and construction of both existing and new nuclear power plants.

As requested during the Sixth Review Meeting, a consultation meeting was organized on 15 October 2014 to exchange views on the rules of procedure and other organizational matters for the diplomatic conference. In addition, a number of meetings of an informal working group of Contracting Parties to the CNS were held to facilitate preparation for the diplomatic conference.

The Second 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 (the Joint Convention) was held in Vienna from 12 to 13 May 2014. During this meeting, the Contracting Parties agreed on a number of changes to guidance documents and to the Rules of Procedure and Financial Rules.

The organizational meeting for the Fifth Review Meeting of the Contracting Parties to the Joint Convention was also held in Vienna in May. Meeting participants, inter alia, elected the officers for the Fifth Review Meeting, decided on the establishment and composition of country groups, and discussed the timetable for the aforementioned Review Meeting, to be held at Agency Headquarters from 11 to 22 May 2015.

Civil liability for nuclear damage

The International Expert Group on Nuclear Liability (INLEX) continued to serve as the Agency's main forum for matters related to nuclear liability. At its 14th regular meeting, held at Agency Headquarters in May, INLEX discussed, inter alia, the revision of the Board decision excluding small quantities of nuclear material from the scope of the nuclear liability conventions following the adoption of the current edition of the Agency's Transport Regulations (*Regulations for the Safe Transport of Radioactive Material — 2012 Edition*, IAEA Safety Standards Series No. SSR-6); liability issues in the context of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; whether there is a need to establish a special liability regime covering radioactive sources; the scope of application of the Agency's liability conventions as regards shutdown reactors or reactors being decommissioned; the revision of the model provisions on nuclear liability in the *Handbook on Nuclear Law: Implementing Legislation*; and outreach activities.

A Workshop on Civil Liability for Nuclear Damage was held in May in Vienna, and was attended by 54 participants from 39 Member States. The workshop provided diplomats and experts from Member States with an introduction to the international legal regime of civil liability for nuclear damage.

Joint IAEA–INLEX missions were conducted to Nigeria in February and to Saudi Arabia in April aimed at raising awareness among policy makers and senior officials of the international legal instruments relevant for achieving a global nuclear liability regime. Preparations were under way to organize similar missions in 2015. In addition, a subregional Workshop on Civil Liability for Nuclear Damage, held in Viet Nam in March, provided participants with information on the existing international nuclear liability regime and advised on the development of national implementing legislation. The event was attended by 35 participants from 12 Member States.

In its November meetings, the Agency's Board of Governors adopted the resolution entitled "The Establishment of Maximum Limits for the Exclusion of Small Quantities of Nuclear Material from the Application of the Vienna Conventions on Nuclear Liability", which established new maximum limits in line with the 2012 edition of the Agency's Transport Regulations for the exclusion of small quantities of nuclear material from their respective scope of application.

Nuclear Security

"The support of activities to improve physical protection measures in States remained a high priority."

The Agency continued to contribute to global efforts to achieve effective security wherever nuclear and other radioactive material is in use, storage or transport, as well as security of associated facilities. Throughout the year, the Agency supported States, upon request, in their efforts to meet their national responsibilities and international obligations to reduce risks and to respond appropriately to threats through its implementation of the *Nuclear Security Plan 2014–2017*. The Agency also encouraged and assisted States to adhere to relevant international instruments; continued efforts aimed at completing international guidance in the IAEA Nuclear Security Series; and built on the progress made during the implementation of the first three Nuclear Security Plans to help States sustain and further improve their national nuclear security regimes. General Conference resolutions, requests for assistance and incidents reported to the Agency's Incident and Trafficking Database clearly demonstrated the need for these continued efforts to improve nuclear security worldwide. The support of activities to improve physical protection measures in States remained a high priority. In response to an increasing number of requests from Member States in areas they regard as requiring increased attention, the Agency placed emphasis in 2014 on providing assistance in transport security, nuclear security culture and computer security, in accordance with the *Nuclear Security Plan 2014–2017*. The Agency continued to work with States on the development and implementation of Integrated Nuclear Security Support Plans, gaining a more comprehensive understanding of nuclear security priorities and enabling the Agency to address the real nuclear security needs of States in a systematic, prioritized and sustainable manner.

Conventions

A Seminar on the Promotion of the Entry into Force of the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM) was held in Vienna in June. The entry into force of the Amendment to the CPPNM is a major piece of unfinished business in international efforts to strengthen nuclear security as well as a priority for the Agency. At the seminar, States were encouraged to contribute to the reinforcement of the global nuclear security regime by adhering to the 2005 Amendment to the CPPNM and to demonstrate a global commitment to the prevention, detection and punishment of offenses related to nuclear material. During 2014, 12 States ratified, accepted or approved the

Amendment to the CPPNM; however, by the end of the year the Amendment still required ratification by an additional 17 States Party to the Convention for it to enter into force.

Capacity building in nuclear security

Capacity building continues to be recognized as a key factor in the establishment of sustainable nuclear security. Through nuclear security education and training activities, the Agency helps States to better implement the international guidance published in the IAEA Nuclear Security Series. The Agency provided training to approximately 1200 people in 85 States and, over the course of the year, released five on-line e-learning modules which provide an introduction to the basic principles of nuclear security for personnel of nuclear facilities and interested members of the public.

International Conference on Advances in Nuclear Forensics

Past Agency reports have highlighted the growing role of nuclear forensics in security. To facilitate expert discussion, the Agency organized the International Conference on Advances in Nuclear Forensics: Countering the Evolving Threat of Nuclear and Other Radioactive Material out of Regulatory Control, the first-ever conference focused entirely on nuclear forensics. The conference, held at Agency Headquarters in July, was attended by more than 280 participants from 76 Member States and eight international organizations, including nuclear forensics experts, law enforcement officials, policy makers and national representatives with an interest or active roles in nuclear forensics. The conference recognized the need for strengthened cooperation in nuclear forensics, and concluded that continual innovation is needed and that nuclear forensics is an essential tool to prevent and respond to acts involving nuclear and other radioactive materials out of regulatory control. In addition, the conference recognized that the threat from malicious acts involving nuclear and other radioactive materials persists, and that nuclear forensics depends upon innovative science and methodologies to identify the origin and history of these materials as part of an investigation of a nuclear security event.

"The Agency provided training to approximately 1200 people in 85 States and…released five on-line e-learning modules."

NUCLEAR VERIFICATION

Implementation of safeguards in 2014

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 2014, safeguards were applied for 180 States[4,5] with safeguards agreements in force with the Agency[6]. Of the 118 States that had both a comprehensive safeguards agreement (CSA) and an additional protocol (AP) in force, the Agency concluded that *all* nuclear material remained in peaceful activities in 65 States[7]; for 53 States, as the necessary evaluation regarding the absence of undeclared nuclear material and activities for each of these States remained ongoing, the Agency was unable to draw the same conclusion.

4 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.

5 And Taiwan, China.

6 The status with regard to the conclusion of safeguards agreements, additional protocols and small quantities protocols is given in the Annex to this report.

7 And Taiwan, China.

For these 53 States, and for the 54 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 conclusion that *all* nuclear material has remained in peaceful activities has been drawn, the Agency implements 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 2014 integrated safeguards were implemented for 53 States[8,9].

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 2014, 12 non-nuclear-weapon States party to the NPT had yet to bring CSAs into force pursuant to Article III of the Treaty. For these States, the Agency could not draw any safeguards conclusions.

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

In 2014, the Agency continued to implement the *Plan of Action to Promote the Conclusion of Safeguards Agreements and Additional Protocols*, which was updated in September 2014. During the year, two APs entered into force[10], and two operational small quantities protocols (SQPs) were amended[11]. By the end of the year, safeguards agreements were in force with 181 States and APs were in force with 124 States. Moreover, 60 States of some 100 States had accepted the revised SQP text (which was in force for 53 of these States) and four States had rescinded their SQPs.

Islamic Republic of Iran (Iran)

During 2014, the Director General submitted four reports to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions in the Islamic Republic of Iran* (GOV/2014/10, GOV/2014/28, GOV/2014/43, and GOV/2014/58 and Corr.1).

In 2014, contrary to the relevant binding resolutions of the Board of Governors and the United Nations Security Council, Iran did not: implement the provisions of its Additional Protocol; implement the modified Code 3.1 of the Subsidiary Arrangements General Part to its Safeguards Agreement; suspend all enrichment related activities; or suspend all heavy water related activities. Neither did Iran resolve the Agency's concerns about possible

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8 Armenia, Australia, Austria, Bangladesh, Belgium, 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, Republic of Korea, Latvia, Libya, Lithuania, Luxembourg, Madagascar, Mali, Malta, Monaco, Netherlands, Norway, Palau, Peru, Poland, Portugal, Romania, Seychelles, Singapore, Slovakia, Slovenia, Spain, Sweden, The former Yugoslav Republic of Macedonia, Ukraine, Uruguay and Uzbekistan.

9 And Taiwan, China.

10 India, and Saint Kitts and Nevis.

11 Cambodia and New Zealand.

military dimensions to Iran's nuclear programme. This resolution is necessary to establish international confidence in the exclusively peaceful nature of that programme.

In the Framework for Cooperation, the Agency and Iran, between November 2013 and May 2014, agreed on a total of 18 practical measures to be implemented by Iran in three sequential steps as part of an approach to resolve all present and past issues.[12] As of the end of 2014, Iran had implemented 16 of these practical measures; two practical measures related to possible military dimensions to Iran's nuclear programme, agreed for the third step of the Framework for Cooperation, remained to be implemented. The Agency also invited Iran to propose new practical measures to address the concerns over possible military dimensions to Iran's nuclear programme, to be implemented in the next step of the Framework for Cooperation. As of 31 December 2014, Iran had not proposed any such measures.

Since 20 January 2014, the Agency has undertaken monitoring and verification in relation to the nuclear-related measures set out in the Joint Plan of Action agreed between China, France, Germany, the Russian Federation, the United Kingdom, the United States of America and Iran, the aim of which is to reach a "mutually-agreed long-term comprehensive solution that would ensure Iran's nuclear programme will be exclusively peaceful". The initial duration of the Joint Plan of Action was six months. On 24 July 2014, the Joint Plan of Action was extended until 24 November 2014, when it was further extended until 30 June 2015. The Agency's work in relation to the Joint Plan of Action has required an approximate doubling of its verification activities compared with those the Agency had already been carrying out pursuant to Iran's Safeguards Agreement and the relevant resolutions of the Board of Governors and the Security Council.

While the Agency continued throughout 2014 to verify the non-diversion of declared nuclear material at the nuclear facilities and locations outside facilities (LOFs) declared by Iran under its Safeguards Agreement, the Agency was not in a position to provide credible assurance about the absence of undeclared nuclear material and activities in Iran and, therefore, was unable to conclude that all nuclear material in Iran was in peaceful activities[13].

Syrian Arab Republic (Syria)

In September 2014, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic* (GOV/2014/44). According to the report, 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 remained unchanged[14]. In 2014, 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.

In 2014, Syria indicated its readiness to receive Agency inspectors, and to provide support, for the purpose of performing a physical inventory verification (PIV) at the Miniature

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[12] The initial six practical measures were agreed on 13 November 2013; another seven practical measures were agreed on 9 February 2014; and a further five practical measures were agreed on 20 May 2014.

[13] As, for example, Iran did not implement its Additional Protocol, as required in the binding resolutions of the Board of Governors and the United Nations Security Council.

[14] The Board of Governors, in its resolution GOV/2011/41 of June 2011 (adopted by a vote) had, inter alia, called on Syria to remedy urgently 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 assurances as to the exclusively peaceful nature of Syria's nuclear programme.

Neutron Source Reactor in Damascus. The Agency — after considering the United Nations Department of Safety and Security's assessment of the prevailing security level in Syria and the small amount of nuclear material declared by Syria to be at the reactor — decided to postpone the PIV at the reactor until the security level has sufficiently improved. By the end of 2014 the assessment of the security level in Syria had not changed.

Based on the evaluation of information provided by Syria and other safeguards relevant information available to it, the Agency found no indication of the diversion of declared nuclear material from peaceful activities. For 2014, the Agency concluded for Syria that declared nuclear material remained in peaceful activities.

Democratic People's Republic of Korea (DPRK)

In September 2014, 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/2014/42–GC(58)/21), which provided an update of developments since the Director General's report of August 2013.

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, could not draw any safeguards conclusion regarding the DPRK.

Since April 2009, the Agency has not implemented any measures under the ad hoc monitoring and verification arrangement agreed between the Agency and the DPRK and foreseen in the Initial Actions agreed at the Six-Party Talks. Statements by the DPRK concerning its conducting of a third nuclear test, reiterating its "right" to conduct further nuclear tests, and its intention to readjust and restart its nuclear facilities at Yongbyon, together with its previous statements about uranium enrichment activities and the construction of a light water reactor, are deeply regrettable.

No verification activities were implemented in the field in 2014, but the Agency continued to monitor the DPRK's nuclear activities by using open source information (including satellite imagery and trade information). Using satellite imagery, the Agency continued to observe signatures which were consistent with the operation of the 5 MW(e) reactor at Yongbyon throughout 2014, and renovation or expansion of other buildings was also seen within the Yongbyon site. However, without access to the site, the Agency cannot confirm the operational status of the reactor or the purpose of the other observed activities. The Agency also continued to further consolidate its knowledge of the DPRK's nuclear programme with the objective of maintaining operational readiness to resume safeguards implementation in the DPRK.

Evolving safeguards implementation

In 2014, the Agency continued to strengthen the effectiveness and improve the efficiency of safeguards by continuing to improve the way in which they are implemented. Recent developments in the continued evolution of safeguards implementation were described in a report submitted by the Director General to the Board of Governors in August entitled *Supplementary Document to the Report on The Conceptualization and Development of Safeguards Implementation at the State Level (GOV/2013/38)*. The Supplementary Document was issued following an extensive consultation process between the Secretariat and Member States, providing clarifications and additional information on the State-level concept. To continue to ensure consistency and non-discrimination in the implementation of safeguards and to generate further efficiencies, the Agency continued to improve associated processes and procedures, making them more uniform.

Information analysis

Throughout 2014, the Agency continued to investigate new tools and methodologies to streamline and prioritize workflows and processes. To continuously improve the quality of the information on which it must rely, the Agency monitored laboratory and measurement system performance, and organized international technical meetings, training and workshops for various States on nuclear material accounting, including measurement data analysis, statistical methodologies and material balance evaluation concepts.

Cooperation with State and regional authorities

To assist States with SQPs in building capacity for implementing their safeguards obligations, an updated version of the *Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols* (IAEA Services Series 21) was issued in December. In addition, the first of four planned Safeguards Implementation Practices (SIP) Guides, entitled *Safeguards Implementation Practices Guide on Facilitating IAEA Verification Activities* (IAEA Services Series 30), was published in December. The Agency also conducted three IAEA SSAC Advisory Service (ISSAS) missions, to Kyrgyzstan, the United Arab Emirates and Uzbekistan, and held seven international, regional and national training courses for personnel responsible for overseeing and implementing the State systems of accounting for and control of nuclear material (SSACs).

"In 2014, more than 200 old DCM-14 cameras and systems were replaced with [next generation surveillance system] technology."

Enhancing the Capability of the Safeguards Analytical Services (ECAS)

Transition activities needed to move into the newly completed Nuclear Material Laboratory (NML) continued throughout 2014, including the procurement and receipt of equipment required for both the chemical and instrumentation laboratories. At the end of 2014, approvals to operate the new facility were being sought from both the Agency's Internal Regulator as well as the Host Government. Overall, the ECAS project activities had reached 84% completion as of 31 December 2014.

Information technology

The Agency's safeguards information technology modernization needs are being addressed through the Modernization of Safeguards Information Technology (MOSAIC) project. In 2014, work on defining the full scope of MOSAIC was completed, with identification of projects, resource needs and a timeline for completion.

Safeguards equipment and tools

The Agency continued with the next generation surveillance system (NGSS) replacement campaign, replacing large numbers of old and obsolete pieces of surveillance equipment (DCM-14). In 2014, more than 200 old DCM-14 cameras and systems were replaced with NGSS technology. This replacement campaign is currently partially funded through a dedicated item in the Agency's Major Capital Investment Fund.

Safeguards symposium

In October, the Agency held the Symposium on International Safeguards: Linking Strategy, Implementation and People, at its Headquarters in Vienna. The symposium was attended by over 600 registered participants from 54 Member States and 11 international organizations. The objective of the symposium, the twelfth in a series, was to foster dialogue,

exchange information and promote cooperation among the Agency, Member States, the nuclear industry and members of the broader safeguards and nuclear non-proliferation community.

Preparing for the future

Research and development are essential to meeting the safeguards needs of the future. During 2014, the Agency continued to implement the *Department of Safeguards Long-Term Research and Development Plan, 2012–2023* with the assistance of Member State Support Programmes (MSSPs). To address near term development objectives and to support the implementation of its verification activities, the Agency continued to rely on MSSPs in implementing its *Development and Implementation Support Programme for Nuclear Verification 2014–2015*. At the end of 2014, 20 States[15] and the European Commission had formal support programmes with the Agency.

MANAGEMENT OF TECHNICAL COOPERATION FOR DEVELOPMENT

Through its cross-Departmental technical cooperation programme, the Agency helps Member States to build, strengthen and maintain capacities in the safe, peaceful and secure use of nuclear technology in support of sustainable socioeconomic development. Technical cooperation projects provide expertise in fields where nuclear techniques offer advantages over other approaches, or where nuclear techniques can usefully supplement conventional ones. All Member States are eligible for support, although in practice technical cooperation activities tend to focus on the needs and priorities of underdeveloped countries.

The Agency's technical cooperation programme supports capacity building activities, networking, knowledge sharing and partnership facilitation, as well as the procurement of equipment. Projects are delivered in seven areas: health and nutrition; food and agriculture; water and the environment; industrial applications/radiation technology; energy; nuclear knowledge development and management; and safety and security. Through the Programme of Action for Cancer Therapy (PACT), the Agency helps Member States to establish comprehensive national cancer control programmes.

Technical cooperation and the global development context

The Secretariat is preparing the technical cooperation programme for increased alignment with the post-2015 sustainable development goals (SDGs) by correlating the new global developmental goals with Agency fields of activity. Climate change adaptation is a cross-cutting goal in the new SDGs and will require the widest possible cooperation between Member States if the goal to fully operationalize the Green Climate Fund and reach US $100 billion by 2020 (SDG 13a) is to be reached. With the signature of a Practical Arrangement with the United Nations Environment Programme (UNEP), the Agency is making good progress towards the establishment of a thematic partnership framework for climate change. Such a framework would involve current Agency partners, including the Food and Agriculture Organization of the United Nations (FAO), the United Nations Convention to Combat Desertification and UNEP, and would seek to set up agreements in 2015 with the United Nations Framework Convention on Climate Change, and eventually

[15] 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.

with CGIAR and the Global Environment Facility, which is managing the Special Climate Change Fund.

Discussions held in Kenya in mid-2014 with the aim of expanding cooperation with the United Nations Children's Fund have led to proposals for new projects (both regional and interregional) on human nutrition. These projects will address the universal problem of childhood stunting, in cooperation with the Scaling Up Nutrition (SUN) Movement, and will aim to develop capacities in Africa to assess the body composition of children. It is expected that such field collaboration leading to joint programmes will provide new opportunities for resource mobilization, as counterpart institutes demonstrate the importance of isotopic studies in understanding human nutritional status and in determining fortification and supplementation efficacy.

The technical cooperation programme in 2014

In 2014, health and nutrition accounted for the highest proportion of actuals — that is, disbursements — through the technical cooperation programme, at 25.9%. This was followed by safety and security at 24.9%, and by food and agriculture at 17%. By the end of the year, financial implementation of the Technical Cooperation Fund (TCF) stood at 78%. Regarding non-financial implementation, the technical cooperation programme supported, inter alia, 3461 expert and lecture assignments, 187 regional and interregional training courses, and 1677 fellowships and scientific visits.

Throughout 2014, the Agency continued to provide support to Member States in strengthening human capacity for sustainable development, focusing on the achievement of optimum results in meeting basic human needs and attaining tangible socioeconomic impact. Particular efforts were made to improve quality, build partnerships, strengthen regional cooperation, and enhance radiation safety and security for the peaceful application of nuclear energy. In addition, the Agency assisted Member States in the review of the project concepts submitted for consideration as part of the 2016–2017 technical cooperation programme cycle, which were guided by the priorities expressed in individual Country Programme Frameworks and were in alignment with national development plans.

The technical cooperation programme in Africa supported more than 40 Member States (including 25 least developed countries) in the safe use of nuclear and isotopic techniques for development. Agency support in Africa resulted in enhanced food security through increased and more reliable crop production; improved animal health and livestock production; improved capabilities for the diagnosis and treatment of human and livestock diseases; improved investigation, understanding and management of water resources; and expanded use of nuclear applications in industry. The programme also strengthened radiation protection, built competence in radiation safety through developing and strengthening human resources, and strengthened the management of radioactive waste, with particular attention given to naturally occurring radioactive material. The support provided was focused on capacity building, technology transfer and expert services aligned with the national development needs of African Member States.

The Agency participated in the Third Conference of States Parties to the African Nuclear-Weapon-Free Zone Treaty (Treaty of Pelindaba), held in Addis Ababa, Ethiopia, in May, preparing a document on the status of nuclear science and technology in Africa that was circulated at the conference.

During 2014, the Agency joined the regional and international efforts to fight the Ebola virus disease outbreak in West Africa by enhancing diagnostic capacities in Sierra Leone. The Agency also continued its ongoing contributions to strengthening regional capacities for early detection of emerging zoonotic diseases in wildlife and livestock.

For the Asia and the Pacific region, the regional priorities remained the strengthening of nuclear safety and security, and the improvement of human resources and technological capabilities in the areas of human health and food and agriculture. These priorities are

reflected in the allocation of 67% of the total budget for the Asia and the Pacific region to these three thematic areas, with the remaining funds allocated to nuclear knowledge development and management, industrial applications, water and the environment, and energy. The Agency guided and assisted the Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA) and the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) in the revision of their Guidelines and Operating Rules, which will result in better management of the two agreements and their programmes.

The technical cooperation programme in the Europe region continued to focus on four priority thematic areas: nuclear and radiation safety, nuclear energy, human health, and isotope and radiation technology applications. Maintaining appropriate levels of safety and security in all aspects of the peaceful use of nuclear technology was heavily emphasized. A key component was assisting Member States in strengthening their regulatory infrastructure for safety. This was implemented in 2014 through, inter alia, a two week School for Drafting Regulations on Radiation Safety, held at Agency Headquarters in Vienna, and a postgraduate educational course on radiation protection and safety of radioactive sources, during which significant progress was made on drafting new or revising key regulations to strengthen regulatory infrastructure in the region.

The 2016–2021 Regional Strategic Profile for Latin America and the Caribbean establishes the priority thematic areas of the technical cooperation programme for the region. These are food security and agriculture, human health, environment, energy, radiation technology and radiation safety. In addition to the traditional support to capacity building in the various fields of activity, particular attention was paid in 2014 to supporting developments in the use of stable isotope techniques for assessing body composition and to enhancing understanding of the processes that influence groundwater management. Emphasis was also placed on enhancing medical response to emergencies, with notable advances in standardizing biodosimetry methodologies to be used in case of radiological emergencies, as well as in the implementation of the national occupational dose registry in Member States.

"In 2014, the Agency intensified the promotion of global partnerships in cancer control with a view to enhancing the effectiveness of radiation medicine services in low and middle income countries"

Programme of Action for Cancer Therapy (PACT)

In 2014, the Agency intensified the promotion of global partnerships in cancer control with a view to enhancing the effectiveness of radiation medicine services in low and middle income countries by integrating them within a comprehensive cancer control approach. As a result, the recognition and visibility of the Agency as a key player in cancer issues increased significantly at the global level, demonstrated, inter alia, by extrabudgetary resources of €719 000 that were mobilized for PACT activities.

Strategic partnerships were strengthened with the World Health Organization, the International Agency for Research on Cancer and the Union of International Cancer Control, with the aim of operationalizing joint efforts at the country level. Several new partnerships were initiated or established, including with Pink Ribbon Red Ribbon, the American Cancer Society, the Harvard T.H. Chan School of Public Health, the University of Texas MD Anderson Cancer Center, the African Development Bank, the East African Development Bank and the Centre for Global Health Research, among others. Efforts were also made to advocate the inclusion of cancer and radiation technology in the global health discourse and on the post-2015 development agenda.

The Advisory Group on Increasing Access to Radiotherapy Technology (AGaRT) devised guidance for low and middle income countries seeking to establish or expand radiotherapy services, in particular, on how to improve the sustainability of radiotherapy investments and increase access to such treatment.

The PACT Model Demonstrations Sites in Albania, Ghana, Mongolia, Nicaragua, Sri Lanka, the United Republic of Tanzania, Viet Nam and Yemen were supported through

expert missions and the provision of training and equipment. In 2014, for example, the cancer control plans of Ghana and the United Republic of Tanzania were reviewed; the United Republic of Tanzania's palliative care project received five paediatric care beds; Viet Nam launched a project on early diagnosis of breast and cervical cancer; a cervical and breast cancer diagnosis project in Nicaragua was supported through an evaluation of mammography services and provision of related staff training in May; and in November, the current status of Mongolia's radiation oncology and medical physics infrastructure and services was assessed and extrabudgetary funds were provided to upgrade radiotherapy treatment planning system hardware and software.

The support provided to Member States through integrated missions of PACT (imPACT) reviews and specialized expert missions was improved with regard to both the quality of these assessments and subsequent recommendations, as well as their systematic consideration for future technical cooperation support. Ten Member States[16] received imPACT review missions in 2014.

Numerous African cancer control professionals have benefited from the Virtual University for Cancer Control and Regional Training Network (VUCCnet): three course modules are currently available. To date, some 500 students from the four pilot countries have enrolled in VUCCnet.

Technical cooperation programme management

"Ten Member States… received imPACT review missions in 2014"

In 2014, the Agency continued to focus on improving the programme quality of both the current and future technical cooperation cycles. Training in the logical framework approach and in results based management was conducted for Programme Management Officers, National Liaison Officers, technical officers and counterparts, to support Member States as they developed projects for the 2016–2017 technical cooperation cycle. The aim is to prepare projects that are clearly linked to the Agency's Medium Term Strategy 2012–2017; that are of high quality, with measurable, attainable and timely objectives; and that better respond to Member State needs and priorities, and are in line with their national development plans.

To further improve monitoring of the progress of implementation of technical cooperation projects, templates for Project Progress Assessment Reports (PPARs) were streamlined, and guidelines for the project achievement report to complement the PPAR were developed. Furthermore, a process for outcome monitoring was developed, to be piloted in 2015.

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 €83.6 million in 2014, with approximately €64.4 million for the TCF (including assessed programme costs (APCs), National Participation Costs[17] (NPCs) and miscellaneous income), €18.6 million in extrabudgetary resources, and about €0.6 million representing in kind contributions.

The rate of attainment for the TCF stood at 89.8% on pledges and at 89.5% on payments at the end of 2014, while payment of NPCs totalled €2.2 million.

[16] Costa Rica, Croatia, Fiji, Georgia, Lao People's Democratic Republic, Mozambique, Panama, Peru, Rwanda and Uzbekistan.

[17] National Participation Costs: Member States receiving technical assistance are assessed a charge of 5% of their national programme, including national projects and fellows and scientific visitors funded under regional or interregional activities. At least half the assessed amount for the programme must be paid before contractual arrangements for the projects may be made.

Actuals

In 2014, approximately €74 million was disbursed to 131 countries or territories, of which 33 were least developed countries, reflecting the Agency's ongoing effort to address the development needs of those States.

MANAGEMENT ISSUES

In 2014, prioritization and effective coordination and direction of activities to ensure a consistent one house approach was the priority for programme delivery. The Secretariat also worked closely with the Working Group on Financing the Agency's Activities to advance the consultation process and increase transparency in connection with the preparation of the Agency's Programme and Budget.

Partnership for Continuous Improvement

Through the Partnership for Continuous Improvement (PCI) initiative, the Agency continued to eliminate unnecessary bureaucracy throughout the Secretariat. This year, for example, the handling of host government agreements was streamlined, considerably expediting the process and saving staff time. By using available technology in new ways, work on selected language services projects was able to be carried out remotely, thus reducing travel costs and eliminating the need for additional office space. Also, based on a review of the Agency's travel policy, a number of changes were made to the rules and procedures. Together, these changes are expected to result in significant savings to the Agency.

Agency-wide Information System for Programme Support

The implementation of Plateau 3 of the Agency-wide Information System for Programme Support (AIPS) in December provided new tools for recruitment, talent development, staff planning and administration, and payroll. The automation of business processes was expanded, the use of employee self-services was greatly extended, and dashboards were introduced, providing managers with a graphical overview of staffing, procurement and resource utilization. With the launch of Plateau 3, all staff now interact with the system on a daily basis. The full implementation of AIPS represents the largest change management project the Agency has ever undertaken, involving the re-engineering of a large number of business processes.

Nuclear Technology

Nuclear Power

Objective

To assist Member States considering the introduction of nuclear power programmes in planning and building their national nuclear infrastructures. To provide integrated support to Member States with existing nuclear power programmes and to those planning new nuclear build in order to help improve operating performance and safe 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

In 2014, a number of countries made considerable progress on their first nuclear power plants. In April, Belarus began construction of the second unit at Ostrovets, and in September, the United Arab Emirates (UAE) started construction of Unit 3 at Barakah (Fig. 1). A number of other countries made progress towards introducing nuclear power into their energy mix: a pre-feasibility study was performed in Kenya; the environmental impact assessment report for the Akkuyu project was approved in Turkey; a master plan

FIG. 1. Construction of Units 1 and 2 of the Barakah nuclear power plant in the United Arab Emirates in August 2014; construction of the plant's third unit began in September. (Photograph courtesy of ENEC.)

on nuclear power infrastructure and development was approved in Viet Nam; and the *Polish Nuclear Power Programme* was approved by Poland's Council of Ministers, and a contract for an owner's engineer (a third party company that provides technical support to the future owner/operator) was issued in July. Table 1 shows the number of Member States at different stages of decision making and planning for nuclear power in 2010–2014.

TABLE 1. Number of Member States at different stages of decision making and planning for nuclear power in 2010–2014, according to their official statements

	2010	2011	2012	2013	2014
First nuclear power plant started construction/under construction	1	0	1	2	2
First nuclear power plant ordered	2	3	2	1	1
Decided to introduce nuclear power and started preparing the appropriate infrastructure	10	6	6	6	7
Active preparation for a possible nuclear power programme with no final decision	7	6	6	5	5
Considering nuclear power programme	14	14	13	19	18

Through technical cooperation projects, the Agency provided interested countries extensive support in establishing the appropriate legal and regulatory framework, developing the necessary nuclear power infrastructure and building related national human resource capacity. Member States such as Bangladesh, Jordan, Turkey, the UAE and Viet Nam received significant Agency assistance, by way of expert advisory missions, in areas such as reviewing nuclear laws, developing and reviewing regulations, supporting capacity building, strengthening coordination among national institutions, drafting and reviewing human resource development plans, developing radioactive waste management policies and strategies, establishing project management arrangements, carrying out site assessments, and developing regulatory guidance for site evaluation. Through focused interregional, regional and national workshops, training courses and mentoring programmes, staff of nuclear power development projects, regulatory authorities and technical support organizations received substantive training in the various issue areas of the Agency's 'Milestones' approach.

Additionally, an interregional technical cooperation project entitled Supporting Nuclear Power Infrastructure Capacity Building in Member States Introducing and Expanding Nuclear Power further strengthened information exchange among Member States. The project also focused on the transfer of knowledge related to 'Milestones' issues and the development of specific training mechanisms for integrated management systems, project management and human resource development.

To improve and expand Agency guidance to 'newcomer' countries — Member States that are considering or that have decided to establish a nuclear power programme — in 2014 the Agency issued *Managing Environmental Impact Assessment for Construction and Operation in New Nuclear Power Programmes* (IAEA Nuclear Energy Series No. NG-T-3.11); *Preparation of a Feasibility Study for New Nuclear Power Projects* (IAEA Nuclear Energy Series No. NG-T-3.3); and *Alternative Contracting and Ownership Approaches for New Nuclear Power Plants* (IAEA-TECDOC-1750).

In August, an Integrated Nuclear Infrastructure Review (INIR) mission to Jordan found that notable progress had been made in the development of the country's nuclear infrastructure. A follow-up INIR mission to Viet Nam in November found that the country had implemented some of the Agency's earlier recommendations on siting, stakeholder involvement, environmental protection and industrial involvement, and that it was aware

of what more needed to be done. In addition, Morocco received assistance in 2014 in preparing a nuclear infrastructure self-evaluation report.

Engineering Support for Operation, Maintenance and Plant Life Management

A coordinated research project (CRP) entitled Review and Benchmark of Calculation Methods on Piping Wall Thinning due to Erosion–Corrosion in Nuclear Power Plants compared the ability of a number of commercially available software tools to predict piping wear associated with flow accelerated corrosion in nuclear power plants. Benchmarking covering pressurized water reactor and boiling water reactor designs and both single and two phase water–steam flow was completed for three nuclear power plants. New associated guidelines are under development.

The CRP on Qualification, Condition Monitoring and Management of Ageing of Low Voltage Cables in Nuclear Power Plants was completed, providing information on how to qualify new cables, monitor the performance of existing cables and establish a cable ageing management programme (Fig. 2). Tests were performed by 15 Member States, and development of associated guidelines continued.

"Benchmarking covering pressurized water reactor and boiling water reactor designs and both single and two phase water–steam flow was completed for three nuclear power plants."

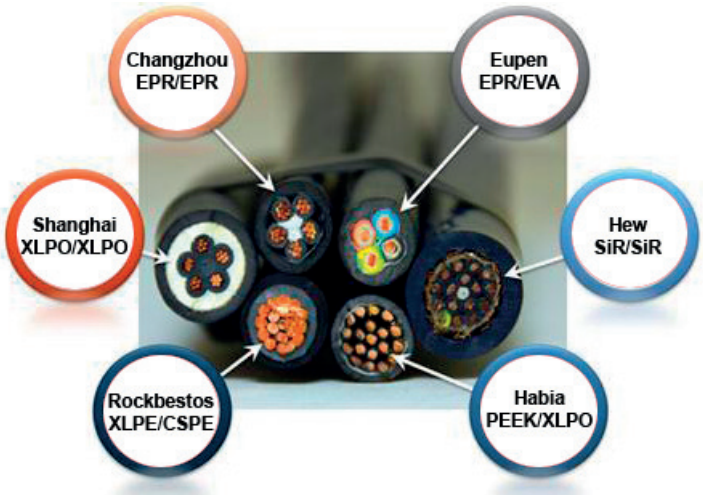

FIG. 2. Samples of low voltage cables for benchmark testing as part of a CRP on Qualification, Condition Monitoring and Management of Ageing of Low Voltage Cables in Nuclear Power Plants. (Photograph courtesy of H.M. Hashemian, Analysis and Measurement Service Corp.)

An Agency Training Workshop on the Assessment of Degradation Mechanisms of Primary Components in Water Cooled Nuclear Reactors: Current Issues and Future Challenges was held in September in Madrid, hosted by the Research Centre for Energy, Environment and Technology (CIEMAT). The course attracted about 60 participants from more than 20 countries, who shared lessons learned on the structural integrity of reactor pressure vessels.

Counterfeit and fraudulent items are becoming an increasing concern for operating organizations and regulators. In some cases, operating nuclear power plants or those under construction have experienced significant economic impacts. A Technical Meeting on Procurement Activities and on Counterfeit, Fraudulent and Substandard Items: Experiences and Lessons Learned, held at Agency Headquarters in September, provided an opportunity for experts to exchange information and experience on the topic. Technical guidelines on procurement engineering are being developed.

Human Resource Development

The Agency is strengthening its support to Member States in the areas of management systems and human performance, including stakeholder involvement and training. In May, the International Conference on Human Resource Development for Nuclear Power Programmes: Building and Sustaining Capacity attracted over 300 delegates from 65 Member States and five international organizations. Participants noted that more systematic training approaches were being used globally in the nuclear field and that development across the skills pyramid was improving. Countries were encouraged to join existing networks and to undertake capacity building self-assessments. In addition, the Agency continued to support the International Nuclear Leadership Education Program, run by the Massachusetts Institute of Technology in the United States of America, by arranging for senior staff to provide input on Agency perspectives and by sponsoring the participation of senior representatives from newcomer countries to expose them to the wide range of responsibilities they will assume in managing a nuclear power programme. In November, a Technical Meeting on stakeholder involvement was held in Bristol, United Kingdom. The meeting, hosted by EDF Energy, attracted 41 participants from 20 Member States. Participants were encouraged to establish partnerships with local industry associations and educational institutions to maximize opportunities and benefits among the local communities. The meeting also highlighted the importance of clarifying the roles and responsibilities of, and ensuring effective coordination between, the government, the regulatory body and future operators in terms of communicating with stakeholders about nuclear power. Also during the year, the Agency reviewed communication plans for the nuclear power programmes of Belarus, the Islamic Republic of Iran, Kazakhstan and Viet Nam.

"In May, the International Conference on Human Resource Development for Nuclear Power Programmes: Building and Sustaining Capacity attracted over 300 delegates from 65 Member States and five international organizations."

At a meeting held in December, 53 participants from 24 Member States and four international organizations shared experience and lessons learned from applying different management system standards in the nuclear industry. Participants presented the status of development of their country's management systems and described the challenges of integrating different standards.

Guidance on *Managing Organizational Change in Nuclear Organizations* (IAEA Nuclear Energy Series No. NG-T-1.1) and on *Use of a Graded Approach in the Application of the Management System Requirements for Facilities and Activities* (IAEA-TECDOC-1740) was published in 2014. Four new e-learning modules — on management systems, safety infrastructure, and emergency preparedness and response, and an introduction to safeguards — were developed based on the 'Milestones' approach and made available on-line. A total of 11 modules are now available on the Agency's web site[1].

Nuclear Technology Development

To address underlying potential issues regarding the deployment of small and medium sized reactors (SMRs), two books, entitled *Options to Enhance Proliferation Resistance of Innovative Small and Medium Sized Reactors* (IAEA Nuclear Energy Series No. NP-T-1.11) and *Progress in Methodologies for the Assessment of Passive Safety System Reliability in Advanced Reactors* (IAEA-TECDOC-1752), were published in May and September, respectively. A booklet on SMRs, published in September as a supplement to the web based Advanced Reactors Information System, provided information on the entire product line of SMRs, including long term technology developments.

[1] See: *http://www.iaea.org/NuclearPower/Infrastructure/elearning/index.html*.

Recognizing the importance of knowledge preservation for fast reactors, a Technical Meeting on the Status of the IAEA Fast Reactor Knowledge Preservation Initiative was held at Agency Headquarters in December. A new CRP on Radioactive Release from the Prototype Fast Breeder Reactor (PFBR) under Severe Accident Conditions was launched in November to further enhance the safety of this technology. To facilitate industry efforts in the progress of sodium cooled fast reactors, a report entitled *Benchmark Analyses of Sodium Natural Convection in the Upper Plenum of the Monju Reactor Vessel* (IAEA-TECDOC-1754) was published in November. A related publication, entitled *Benchmark Analyses on the Control Rod Withdrawal Tests Performed during the PHÉNIX End-of-Life Experiments* (IAEA-TECDOC-1742), was published in June.

Workshops on Nuclear Technology Assessment were conducted in Algeria, India and Viet Nam. The workshops were designed to assist newcomer countries in evaluating available nuclear power technologies against country specific environments, requirements and energy needs. A Technical Meeting on Effective Utilization of Nuclear Power Plant Simulators as Introductory Educational Tools was held in Vienna in May. The purpose of the meeting was to exchange information on how PC based simulators are being used by universities and to discuss future improvements to the suite of reactor simulators that are maintained by the Agency for human resource development by Member States.

Interest in non-electric application of nuclear power continued to grow during the year. With innovative technologies increasing the output temperature range of reactors, the spectrum of potential industrial applications continues to expand. The Agency's Desalination Economic Evaluation Program (DEEP), one of the most widely used tools for economic assessment of nuclear desalination, was further refined in 2014. The new version includes a modified user interface and introduces cash flow analysis for nuclear projects. For nuclear power plant locations being considered in water-starved areas, an economically feasible approach to producing water for the plant is being pursued through a new CRP, launched in December, on Application of Advanced Low Temperature Desalination Systems to Support Nuclear Power Plants and Non-Electric Applications. The CRP is looking at the application of systems that could produce fresh water without sacrificing the electrical output of the nuclear power plant. An updated version of the Agency's Hydrogen Economic Evaluation Program (HEEP), a tool for performance and cost evaluation of large scale hydrogen production using nuclear energy, was also released in December. HEEP can be used for making economic assessments of hydrogen production that could provide the capability to store energy by utilizing the nuclear heat when the electrical grid loading is lighter.

Enhancing Global Nuclear Energy Sustainability through Innovation

The International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) was established in 2000 to help ensure that nuclear energy is available to contribute to meeting the energy needs of the twenty-first century in a sustainable manner. With Bangladesh joining in 2014, INPRO's membership grew to 40. During the year, Nuclear Energy System Assessments (NESAs) were under way in Indonesia, Romania and Ukraine to support strategic, long range nuclear energy planning. Also during the year, preparatory meetings were held to begin limited scope NESAs on sodium cooled fast reactor designs in China and India.

Two revised manuals on aspects of the INPRO methodology — *INPRO Methodology for Sustainability Assessment of Nuclear Energy Systems: Economics* (IAEA Nuclear Energy Series No. NG-T-4.4) and *INPRO Methodology for Sustainability Assessment of Nuclear Energy Systems: Infrastructure* (IAEA Nuclear Energy Series No. NG-T-3.12) — were published in 2014.

"The Eighth INPRO Dialogue Forum ... addressed nuclear energy system sustainability in three topical areas: economics, resource availability and institutional arrangements."

The Eighth INPRO Dialogue Forum, held at Agency Headquarters in August and attended by 62 participants from 40 Member States, addressed nuclear energy system sustainability in three topical areas: economics, resource availability and institutional arrangements. The Ninth INPRO Dialogue Forum, held in Vienna in November, was attended by 56 participants from 33 Member States. Forum participants considered lessons learned and shared experience and good practices in establishing effective collaboration mechanisms to facilitate innovation and R&D.

A Training Meeting on Nuclear Energy System Modelling and Assessment Using the INPRO Methodology, held in November in Santiago, Chile, attracted 23 participants from six Member States.

Nuclear Fuel Cycle and Materials Technologies

Objective

To advance the development and implementation of an increasingly safe, reliable, economically efficient, proliferation resistant and environmentally sustainable nuclear fuel cycle, providing the maximum benefit to Member States. To implement relevant actions under the Action Plan, including the collection of data on damaged fuel and storage facilities at the Fukushima Daiichi nuclear power plant and the strengthening of information exchange on nuclear fuel under severe conditions.

Uranium Resources and Production

In planning the supply of uranium fuel for nuclear power plants, owners and operators require accurate information on uranium resources, production and demand worldwide. In September, the latest issue of the joint IAEA–OECD Nuclear Energy Agency publication *Uranium 2014: Resources, Production and Demand*, also referred to as the 'Red Book', was issued. The report estimates the total amount of identified conventional uranium resources recoverable at a cost of less than US $130 per kilogram of uranium (kg U) to be 5.9 million tonnes of uranium (Mt U), with 7.6 Mt U available at a cost of less than US $260/kg U, both of which represent increases from 2011 levels. Although overall the identified resource base has increased, there has been a significant reduction in lower cost resources — particularly in the category of resources recoverable at a cost of less than US $80/kg U — as resources have moved into higher cost categories, primarily due to increased mining costs. In 2012, the most recent year reported in the Red Book, uranium production worldwide was 58 816 tU, which is 7.4% higher than the 2011 production level. According to the report, three countries accounted for 63% of this production: Australia, Canada and Kazakhstan. These countries, together with China, Malawi, Namibia, Niger, the Russian Federation, Ukraine, the United States of America and Uzbekistan, accounted for 97% of global production. Despite depressed market prices for uranium, exploration and development expenditures increased to US $1.92 billion, an increase of about 22% from 2010 to 2012.

To assist Member States in identifying and extracting uranium resources, the Agency organized a series of meetings and training courses throughout 2014. For example, over 500 experts from 35 countries were trained in uranium geology, exploration, mining and processing in various interregional and regional courses and workshops held in Burkina Faso, Cameroon, China, Indonesia, Morocco, Niger and South Africa (Fig. 1). Meetings were held in Vienna on uranium exploration, uranium from unconventional resources and uranium as a by-product of metals mining, attracting some 80 experts.

"In September, the latest issue of the joint IAEA–OECD Nuclear Energy Agency publication Uranium 2014: Resources, Production and Demand, *also referred to as the 'Red Book', was issued."*

FIG. 1. Participants in a regional workshop on uranium resources held at Mintek, an organization specializing in mineral processing, in Johannesburg, South Africa.

Over 250 experts from more than 60 countries participated in the International Symposium on Uranium Raw Material for the Nuclear Fuel Cycle: Exploration, Mining, Production, Supply and Demand, Economics and Environmental Issues (URAM-2014), held in Vienna in June. All aspects of the uranium production cycle were discussed, including new initiatives such as innovative financing, 'smart mines' based on the use of state of the art technologies, integrated exploration and 'wealth from wastes'. About 90 oral presentations and 80 posters were presented. Issues highlighted during the symposium included the need for priority attention to social licensing and stakeholder engagement; the rollout of new technologies across the mining life cycle; and the focus on sustainable recovery and replacement of low cost resources.

A technical cooperation project on Supporting Sustainable Development of Uranium Resources continued to assist 29 countries in Africa through activities designed to address common priority needs in the region concerning uranium exploration, mining, processing and regulation. Using the available regional infrastructure and expertise, the project has enhanced regional cooperation. A main focus has been on developing teamwork and leadership skills such as planning and communication, so that planned uranium mining projects will not underperform due to inadequate project management. Over 100 regional and international experts participated in three workshops held in Austria, Morocco and South Africa throughout the year.

The Agency also provided focused assistance to francophone African Member States through a Peaceful Uses Initiative (PUI) project on Supporting Sustainable Uranium Mining in Less Prepared Areas. In workshops held in Burkina Faso, Cameroon and Niger, over 125 experts from ten countries discussed the pressing need to strengthen current national capabilities to optimize production, implement good practices and ensure effective management of the region's uranium endowment to match the predicted future growth in uranium activities.

Nuclear Power Reactor Fuel

The Agency undertook cooperative research and assisted countries in sharing information on the development, design, manufacture, use and performance of fuel for all types of nuclear power reactor. Water cooled fuels were a particular focus, as they represent the vast majority of the fleet of nuclear power plants.

In September, the Agency published *Pressurized Heavy Water Reactor Fuel: Integrity, Performance and Advanced Concepts* (IAEA-TECDOC-CD-1751). The report summarizes discussions at two Technical Meetings, held in Bucharest in 2012 and in Mumbai in 2013, on the topic of fuel integrity and performance, and advanced fuels for pressurized heavy water reactors (PHWRs). The publication provides updated information on the performance of PHWR fuels, the status and trends in the use of advanced fuels in PHWRs, and the technical readiness for deployment of such fuel cycles in these types of reactor. The objectives of a new coordinated research project (CRP) on Reliability of High Power, Extended Burnup and Advanced PHWR Fuels were also discussed.

The Agency organized a Technical Meeting on Trends in the Development of Advanced Fuels for Fast Reactors to facilitate the exchange of information on technological progress made in various aspects of fast reactor fuels and fuel cycles, as well as to identify major challenges associated with their development. The meeting, held in March in Kalpakkam, India, was attended by 32 participants from seven countries.

"The Agency undertook cooperative research and assisted countries in sharing information on the development, design, manufacture, use and performance of fuel for all types of nuclear power reactor."

During the Second Research Coordination Meeting on Near Term and Promising Long Term Options for the Deployment of Thorium Based Nuclear Energy, held in April in Milan, seven participating institutes presented their intermediate progress reports on the promising use of mixed thorium-plutonium oxide and thorium-uranium oxide fuels in water cooled reactors, high temperature gas cooled reactors and fast reactors, as well as thorium fuel in molten salt reactors. The initial joint work plan was adjusted to ensure successful finalization of this CRP.

In December, participants in the Technical Meeting on Characterization and Thermo-Physical Properties of Advanced Nuclear Fuels, held in Vienna, reviewed developments in and updated the measurements of thermophysical properties of uranium-plutonium oxide, carbide, nitride, and metallic fuels with and without minor actinides. The meeting participants also discussed the various challenges and developments in both destructive and non-destructive measurement techniques.

Following the completion of the FUMEX series of three CRPs on fuel modelling, carried out from 1993 to 2012 and focused mainly on normal nuclear power plant operations, a new CRP on Fuel Modelling in Accident Conditions (FUMAC) was initiated. The new CRP is being carried out in close cooperation with the OECD Nuclear Energy Agency, which manages the Joint OECD/NEA–IAEA International Fuel Performance Experiments (IFPE) Database, created and supported within the FUMEX project. The first FUMAC Research Coordination Meeting was held in November in Karlsruhe, Germany, at which 30 organizations from 20 countries defined a joint work plan for the 2014–2019 period.

At a Technical Meeting on Accident Tolerant Fuel Concepts for Light Water Reactors, held in October at the Oak Ridge National Laboratory in the United States of America, 60 experts from nine countries and two international organizations addressed the assessment of accident related behaviours of advanced, more accident tolerant nuclear fuels currently under development. A new CRP on Analysis of Options and Experimental Examination of Fuels for Water Cooled Reactors with Increased Accident Tolerance was also outlined.

Preliminary results of the CRP on the Evaluation of Conditions for Hydrogen-Induced Degradation of Zirconium Alloys during Fuel Operation and Storage, initiated just after the accident at the Fukushima Daiichi nuclear power plant, were discussed at the final Regional Coordination Meeting, held in Mito, Japan, in September. Later in the month, these preliminary results were reported at the Water Reactor Fuel Performance Meeting held in Sendai, Japan.

Management of Spent Fuel from Nuclear Power Reactors

Spent fuel storage is an interim step in the back end of the nuclear fuel cycle, the duration of which is dependent on national policy and strategy. Countries opting to dispose of spent fuel need to store it until deep geological disposal facilities become available. The first geological disposal facility is expected to be operational after 2020, and it will be several decades until such facilities are commonly available in countries with nuclear power programmes.

To ensure the safety of spent fuel in long term storage, a good understanding of the processes that may cause deterioration of both the spent fuel and the storage system is needed (Fig. 2). In 2014, work to increase understanding of these processes continued through the ongoing PUI funded CRP on Demonstrating Performance of Spent Fuel and Related Storage System Components during Very Long Term Storage (DEMO), which addresses the specific research needs of the dry storage demonstration tests set up in Japan and in the United States of America. The second Regional Coordination Meeting for this CRP was held in Tokyo in November. Another CRP on Spent Fuel Performance Assessment and Research — Phase III (SPAR-III), aimed at bridging knowledge gaps in this area, was completed in October.

FIG. 2. Experts check the confinement integrity of the spent fuel and the structural integrity of the reinforced concrete silos at the Embalse nuclear power plant's dry storage, in Argentina, one example of research on the very long term storage performance of spent nuclear fuel and related storage system components supported through Agency CRPs. (Photograph courtesy of CNEA/NASA.)

The importance of partitioning and transmutation (P&T) processes for sustaining nuclear energy growth has been recognized in several countries around the world. The 13th Information Exchange Meeting on Actinide and Fission Product Partitioning and Transmutation (IEMPT), organized jointly by the IAEA and the OECD/NEA and held in Seoul, Republic of Korea, was attended by 110 participants from 19 countries and two international organizations. Thirty-nine oral presentations and 64 posters were presented in sessions on fuel cycle strategies and transition scenarios, transmutation systems and infrastructure, fuels and targets for transmutation, advanced nuclear recycling, and waste management. The meeting highlighted the similarity of the motivations for developing national R&D programmes on P&T around the world, including reducing the waste burden for future generations.

The quantity of plutonium and other fissionable materials present in fast reactor spent fuels, their high burnup and the short time for cooling pose new challenges to the technology currently deployed for the reprocessing of spent fuels discharged from water cooled reactors. At an expert meeting held in June in Vienna, participants discussed various challenges regarding the reprocessing of used fast reactor fuels and emerging reprocessing technologies, and identified R&D needs towards improvements in reprocessing processes.

Spent fuel management activities are part of the implementation of the IAEA Action Plan on Nuclear Safety. The third meeting to collect and analyse data from the Fukushima Daiichi spent fuel storage facilities was held in June in Vienna and the second progress

FIG. 3. The Connect platform, launched in October, facilitates collaboration and sharing of information and experience among 11 networks sponsored by the Agency, including the Spent Fuel Management Network.

report, entitled "Status of the Spent Fuel Pools at Units 1 to 4 and Common Spent Fuel Pool at Fukushima Daiichi Nuclear Power Station", was drafted. This report, currently subject to a confidentiality agreement between the Agency and the Tokyo Electric Power Company (TEPCO), was finalized and submitted to TEPCO in 2014. In addition, a meeting to analyse design basis scenarios for spent fuel storage facilities and review the Specific Safety Guide on *Storage of Spent Nuclear Fuel* (IAEA Safety Standards Series No. SSG-15) in view of the lessons learned from the Fukushima Daiichi accident was held at Agency Headquarters in July.

A meeting on Lessons Learned in Spent Fuel Management, held in Vienna in July, was attended by 36 participants from 16 Member States and included reporting of activities related to the management of damaged and severely damaged spent fuel. Additional efforts in this area were the inclusion of the Spent Fuel Management Network on the CONNECT platform (Fig. 3),[1] which was launched in October, and plans for a new CRP on the Management of Severely Damaged Spent Fuel and Corium.

1 See: *http://www.iaea.org/OurWork/ST/NE/NEFW/WTS-Networks/CONNECT.html*.

Capacity Building and Nuclear Knowledge Maintenance for Sustainable Energy Development

Objective

To strengthen Member State capacities to use 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.

"In 2014, through a mix of e-learning courses and face-to-face training, approximately 600 energy analysts and planners from 70 Member States were trained in the use of the Agency's analytical tools for conducting national and regional studies of future energy strategies and the role of nuclear power."

Energy Modelling, Databanks and Capacity Building

The Agency continued to support Member States in building capacity for energy system planning and assessment of the potential contribution of nuclear power to meeting energy needs. In 2014, through a mix of e-learning courses and face-to-face training, approximately 600 energy analysts and planners from 70 Member States were trained in the use of the Agency's analytical tools for conducting national and regional studies of future energy strategies and the role of nuclear power. Efforts to enhance the tools also continued during the year, with the release of improved versions of MAED-D (Model for Analysis of Energy Demand) and SIMPACTS (Simplified Approach for Estimating Impacts of Electricity Generation). A simple tool for simulation and analysis of energy supply scenarios was also developed. These tools are now being used in research and planning institutions in 130 countries and have also been acquired by 20 international and regional organizations for use in their energy projects in developing countries.

Energy–Economy–Environment (3E) Analysis

In advance of the 20th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP20), the Agency published *Climate Change and Nuclear Power 2014*. The report, significantly updated since the 2013 edition, emphasizes the importance of nuclear energy in reducing carbon dioxide emissions from the electricity sector, and identifies nuclear power as a low carbon technology, along with wind and hydropower. The report concludes that any restriction on nuclear energy reduces the environmental effectiveness and increases the cost of climate protection measures.

The Agency continued its involvement with the United Nations High-Level Committee on Programmes Working Group on Climate Change and contributed to the Working Group's joint publication prepared for the United Nations Secretary-General's Climate Summit. At COP20 in December, the Agency reported on its climate change mitigation work at a United Nations system side event and provided information on climate change and nuclear

power, sustainable energy development and other related issues at its information booth (Fig. 1).

A special issue of the *International Journal of Global Energy Issues* was published in October, and a publication entitled *Techno-economic Comparison of Geological Disposal of Carbon Dioxide and Radioactive Waste* (IAEA-TECDOC-1758) was issued by the Agency in December. The two publications provide information to help countries assess options for the disposal of waste from fossil based and nuclear power generation technologies. The Agency also edited a special supplement to *Energy Policy*, entitled 'Nuclear Energy and Sustainable Development: Selected Topics', which was published in December. The articles included in the supplement demonstrate the potential contribution of nuclear energy to addressing the challenge of sustainable development in natural resource management, the environment, human health and water supply.

FIG. 1. At its information booth at COP20, the Agency provided visitors with information on nuclear power as a low carbon source of electricity.

Participants from 16 countries attended a meeting on Financial Modelling for Nuclear New Build held in Vienna in November. In December, the Agency launched a coordinated research project (CRP) on Assessing the National and Regional Economic and Social Effects of Nuclear Programmes. Under this CRP, participants from 11 countries and the OECD Nuclear Energy Agency are developing analytical tools for assessing the social and economic impacts of nuclear energy programmes. The tools developed will assist policy makers in analysing key implications of construction and operation of nuclear power plants.

Nuclear Knowledge Management

Knowledge Management Assist Visits continue to be an important service provided by the Agency. Three assist visits were conducted in 2014: one to the United Arab Emirates' Federal Authority for Nuclear Regulation in January; one to the Russian Federation's State Atomic Energy Corporation 'Rosatom' in July; and one to the Tianwan nuclear power plant in China in October. These visits focused on improving understanding of the strategic importance, shared responsibilities and specific challenges of sustaining the nuclear knowledge base needed for high levels of safety in nuclear organizations, and on sharing experience on related programme implementation.

During the year, the Agency developed the collaboration framework for the International Nuclear Management Academy (INMA) and the competency requirements to be taught in INMA programmes. As part of this process, four missions were undertaken to participating institutions: the National Research Nuclear University MEPhI in the Russian Federation; the University of Tokyo in Japan; the University of Manchester in the United Kingdom; and Texas A&M University in the United States of America.

The fifth annual Joint ICTP–IAEA Nuclear Energy Management School (NEMS), held in November at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, and the third annual NEMS held in Tokyo and Tokai-Mura, Japan, in June, were attended by 72 participants. In addition, 41 young professionals participated in the tenth annual ICTP–IAEA Nuclear Knowledge Management School (NKMS), held in Trieste

in August. In November, an NKMS was held in the Republic of Korea for the first time. Hosted by the Korea Atomic Energy Research Institute (KAERI), the NKMS attracted 22 participants from the region.

The Agency continued to support the activities of, and collaboration among, regional nuclear education networks, including the AFRA Network for Education in Science and Technology (AFRA-NEST), the Asian Network for Education in Nuclear Technology (ANENT) and the Latin American Network for Education in Nuclear Technology (LANENT). Close collaboration with the European Nuclear Education Network (ENEN) Association continued during the year. At a consultancy meeting held in January in Vienna, several universities from central and eastern Europe confirmed their interest in forming a regional nuclear education network, provisionally called the Regional Network for Nuclear Education and Training in Nuclear Technology (STAR-NET).

In July, the Agency published *Nuclear Engineering Education: A Competence Based Approach to Curricula Development* (IAEA Nuclear Energy Series No. NG-T-6.4). The book is being used as a model for developing nuclear education curricula and as a framework for benchmarking nuclear education.

The Cyber Learning Platform for Nuclear Education and Training (CLP4NET) continued to be recognized by the regional educational networks as an effective learning management system platform for capacity building, supporting the delivery of high impact on-line learning. CLP4NET was used for various Agency education and training activities during the year, including the NEMS and pre-training courses on nuclear knowledge management and radiation protection of patients, involving the training of over 400 students. New courses were made available on the platform in 2014 in areas such as food irradiation, oncology and training for nuclear medicine professionals.

"Over 115 000 metadata records and 8000 new full texts were added to the INIS Collection during the year."

Collection and Dissemination of Nuclear Information

In 2014, Afghanistan joined the International Nuclear Information System (INIS), the Agency's largest document database, operated in collaboration with 129 Member States and 24 international organizations. INIS now comprises over 3.7 million records and more than 492 000 full texts not readily available through commercial channels. Over 115 000 metadata records and 8000 new full texts were added to the INIS Collection during the year.

The INIS Collection Search offers a single point of access to the Agency's INIS and NUCLEUS databases and the Library catalogue. The INIS Collection was made searchable through Google.com and Google Scholar in 2014, which helped increase the annual page views to 3.4 million and yearly document downloads to over 420 000. Assistance and training were provided to a number of national INIS centres, improving all aspects of their INIS operational capabilities. The INIS/ETDE Thesaurus, prepared jointly with the IEA Energy Technology Data Exchange (ETDE), was expanded and now contains almost 31 000 well defined descriptors. The interface of the INIS Multilingual Thesaurus was updated, allowing browsing of the INIS Collection directly from the INIS/ETDE Thesaurus.

The 37th Consultative Meeting of INIS Liaison Officers took place in Vienna in October, attended by representatives of 49 Member States and six international organizations. A number of recommendations were made regarding INIS input preparation, the INIS/ETDE Thesaurus, digital preservation, further enhancement of the INIS Collection Search, INIS web sites, capacity building, outreach and promotion, and the future direction of INIS development. A special iPhone app was developed for the IAEA Scientific Forum offering background and logistics information, the meeting agenda and related documents, as well as important contact information.

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 from 20 000 in 2013 to over 28 000 in 2014. More than 14 000 people visited the Library in 2014, and 30 000 documents were loaned out. Responding to customer requests for tailored packaging of nuclear information products and services, personalized user profiles reached 1297 and the number of information packages delivered increased to 71 203.

Fulfilling the Agency's mandate of fostering information exchange, membership in the International Nuclear Library Network, coordinated by the IAEA Library, grew to 52 partners. The three new members are the Nuclear Energy Department of the Ministry of Economy of Poland, the ITER Document Control Section and the Saints Cyril and Methodius National Library of Bulgaria.

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.

Atomic and Nuclear Data

"The Agency's databases of nuclear, atomic and molecular data… [received] more than two million hits per month in 2014, a 32% increase over 2013."

The Agency's databases of nuclear, atomic and molecular data that form the basis of all power and non-power nuclear applications continued to serve as a valuable resource for Member States,[1] receiving more than two million hits per month in 2014, a 32% increase over 2013. In addition, almost 170 000 documents were downloaded in that time period.

During the year, the Agency continued to coordinate the International Network of Nuclear Reaction Data Centres (NRDC) and the International Network of Nuclear Structure and Decay Data Evaluators (NSDD). A Technical Meeting on the International Network of Nuclear Reaction Data Centres was hosted by the Slovak Academy of Sciences in May, with 22 participants representing 13 centres in eight countries. Fifty-six working papers were presented at the meeting, and the results of the discussions were summarized in 31 conclusions and 89 actions. The Experimental Nuclear Reaction Data (EXFOR) database, the main product of the network, covers more than 20 500 experiments, with more than 400 added in 2014. Nuclear structure data were regularly updated and maintained by the NSDD throughout the year.

Through the OECD Nuclear Energy Agency's Collaborative International Evaluated Library Organization (CIELO) project, the Agency contributed to efforts to address discrepancies in evaluated data. Specifically, the Agency made substantial contributions to data on uranium isotopes, in particular uranium–238.

The current status of the analysis and utility codes used for the Evaluated Nuclear Structure Data File (ENSDF) was assessed during a Technical Meeting on Improvement of Analysis Codes for Nuclear Structure and Decay Data Evaluations, held at Agency Headquarters in June. Meeting participants also drew a road map for updating and maintaining existing codes and developing new ones. In a Technical Meeting on Current Status of Neutron Standards, held at Headquarters in December, meeting participants from ten countries reviewed new experiments for inclusion in the neutron cross-section standards database and assessed the progress toward releasing a new set of neutron standards in 2016.

[1] See: *https://www-nds.iaea.org/*.

The Isotope Browser, introduced in 2013 as an Android app, was released as an app for Apple devices in 2014. During the year, the Isotope Browser was downloaded more than 12 000 times.

A Technical Meeting on Uncertainty Assessment and Uncertainty Propagation for Calculated Atomic and Molecular Data, held jointly with the Institute for Theoretical Atomic, Molecular and Optical Physics (ITAMP) in Cambridge (United States of America) in July, provided a forum for participants to discuss ways to obtain reasonable uncertainty estimates for calculated atomic and molecular cross-sections.

Three coordinated research projects (CRPs) — on Development of a Reference Database for Particle-Induced Gamma Ray Emission (PIGE) Spectroscopy, on Prompt Fission Neutron Spectra for Actinides and on Spectroscopic and Collisional Data for Tungsten from 1 eV to 20 KeV — were concluded during the year.

The Agency and the Abdus Salam International Centre for Theoretical Physics (ICTP) conducted three training workshops during the year: a Workshop on Nuclear Structure and Decay Data: Theory and Evaluation, held in March; a Workshop on Nuclear Reaction Data for Nuclear Power Applications, held in September; and the ITER–IAEA–ICTP Advanced Workshop on Fusion and Plasma Physics, held in August with the International Thermonuclear Experimental Reactor (ITER) to examine models and data for plasma–material interactions in fusion devices. Through these workshops and an EXFOR workshop held in Vienna in October, 99 participants from 34 countries received training in 2014.

Research Reactors

Improving utilization

"In 2014, the Agency received and reviewed strategic [utilization and business] plans from 23 research reactor organizations."

The development and implementation of strategic utilization and business plans for research reactors is becoming increasingly important for preventing underutilization and for exploring opportunities for additional revenue generation. In 2014, the Agency received and reviewed strategic plans from 23 research reactor organizations. The resulting Training Workshop on Development of Research Reactor User Communities and Industrial Partnerships, held in Vienna in October, enabled 33 participants representing 20 Member States and four external experts to share good practices and lessons learned from the preparation, review and implementation of strategic utilization and business plans at their individual facilities.

In cooperation with the International Group on Research Reactors (IGORR), the Agency held the Joint 2014 IGORR Conference–IAEA Technical Meeting on Enhanced Utilization of Zero Power Reactors and Subcritical Assemblies, in Bariloche, Argentina, in November. Around 200 participants from 26 countries attended the event, where approximately 100 oral presentations were given and 50 posters were presented covering all topical areas of research reactors and highlighting new projects in Argentina, Brazil, France, Jordan, the Republic of Korea, the United States of America and Viet Nam.

In cooperation with AFRA and the Agency, the Algerian Atomic Energy Commission (COMENA) hosted the Eighth African Conference on Research Reactor Utilization and Safety, held in Algiers in December. The event outlined aspects of enhanced research reactor utilization, improved safety, integrated management, business planning and regional cooperation. More than 50 participants representing 18 Member States attended the event.

The Agency published a number of books on research reactor utilization during the year, including *Applications of Research Reactors* (IAEA Nuclear Energy Series No. NP-T-5.3), *Development and Applications of Residual Stress Measurements Using Neutron Beams* (Technical Report Series No. 477), *Hands-on Training Courses Using Research Reactors and Accelerators* (Training Course Series No. 57) and *Compendium of Neutron Beam Facilities for High Precision Nuclear Data Measurements* (IAEA-TECDOC-1743).

Education and training

In 2014, the Agency continued to support the six week Group Fellowship Training Programme on Research Reactors, which was held twice during the year, covering research reactor safety, utilization, operation and maintenance. The courses were hosted by the Atominstitut in Austria; the Czech Technical University in Prague and the Research Centre Řež in the Czech Republic (Fig. 1); and the Budapest University of Technology and Economics in Hungary. The programme included guest lecturers from the Jožef Stefan Institute in Slovenia, part of the Eastern European Research Reactor Initiative. Since 2009, 66 students from around the world have benefitted from the fellowship training programme.

FIG. 1. Neutron detection experiment demonstrated at the VR1 research reactor at the Czech Technical University in Prague, part of the Group Fellowship Training Programme on Research Reactors. (Photograph courtesy of CTU Prague.)

"The Agency continued to support Member State requests to minimize civilian use of high enriched uranium"

Infrastructure

A workshop held in Vienna in May provided Member States with practical information on applying the guidance in *Specific Considerations and Milestones for a Research Reactor Project* (IAEA Nuclear Energy Series No. NP-T-5.1). The workshop served as a forum for 50 participants from 30 Member States to share their experience, challenges and lessons learned during the development and implementation of new research reactor projects. A related Training Workshop, held at Agency Headquarters from 29 September to 1 October and attended by 37 participants from 23 Member States, focused on the technical requirements in the bidding process for a new research reactor. Expert missions on an integrated approach to the establishment of safety and technical infrastructure of new research reactor projects were carried out to Kuwait, Saudi Arabia, South Africa and the United Republic of Tanzania. The missions provided guidance on applying the 'Milestones' approach.

Research reactor fuel

The Agency continued to support Member State requests to minimize civilian use of high enriched uranium (HEU). During the year, 53 kg of spent HEU fuel from Poland as well as 10.2 kg of fresh HEU fuel and 37.3 kg of spent HEU fuel from Kazakhstan (Fig. 2) was repatriated to the Russian Federation. Liquid HEU fuel was discharged from

FIG. 2. Transport containers containing fresh HEU fuel are prepared to be returned to the Russian Federation from Almaty, Kazakhstan.

the 'FOTON' research reactor in Uzbekistan and a project to carry out its decommissioning was launched in December.

An agreement was finalized to support the conversion of the Miniature Neutron Source Reactor (MNSR) in Ghana from the use of HEU fuel to low enriched uranium (LEU) fuel. At Ghana's request, the Agency provided assistance in preparing for the return of the irradiated HEU MNSR core from Ghana to China by convening four consultancy meetings and conducting a site survey mission at the GHARR-1 facility in Accra, Ghana, in 2014. In December, representatives of each country hosting an MNSR, as well as stakeholders supporting the HEU conversion and removal activities, participated in a Technical Meeting on the Conversion of Miniature Neutron Source Reactors from High Enriched Uranium to Low Enriched Uranium Fuel, held in Vienna.

In June, Viet Nam hosted the Eighth Technical Meeting on Lessons Learned from the Russian Research Reactor Fuel Return (RRRFR) Programme, attended by 83 participants from 16 countries. The event included updates on HEU minimization projects for HEU originating from China and the United States of America. Representatives of the research reactor community, including experts from developing Member States, attended the 18th International Topical Meeting on Research Reactor Fuel Management (RRFM) in Ljubljana, Slovenia, held in cooperation with the Agency from 30 March to 3 April, as well as the 35th Annual International Meeting on Reduced Enrichment for Research and Test Reactors (RERTR), hosted by the Agency in Vienna in October.

Operation and maintenance

A Workshop on the Implementation of Integrated Management Systems for Research Reactors, held in Vienna in November, was attended by 24 participants from 21 Member States. The workshop presented the Agency's Safety Requirements publication *The Management System for Facilities and Activities* (IAEA Safety Standards Series No. GS-R-3) and the main concepts of a management system for nuclear facilities and activities. Participants shared experience, challenges and lessons learned on the development, implementation and continuous improvement of management system aspects of research

reactors. A mission to Peru provided assistance to the RP10 reactor regarding maintenance and ageing management programmes, and assisted in improving safety culture.

The second Research Coordination Meeting of a CRP on Improved Instrumentation and Control (I&C) Maintenance Techniques for Research Reactors using the Plant Computer, held at Agency Headquarters in February, reported significant progress, making a third Research Coordination Meeting unnecessary. A consultancy meeting to finalize the report was held in December.

The second Research Coordination Meeting of a CRP on the Establishment of a Material Properties Database for Irradiated Core Structural Components for Continued Safe Operation and Lifetime Extension of Ageing Research Reactors was held in Daejeon, Republic of Korea, in November. Data gaps that had been identified in the compiled database were assessed and actions to address these gaps are being undertaken.

Accelerator Applications and Nuclear Instrumentation

"The Agency's Nuclear Science and Instrumentation Laboratory completed the installation of a beam line end station at the synchrotron facility at Elettra, in Trieste, Italy"

The Agency's Nuclear Science and Instrumentation Laboratory completed the installation of a beam line end station at the synchrotron facility at Elettra, in Trieste, Italy (Fig. 3). Systematic evaluation of the facility demonstrated the excellent performance of this advanced experimental set-up, which integrates different variants of the X ray fluorescence technique. The first Coordination Meeting of the CRP on Experiments with Synchrotron Radiation for Modern Environmental and Industrial Applications took place in July at the Elettra synchrotron facility, with participants from 16 Member States. Eight groups from the CRP later conducted synchrotron radiation experiments.

As part of a regional technical cooperation project, the Agency conducted a week long training course at the Elettra synchrotron facility on Utilization of Synchrotron Radiation Techniques for Advanced Analytical Studies on Air Pollution. In collaboration with ICTP, the Agency also held a two week school on Novel Experimental Methodologies for Synchrotron Applications in Nano-Science and Environmental Monitoring, also in Trieste, Italy. Both events included hands-on experimental sessions at the Agency's beam line end station.

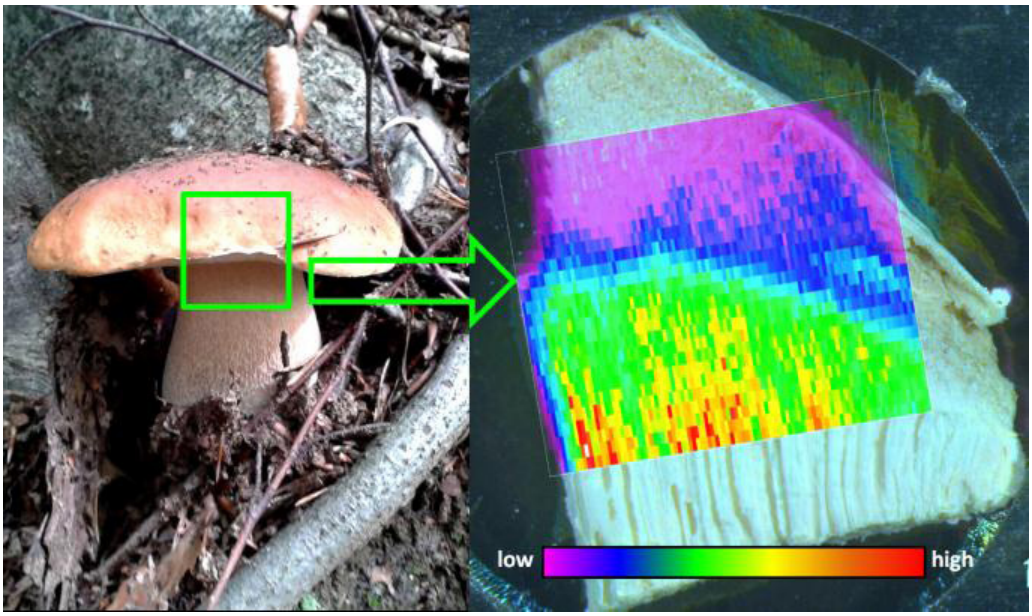

FIG. 3. Experimental results from the Agency's new beam line showing the distribution of selenium in the cap of an edible mushroom (Boletus edulis); XRF imaging, 2.5 mm × 5 mm, 141 × 50 µm, 13 keV excitation energy. (Photographs courtesy of K. Vogel-Mikus.)

Nuclear Fusion

In October, more than 850 participants from 39 Member States attended the 25th IAEA Fusion Energy Conference in Saint Petersburg, Russian Federation. The conference provided a review of the recent advances and achievements in physics and technology required for demonstration of electricity production from fusion and the substantial progress in the construction of ITER, a project to demonstrate self-sustained fusion energy generation in excess of 500 MW (Fig. 4). Activities aimed at closing the gaps between ITER and a demonstration fusion plant at industrial scale were presented. Participants agreed that the following were key areas for future focus: blanket and radiochemistry technologies; systems integration; technologies for the steady-state operation of fusion systems; and technologies for fusion–fission hybrid systems.

FIG. 4. Aerial view of the 42 hectare ITER platform at the end of 2014, with visible progress in the construction of office and functional buildings. (Photograph courtesy of ITER.)

Support to ICTP

In 2014, the Agency, in cooperation with ICTP, provided training to more than 500 participants from a number of Member States in 12 joint workshops on various topics of relevance to both organizations and supported 12 young scientists from developing countries through STEP (Sandwich Training Educational Programme) fellowships. STEP Fellows carry out part of their doctoral research work under a mentor from a developed country, gaining insight and experience in advanced research. The students are expected to enrich the R&D capabilities in their home countries. Over the past decade more than 120 students have received a STEP fellowship.

Food and Agriculture

Objective

To contribute to 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 in and technology transfer to Member States.

Animal Production and Health

"The Agency contributed to global efforts to combat [Ebola virus disease] by providing diagnostic advice, equipment and reagents to Member States at risk."

Advances in transportation and technology have led to the unprecedented movement of people and goods in recent decades. As a consequence, pathogens can now be transferred farther and faster than ever before, bringing outbreaks of disease into previously non-endemic areas. The recent outbreaks of avian influenza H5N1 and H7N9, the spread of African swine fever from Africa to Europe and the outbreaks of bluetongue in Central and Western Europe demonstrate that new epidemiological approaches and solutions are needed. Furthermore, over 75% of human infectious diseases are zoonotic, which means they have a proven origin in animals. The 13 most important zoonotic diseases account for 2.2 million deaths and 2.4 billion new infections in humans each year.

The Veterinary Diagnostic Laboratory (VETLAB) network of veterinary institutes and laboratories is a platform for information exchange on animal health that facilitates technology and knowledge transfer among Member States. Through the network, experts share information on animal production and health procedures, and on emergency response to animal disease outbreaks. At the end of 2014, the VETLAB network included national laboratories in 32 African countries, with plans to extend the network to 17 countries in Asia.

The 2014 epidemic of Ebola virus disease (EVD), the largest such outbreak in history, has affected multiple countries in West Africa and claimed nearly 9000 lives. The Agency contributed to global efforts to combat EVD by providing diagnostic advice, equipment and reagents to Member States at risk. An off-cycle technical cooperation project was developed to improve Member State capacities to respond to emerging and re-emerging zoonotic diseases, such as EVD.

A project was also launched, with funding through the Peaceful Uses Initiative (PUI), to establish and strengthen national teams of virologists and to provide them with training and equipment to perform disease diagnosis, including diagnosis of EVD, using relevant nuclear-derived techniques and maintaining high levels of biosafety in the work environment. As programme support, the project includes a comprehensive capacity building package on biosecurity issues related to EDV, including sampling, and rapid and specific diagnostic techniques.

In addition, the Agency provided support to 13 Member States — Argentina, Bangladesh, Brazil, Burkina Faso, China, Ethiopia, Indonesia, Islamic Republic of Iran, Madagascar,

Myanmar, Nigeria, Pakistan and Sri Lanka — for the development of laboratory capacity for genetic characterization of indigenous animals. The Agency also provided support to nine Member States — Burkina Faso, Cambodia, Eritrea, Kenya, Madagascar, Myanmar, Sierra Leone, Thailand and Zambia — for strengthening artificial insemination services. Also in 2014, novel research on enzyme treatment of crop residues and tropical forage resulted in up to a 20% increase in fibre degradability and a 15% reduction in methane emissions.

Food and Environmental Protection

The International Symposium on Food Safety and Quality: Applications of Nuclear and Related Techniques, held at Agency Headquarters in November, attracted more than 300 participants from around the world. The symposium underlined the importance of developing novel, cost effective food authenticity and traceability testing techniques and systems. It also emphasized the continuing need for methods to detect and control agrochemical residues and contaminants, and highlighted recent developments and initiatives in food irradiation.

Having access to proven analytical methods is one of the biggest challenges faced by food control institutions in Member States. The Agency has been developing laboratory networks and on-line tools to support expanded access to nuclear and related analytical methods to improve food safety. Based on the successful model of the Latin American and Caribbean Analytical Network (RALACA), an African Food Safety Network (AFoSaN) was established in 2014.

The increasing commercial use of food irradiation as a phytosanitary treatment is helping producers reach markets that had previously been closed owing to insect pest related trade restrictions. Standards and guidelines supported and developed by the Agency in collaboration with Member States provide the framework for this trade. Developing and making available different irradiation techniques will facilitate future adoption of the technology. In this regard, research on, and support for, the use of machine generated food irradiation technologies (e.g. electron beams, X rays) included an international consultants meeting, held in June at Agency Headquarters, where 24 representatives of 18 radiation processing companies provided input on the effective use of these technologies. Also, meetings held in Mexico and the United States of America marked the beginning of a technical cooperation project aimed at making more use of machine sources to complement radionuclide facilities in the Caribbean and Latin America region and at increasing existing capacity. In addition, a coordinated research project (CRP) on Development of New Applications of Machine Generated Food Irradiation Technologies was designed at a consultants meeting held at Agency Headquarters in June.

Sustainable Management of Major Insect Pests

Insect pests are a major threat to human health and food security. The burden of mosquito transmitted diseases is enormous, with the incidence of dengue, malaria and other diseases increasing dramatically around the world. Compounding the problem, chemical control measures are becoming less effective as mosquitoes develop resistance to insecticides. The Agency supports Member States in the use of the sterile insect technique (SIT) as a means to combat mosquitoes and the diseases they transmit. Mosquito larvae mass-rearing methods are being researched to increase the scale of production and the impact of the use of SIT against mosquitoes (Fig. 1). In response to the demand for innovative mosquito control methods, a Thematic Plan for the Development and Application of the Sterile Insect Technique (SIT) and Related Genetic and Biological Control Methods for Disease

FIG. 1. Maturing mosquito larvae feeding in water, with spiracles pointed upward to the water surface for respiration. (Photograph courtesy of J. Reyes.)

Transmitting Mosquitoes was developed by Agency and external experts, including a representative of the World Health Organization. The plan reviews the current status of the management of malaria, dengue, chikungunya and yellow fever vectors, identifies research gaps, and provides guidance on opportunities and required policies to manage these diseases in a more sustainable and environmentally friendly way.

Fruit flies damage fruit and vegetables, reduce the quality of produce and create trade barriers owing to the quarantine regulations of importing countries. Dragon fruit is the most important fruit export commodity of Viet Nam, but fruit fly infestation is a major phytosanitary problem in the country, necessitating effective pre- and post-harvest treatments to meet the regulations of importing countries. Since 2013, the Agency has been supporting a pilot project in Binh Thuan Province to demonstrate the effectiveness of area-wide fruit fly suppression. In 2014, through continuous area-wide trapping to measure the adult fly population densities and through fruit sampling to measure the larval infestation in fruit, the project was proven to be successful in the pilot area, which has since been expanded. As a result, the possibility of using sterile flies as an additional suppression method is now under consideration, especially for markets requiring low insecticide residues.

A ten year international collaborative effort that involved the Agency through its Insect Pest Control Laboratory, part of the FAO/IAEA Agriculture and Biotechnology Laboratories in Seibersdorf, culminated in the sequencing of the tsetse genome. This development will allow scientists to better study the fly's genes and their functions, knowledge that should open the door for improved control. The initial findings were published in the journal *Science* in April 2014.

Another global research effort, involving 33 institutes in 20 countries working as part of a CRP entitled Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to SIT Application and International Trade, culminated in the synonymization of four major fruit fly pests that number among the most important invasive insect species. The CRP results resolve a major biosecurity issue, as confirmation that the four species are actually one and the same is central to quarantine, agricultural trade and management of these insect pests through the integrated application of SIT.

Crop Improvement through Mutation Breeding

Annual global losses from a new strain of wheat black stem rust (Ug99) are estimated at 8.3 million tonnes of wheat worth some US $1.23 billion. The Agency has been assisting Member States in addressing this problem through an interregional technical cooperation project entitled Responding to the Transboundary Threat of Wheat Black Stem Rust (Ug99). The project was completed in 2014, having successfully identified 350 distinct wheat plants with varying levels of resistance to black stem rust, which were then developed into lines (Fig. 2). Two mutant wheat varieties resistant to black stem rust Ug99 — Eldo Ngano 1 and Eldo Mavuno 1 — were officially released in Kenya.

FIG. 2. A mutant wheat variety resistant to wheat black stem rust (Ug99) identified during a technical cooperation project aimed at responding to this devastating transboundary threat; 350 distinct wheat plants with varying levels of resistance to black stem rust were identified over the course of the project, which concluded in 2014.

"Two mutant wheat varieties resistant to black stem rust Ug99 — Eldo Ngano 1 and Eldo Mavuno 1 — were officially released in Kenya."

The CRP on Improving Nutritional Quality by Altering Concentrations of Enhancing Factors Using Induced Mutation and Biotechnology in Crops was also completed in 2014, having produced more than ten stable rice mutants. In all, 30 new mutant cultivars in 15 crops were released to farmers in 12 Member States during the year.

On the occasion of the 50th anniversary of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, the Agency presented the Plant Mutation Breeding Awards to recognize Member States' achievements in plant breeding. An international selection panel identified five Outstanding Achievement Awardees and 18 Achievement Awardees. The awards were presented at a side event of the IAEA General Conference in September.

Through its Plant Breeding and Genetics Laboratory, in 2014 the Agency developed a new kit for molecular characterization of induced and natural mutations. The kit, the third in a series, is being distributed to researchers, upon request, to foster the application of molecular tools for crop improvement in countries that do not have advanced molecular laboratories.

In cooperation with counterparts from Kenya, Lesotho and Morocco, new in vitro methods for mutation induction in potato were developed. The new methods reduce the time required for developing new mutant varieties, meaning that varieties can reach farmers in a much shorter time and breeders can react more quickly to new challenges.

Soil and Water Management and Crop Nutrition

Land degradation currently affects 1.9 billion hectares around the world, representing around 65% of global soil resources. Not only does land degradation lead to declines in productivity and increases in biodiversity loss, it also affects vital soil–water ecosystem

functions and services, and increases regional vulnerability to climate change, all of which are linked to social, economic and environmental impacts.

Soil erosion is the main process of land degradation. Through a regional project entitled Improving Soil Fertility, Land Productivity and Land Degradation Mitigation, scientists from 14 countries — Australia, Bangladesh, China, Indonesia, Republic of Korea, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam — have been using fallout radionuclides (FRNs) and compound-specific stable isotope techniques to meet the challenge of protecting soils from soil erosion. These nuclear techniques are used to gather information on soil erosion rates in agricultural landscapes and to identify hot spots of land degradation. Such information helps farmers and land users to minimize soil erosion, make the best use of soil resources and improve agricultural land management. For example, since the project began in 2012, by implementing appropriate conservation measures, soil erosion rates have been reduced by an average of 48% in the study area in China and by 45% in coffee plantations in Viet Nam's Lam Dong Province. A new Agency publication, *Guidelines for Using Fallout Radionuclides to Assess Erosion and Effectiveness of Soil Conservation Strategies* (IAEA-TECDOC-1741), on the use of FRNs to assess soil erosion magnitude in agricultural lands, was published in 2014. The guidelines provide researchers with step by step guidance and up to date information on the use of FRNs to assess soil erosion rates of agricultural lands. These can then be used for developing management practices to minimize land degradation and improve land productivity and environmental sustainability.

"In 2014...the Agency developed an information system linking data management and visualization using the latest information technology applications."

Through an interregional technical cooperation project entitled Assessing the Impact of Climate Change and Its Effects on Soil and Water Resources in Polar and Mountainous Regions, 35 experts from over 20 countries attended a coordination meeting in June to prepare strategies and protocols for investigations at 13 benchmark sites around the world aimed at assessing the impact of climate change on land, water and ecosystem quality. A consultants meeting on Soil and Water Conservation for Climate Change Adaptation in Agricultural Uplands was held in December to enhance and complement the research being carried out within this technical cooperation project.

Emergency Preparedness and Response

The Agency coordinates international research aimed at developing and evaluating electronic platforms for innovative agricultural data collection and assessment. The goal is to develop platforms that can be used not only for routine agricultural monitoring, but also for emergency response to nuclear or radiological incidents. This work also aims at stimulating the development of electronic methods of maintaining, sharing and visualizing food and agricultural monitoring data. An early success was the development, in 2014, of an innovative geovisualization tool that makes use of a novel programming approach to provide capabilities such as automatic scaling of mapped data. The new tool is already being used by the incident response community.

To facilitate timely decisions for enforcing food restrictions in the case of a nuclear emergency, simple data management and geovisualization of radionuclide concentrations in food are needed for effective emergency communication. In 2014, through a CRP entitled Response to Nuclear Emergency affecting Food and Agriculture, the Agency developed an information system linking data management and visualization using the latest information technology applications. The system allows international organizations to improve their follow-up on the nuclear emergency response for food safety at the national and international levels. The system is currently being validated.

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 techniques within a framework of quality assurance.

Malnutrition in Early Life

Poor nutrition in early life can have long term consequences, including reduced body size (stunting), diminished cognitive development, and a higher risk of metabolic disorders and chronic diseases later in life. The Agency is assisting Member States in the evaluation of programmes designed to prevent and treat malnutrition in early life through capacity building in the use of stable isotope techniques to assess changes in body composition (i.e. the relative amounts of fat and lean tissue), as well as the bioavailability of nutrients in foods used to prevent and treat malnutrition.

In May, the Agency hosted an International Symposium on Understanding Moderate Malnutrition in Children for Effective Interventions. The symposium, which brought together over 350 participants from 63 countries, concluded that better tools are required to evaluate interventions to prevent and treat malnutrition. In addition, there was agreement that changes in height and weight do not provide sufficient information on body composition, which is a better indicator of health risk. The potential of stable isotope techniques to determine successful approaches to combating malnutrition, and the Agency's contributions in this area, were recognized.

Building Capacity with Distance Assisted Training for Nuclear Medicine Professionals through the Human Health Campus

In recent years, advances in the field of hybrid diagnostic imaging techniques, novel analysis methods and computed tomography procedures have been broadly adopted by medical facilities around the world. In concert, there has been growing awareness that the safe management and use of radiation in medicine depends on well trained medical professionals. While Member States have made noteworthy investments in nuclear medicine, gaps in expertise remain. In some regions, the nuclear medicine discipline has not yet reached the critical mass necessary to justify targeted training programmes; elsewhere, the available training programmes need to be updated to meet the evolving requirements of the field.

To address these skills gaps, in September the Agency officially launched the Distance Assisted Training Online (DATOL) programme, a three year professional training

programme available through the Agency's Human Health Campus. A side event was held at the 58th regular session of the Agency's General Conference to showcase the many benefits of DATOL and to promote its use among Member States. What began in 1996 as a paper based introduction to nuclear medicine technology is today a harmonized, web based, distance learning programme offering comprehensive on-line training resources covering fundamental concepts and practical applications. This on-line training platform is intended to further equip nuclear medicine professionals with the knowledge and skills necessary to conduct high quality studies and deliver safe, appropriate medical services.

New Developments in the Technology of Radiation Oncology

In 2014, the Agency published *A Handbook for the Education of Radiation Therapists (RTTs)* (Training Course Series No. 58). This publication presents the guiding educational principles as well as information on practical implementation of education programmes for radiation therapy technologists. In 2014, the handbook was recommended by the Association of Radiation Therapy Technologists of India (ARTTI) to the Ministry of Health and Family Welfare of India for use as the basis for establishing the country's national education programme in radiation therapy.

"the Agency hosted a side event at the 58th regular session of the Agency's General Conference highlighting technological developments in radiation therapy"

A collection of recorded radiotherapy seminars was made available on the Human Health Campus web site in 2014. These seminars, presented by international experts, address the present status of modern radiotherapy techniques. Also in 2014, the Agency hosted a side event at the 58th regular session of the Agency's General Conference highlighting technological developments in radiation therapy, including three dimensional conformal radiotherapy, intensity modulated radiotherapy and particle therapy.

The delivery of proton therapy on a wide scale is restricted by the limited availability of proton therapy machines owing to the extensive financial resources required. To investigate the relevance and future prospects of this emerging technology for low and middle income countries, the Agency held a consultants meeting that brought together 11 worldwide experts in the field of particle therapy. The meeting's conclusions on particle therapy facilities were that: a feasibility study should be carried out before any such project is undertaken; strong project management skills are very important; a small core group with multidisciplinary skills and specific experience is essential (as a minimum, a radiation oncologist, medical physicist and health administrator); and the national regulatory authority and all relevant stakeholders including professional societies need to be involved from the beginning of the project.

Quality Assurance and Metrology in Radiation Medicine

The Agency continued to focus on further improving and refining the guidelines on quality control and on education and training of medical physicists for the safe and effective use of radiation technology in medicine. In this context, two new Agency publications on quality control in nuclear medicine were published during the year: *PET/CT Atlas on Quality Control and Image Artefacts* (IAEA Human Health Series No. 27) and *Quantitative Nuclear Medicine Imaging: Concepts, Requirements and Methods* (IAEA Human Health Reports No. 9). The Agency also published *Diagnostic Radiology Physics: A Handbook for Teachers and Students*. Endorsed by the American Association of Physicists in Medicine, the Asia–Oceania Federation of Organizations for Medical Physics and the European Federation of Organisations for Medical Physics, the Handbook is expected to become a reference textbook for postgraduate medical physics education programmes.

In 2014, a Joint ICTP–IAEA Workshop on Determination of Uncertainties of Measurements in Medical Radiation Dosimetry was held at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. The workshop was attended by 50 participants from 34 countries. Its purpose was to familiarize lecturers and physicists working in radiation dosimetry with procedures and methodologies to be utilized for the determination of uncertainties in medical radiation dosimetry.

To ensure harmonization and consistency of radiation measurements, the Agency has conducted dosimetry audits for over 700 radiation beams used to treat cancer patients in Member State hospitals. The advantages for a radiotherapy centre of participating in such an audit are considerable, as this service provides assurance that the radiation dose delivered to cancer patients is in the acceptable range. In 2014, through the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories (SSDLs), the Agency calibrated 55 reference standards of SSDL Network members and conducted 16 interlaboratory comparisons with SSDLs (Fig. 1).

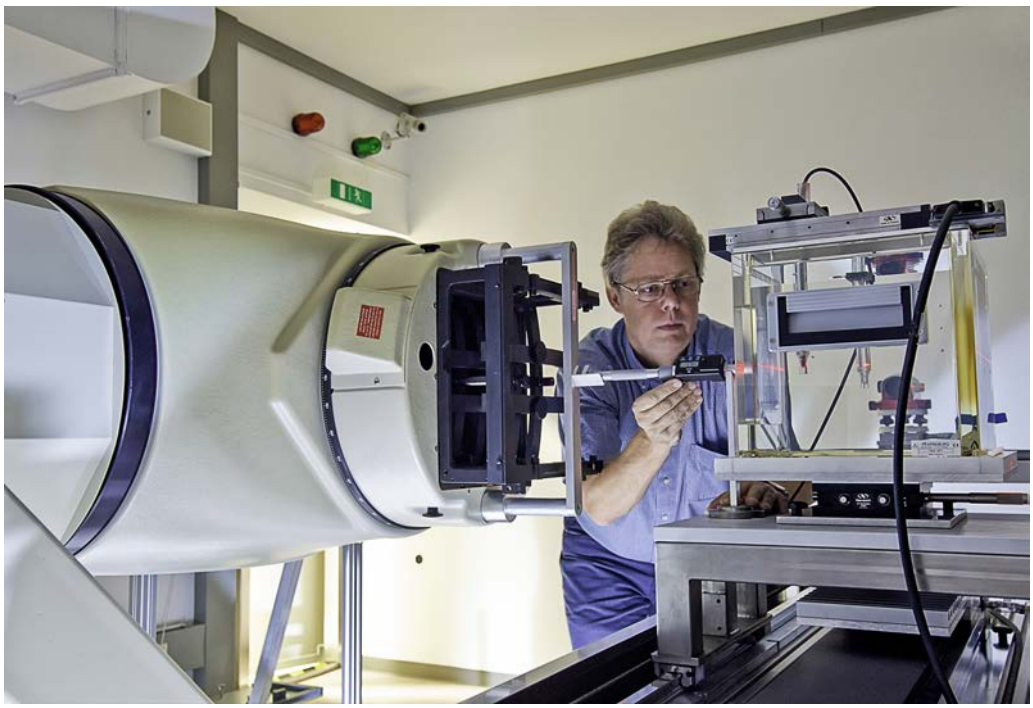

FIG. 1. Calibration measurement of dosimetry reference standards at the IAEA Dosimetry Laboratory.

The Agency's dosimetry services are operated under a quality management system based on the ISO/IEC 17025:2005 standard and are also approved by the European Association of National Metrology Institutes. As required by the quality system, the Agency completed two international dosimetry comparisons in 2014. The comparisons were held with the Primary Standards Dosimetry Laboratories of Germany's Federal Institute of Physics and Technology (PTB) and the D.I. Mendeleyev Institute for Metrology (VNIIM) in the Russian Federation. The results obtained confirm the high quality dosimetry capabilities of the Agency.

Water Resources

Objective

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

Hydrological Modelling

Sustainable water resource management is closely linked to development goals in many parts of the world. A number of the Agency's activities are aimed at providing Member States with science based information and technical skills to better understand and manage their water resources. In 2014, IWBMIso (IAEA Water Balance Model with Isotope inputs), a hydrological model for improving the assessment of water resources in river basins and watersheds, was made available to all Member States through the Agency's web site. Developed by the Agency in collaboration with Colorado State University in the United States of America, the model permits the use of stable isotopes of water to more reliably assess river flow and lake volumes. IWBMIso uses climate and related data from publicly available data sources to make assessments more seamless and less time consuming. Its usefulness was demonstrated through improved estimates of the water balance in the Upper Blue Nile and Lake Victoria watersheds in eastern Africa as part of a technical cooperation project entitled Adding the Groundwater Dimension in the Nile River Basin. Project counterparts were trained in the use of the model with isotope data collected within the project.

Assessing the Availability of Groundwater

The IAEA Water Availability Enhancement Project assisted the three pilot countries — Costa Rica, Oman and the Philippines — in addressing priority gaps in hydrological data and information. Water samples from rivers, lakes and aquifers were collected and analysed as part of the efforts to develop the first nationwide isotope hydrology maps. Nine workshops and training events were organized at the Agency's Headquarters and in Roorkee (India), Delft (the Netherlands), Muscat (Oman) and Manila (the Philippines) to strengthen the capacity of 102 water professionals to carry out isotope data collection and interpretation, as well as design of water resources monitoring networks. The Philippines completed preparation of groundwater aquifer vulnerability maps for Tuguegarao City in Cagayan Province (Region II) and Cagayan de Oro City in Misamis Oriental Province (Region X). In Oman, a plan for the final phase of the study of the Samail catchment was prepared and additional samples were collected.

In Latin America, a research project involving Argentina and Brazil was carried out aimed at developing advanced methods that can be adapted for local hydrological conditions to evaluate the sustainability and potential of the Guarani Aquifer, the region's largest transboundary freshwater reservoir. Naturally produced, long lived radionuclides and noble gases such as krypton-81, helium-4 and carbon-14 were used to estimate groundwater ages of up to 800 000 years. This critical information will improve aquifer management models, which were previously based on an incomplete understanding of aquifer hydrology. Another project funded by the Peaceful Uses Initiative is helping to strengthen cooperation among isotope and non-isotope hydrologists within Brazil to expand the use of isotope hydrology in the Guarani Aquifer and in other aquifers in Brazil.

A Technical Meeting on Surface Water and Groundwater Contamination Following the Accident at the Fukushima Daiichi Nuclear Power Plant was held in September, in cooperation with the United Nations Educational, Scientific and Cultural Organization (UNESCO). The meeting, attended by 16 experts from Japan and other countries, addressed issues related to the extent of contaminated groundwater at and in the vicinity of the Fukushima Daiichi nuclear power plant following the earthquake and tsunami in March 2011. The meeting reviewed the impact of environmental releases of radioactivity on surface water and groundwater systems, and the measures adopted by the Japanese authorities to manage contaminated groundwater. It also highlighted the importance of a priori characterization of detailed hydrogeological settings of nuclear power plant sites worldwide as a key to better addressing and managing any accidental releases of radioactivity.

"Naturally produced, long lived radionuclides and noble gases… were used to estimate groundwater ages of up to 800 000 years."

The second Research Coordination Meeting of the coordinated research project (CRP) entitled Estimation of Groundwater Recharge and Discharge by Using the Tritium-Helium-3 Dating Technique was held at Agency Headquarters in February. Twelve Member States participating in the project are field-testing the tritium–helium-3 isotope method for estimating aquifer recharge. The meeting reviewed the results obtained from around 500 water samples collected under different hydrological settings and formulated plans for the final phase of the CRP.

A Coordination Meeting for the CRP on Application and Development of Isotope Techniques to Evaluate Human Impacts on Water Balance and Nutrient Dynamics of Large Rivers was held at Agency Headquarters in October. More than 30 research groups in 17 Member States have embarked on detailed monitoring of isotopes and chemical tracers in 40 important river basins across the five continents. The intense Member State interest in this initiative illustrates the need for better methodologies for estimating the water balance of river basins, and for addressing water quality issues affecting surface waters. The isotope and related hydrological data sets generated within this CRP will constitute a major contribution to the Agency's Global Network of Isotopes in Rivers (GNIR).

In 2014, a new system for the electrolytic enrichment of tritium in large water samples (up to about 2 L) was tested. Advantages of the new system include detection of very low tritium activities (<0.01 mBq/L) with higher precision. Simplified data processing and reporting software for low level tritium analysis was developed in 2014. The new compact tritium enrichment system and accompanying software, to be made available to Member States in 2015, will substantially increase their capacity for integrating isotope hydrology into the water sector.

In October, participants from ten Member States took part in a one week training course on tritium analysis, with the goal of attaining improved operational competency in low level tritium measurements using the new enrichment system. Additionally, 12 participants from eight Member States were trained in the analysis of stable hydrogen and oxygen isotopes in water by laser spectroscopy.

A system for extracting and purifying trace amounts of krypton gas from groundwater samples was operationalized at the IAEA Isotope Hydrology Laboratory in 2014. The lack

of this purification capacity has been a major factor limiting the wider use of krypton-81 for groundwater age dating. Samples from Argentina, Brazil, the Czech Republic, Hungary and Viet Nam were collected for krypton gas extraction (Fig. 1). Measurement of this radioactive noble gas in extracted gas samples is conducted by atom trap analysis at Argonne National Laboratory, United States of America.

FIG. 1. Sampling for krypton-81 and noble gases for age dating of deep groundwater in the Mekong Delta Aquifer in southern Viet Nam.

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.

Monitoring Pollutants in the Environment

In 2014, the Agency continued to assist Member States in their efforts to study environmental pollution, assess environmental degradation, and build capacity to analyse radionuclides, trace elements, organic contaminants and stable isotopes in environmental samples. In addition, within the framework of the Peaceful Uses Initiative (PUI), methods were developed for the determination of long lived radionuclides in the marine environment and for fingerprinting oil spills using stable isotope analysis (Fig. 1).

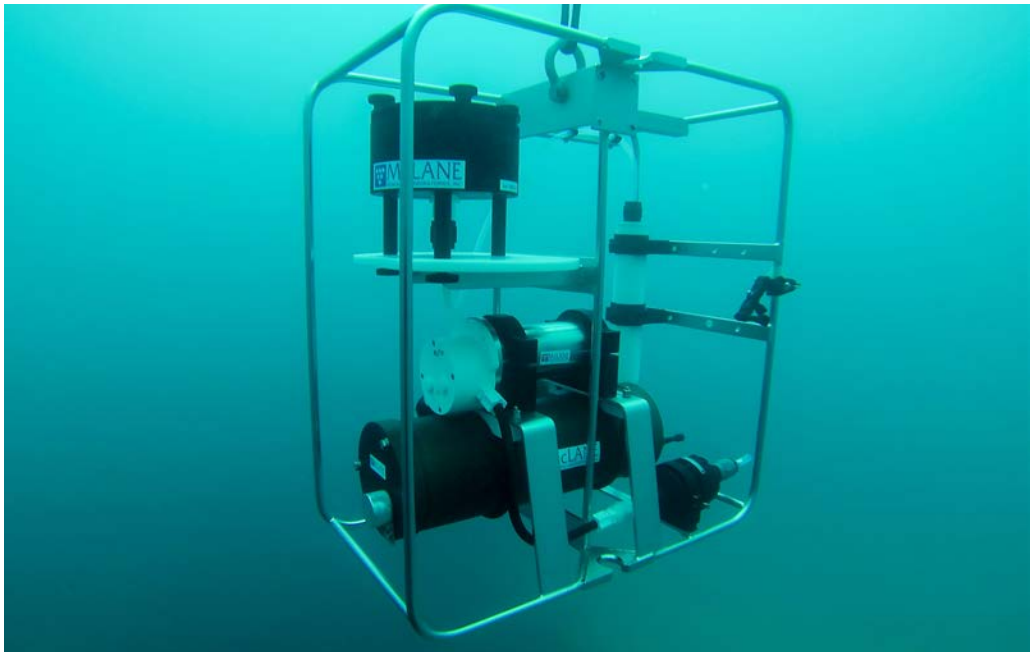

FIG. 1. Deployment of an underwater in situ pump for the collection and preconcentration of petroleum hydrocarbons for oil spill identification.

Two analytical procedures were developed to improve the measurement of radionuclides, and several methods were validated for the analysis of mercury, methylmercury and other trace elements in environmental samples. These methods can be used by Member States to improve their environmental monitoring capabilities.

The Agency supported GESAMP (the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection) in its global assessment of pollution trends during the past century based on retrospective data analysis. The Agency hosted a GESAMP Meeting on Open Ocean Pollution in Monaco in February to update scientific information on pollution in the open ocean. The meeting results will contribute to the Transboundary Waters Assessment being carried out by the Global Environment Facility (GEF), the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) and the United Nations Environment Programme (UNEP).

Support was also provided to Namibia and the Regional Organization for the Protection of the Marine Environment (ROPME) to carry out baseline assessments and monitoring of radionuclides and other contaminants in the marine environment (Fig. 2).

"Two analytical procedures were developed to improve the measurement of radionuclides."

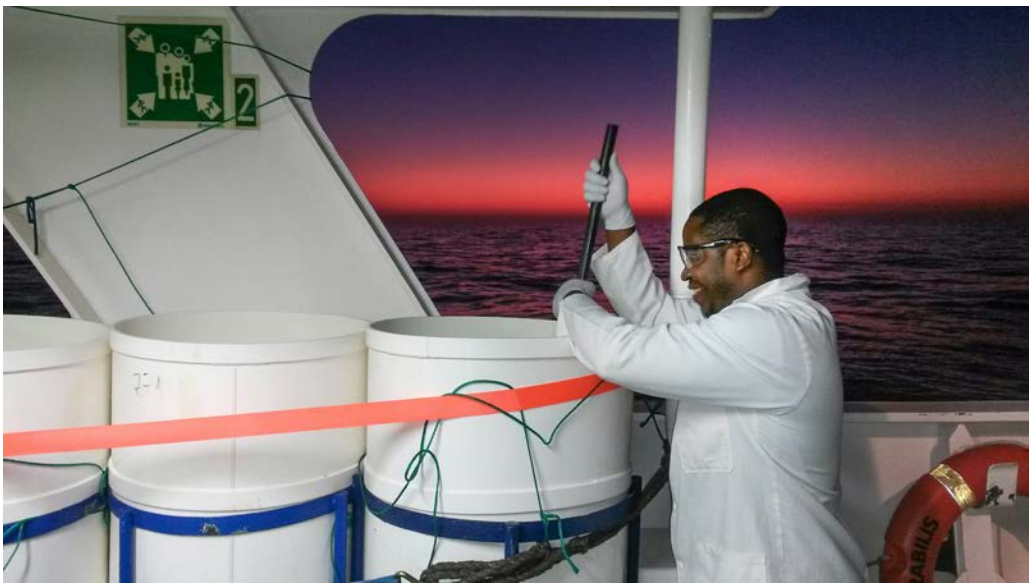

FIG. 2. On-board sample preparation during a scientific cruise along the Namibian coast carried out at the request of the Namibian Ministry of Fisheries and Marine Resources.

Environmental remediation was another area of focus in 2014. The Agency published a report entitled *Lessons Learned from Environmental Remediation Programmes* (IAEA Nuclear Energy Series No. NW-T-3.6), which summarizes work experience in remediation areas affected by uranium mining activities. Remediation at uranium production legacy sites was the topic of five training courses held at the Agency's Headquarters and in Belarus, Germany and the Russian Federation during the year, with 104 participants from over ten Member States.

In the framework of the IAEA Action Plan on Nuclear Safety, the Agency began a programme to ensure the quality of Japanese marine monitoring data following the 2011 accident at the Fukushima Daiichi nuclear power plant. In this context, two missions to support Japan's marine monitoring programme were carried out in 2014. In addition, a proficiency test for radionuclides in seawater and two interlaboratory comparisons of analyses of radionuclides in seawater were jointly organized with the Agency and laboratories in Japan.

Understanding Biological and Ecosystem Processes

Approximately 25–30% of carbon dioxide emissions are absorbed by the world's oceans. Therefore, understanding how marine ecosystems respond to increasing levels of dissolved carbon dioxide is necessary to predict future changes arising from climate change. Naturally occurring radionuclides are useful tools to study biogeochemical processes, for example, carbon sequestration. During the year, the Agency, through the IAEA Environment Laboratories in Monaco, conducted studies to examine these processes in the highly vulnerable Arctic Ocean and off the Peruvian and Mauritanian coasts, regions of economic importance for the fishing industry (Fig. 3).

FIG. 3. An Agency staff member programs in situ pumps to sample water and particles off the Peruvian coast to assess carbon export.

Ocean acidification (OA), a consequence of increasing dissolved carbon dioxide concentrations, is the focus of the Agency's Ocean Acidification International Coordination Centre (OA-ICC). Consistent with its mission to communicate, promote and facilitate global activities on OA, the Agency participated in major events, such as the 20th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP20), held in December in Lima, Peru, highlighting the impact of OA on ecosystems. It also organized training courses to provide quality capacity building for developing Member States around the Mediterranean Sea and in South America.

Through a number of activities carried out at the IAEA Environment Laboratories during the year, the Agency provided significant input to the Modelling and Data for Radiological Impact Assessments (MODARIA) project, contributing expertise and data for dose assessments related to remediation, radioecological data, biota and marine dispersion.

Capacity Building in Member States for Environmental Assessment

Capacity building activities continued during 2014 aimed at helping Member States to accurately analyse radionuclides and pollutants in environmental samples, and to use nuclear and isotopic techniques to study pollution and the process of climate change. To ensure the reliability of environmental data and to support Member State monitoring and research programmes, the Agency provides a range of reference materials for

radionuclides, stable isotopes, trace elements and organic pollutants. In 2014, more than 2100 units of reference materials were supplied to over 700 laboratories worldwide, and eight new reference materials were released.

More than 400 laboratories participated in proficiency tests for the analysis of radionuclides in environmental materials. Some of the tests were aimed at verifying the rapid response capacity of laboratories in the Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA) network. ALMERA received targeted support for enhancing its rapid response capacity for radiological or nuclear emergencies through hands-on training and a method validation exercise for analysis of radiostrontium in milk and transuranics in sediments. To further support proficiency test activities, the Agency produced a milk reference material containing short lived radionuclides typically present shortly after a radionuclide release to the environment. Forty-four laboratories participated in two proficiency tests for trace elements and organic contaminants in marine samples, organized in the framework of an extrabudgetary agreement with UNEP.

The Agency provided support in setting up laboratories in several Member States for OA experimental work and harmful algal bloom (HAB) toxin detection. Additional capacity building included training courses held in Member States and at the IAEA Environment Laboratories; the hosting of fellowships on the toxicity of metals in seafood, radiobinding assay for HAB biotoxins detection and carbon cycle studies; studies of the effect of OA in marine organisms; and support for national and regional technical cooperation projects.

"More than 400 laboratories participated in proficiency tests for the analysis of radionuclides in environmental materials."

Technical support was provided to the Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA) to assess the impact of the phosphate and oil and gas industries on the marine environment. Two training courses were held in Karlsruhe, Germany, and in Amman, Jordan, with the participation of 28 trainees from eight ARASIA Member States.

Training on trace element analysis in environmental samples was also provided to 21 scientists from nine African Member States in Tunis, Tunisia. Three training courses on gamma ray spectrometry were held at Agency Headquarters and in Amman, Jordan, and Ulaanbaatar, Mongolia, for countries participating in the technical cooperation programme, and two training courses for Member States in the Mediterranean region on the analysis of marine pollutants were held in Monaco. A two week Training Course on the Theory and Practical Application of RESRAD-BIOTA and Other Codes in the RESRAD Family for the Determination of Dose, Risk and Authorized Limits at Radioactively Contaminated Sites was financed by and held at Argonne National Laboratory, in the United States of America, in October.

Support for capacity building for marine environmental protection was provided in the framework of the technical cooperation programme through an interregional advanced training course on analytical techniques and quality management for marine radioactivity measurement and monitoring, held in Karlsruhe, Germany, from 21 July to 1 August 2014, with the participation of 19 trainees from 16 Member States.

Capacity building via Agency publications also continued with the release of *The Environmental Behaviour of Radium: Revised Edition* (Technical Reports Series No. 476) on the radiological assessment of routine discharges and accidental releases of radium to the environment.

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 safe, clean industrial development in Member States.

Radioisotopes and Radiopharmaceuticals

Throughout the year, the Agency continued its activities aimed at addressing the issue of worldwide availability of medical radioisotopes. Possible shortages of molybdenum-99, which is used to obtain technetium-99m, the most widely used medical isotope, are of particular concern to Member States. A side event held at the 58th regular session of the Agency's General Conference highlighted molybdenum-99 supply challenges, crisis mitigation efforts and emerging new alternatives, focusing on the role of Agency initiatives and support to Member States (Fig. 1).

FIG. 1. Radionuclide generators like this molybdenum-99/technetium-99m generator are ideal sources of radionuclides for in-house preparation of radiopharmaceuticals for diagnosis and therapy. (Photograph courtesy of GE Healthcare.)

During 2014, a new coordinated research project (CRP) on Nanosized Delivery Systems for Radiopharmaceuticals was launched. Delivering therapeutic doses of radiopharmaceuticals on a nanometer scale would allow for more precise targeting of cancerous cells and hence more effective treatment. This new CRP brings together the Agency's expertise in both radiation-engineered nanoparticles and radiopharmaceuticals.

Impressive progress was made in the development of radioisotope production technologies, allowing broader access to a number of new radionuclides, including gallium-68. The third Research Coordination Meeting for a CRP on Development of Ga-68 based PET-Radiopharmaceuticals for Management of Cancer and other Chronic Diseases was held in Vienna in September. Participants discussed the promising results in the development of gallium-68 based radiopharmaceuticals for oncological applications. The CRP was extended for an additional year, during which the use of kit based formulations for radiolabelling is planned.

Notable achievements were reported during the third Research Coordination Meeting for a CRP on Development and Preclinical Evaluations of Therapeutic Radiopharmaceuticals Based on Lu-177 and Y-90 Labelled Monoclonal Antibodies and Peptides. Many laboratories have already demonstrated the ability to develop suitable antibody conjugates and efficiently label them with lutetium-177 or yttrium-90. The results achieved set the stage for developing a kit for labelling the antibody rituximab that could be used by hospitals to more quickly and safely treat many types of cancer.

Other activities were aimed at assisting Member States in building capacity and establishing facilities for the production of radiopharmaceuticals in accordance with regulatory requirements. Internationally agreed quality criteria are in place for the safe use of radiopharmaceuticals in clinical and research applications. It is therefore essential that radiopharmaceuticals be produced by appropriately trained staff and that the radiopharmaceutical products be checked for adequate quality. In this context, an e-learning programme for radiopharmacy technologists and radiopharmacists is under development. As the first step, in 2014 experts from participating universities and professional organizations from around the world prepared the syllabus and associated practical training materials.

Radiation Technology Applications

Increasing industrialization worldwide poses a threat to human health and the environment. Radiation technologies are making a contribution to mitigating these impacts in two important ways: by treating polluted industrial effluents to lessen their impact on the environment, and by producing novel materials and industrial processes that are environmentally friendly.

The unique ability of high energy radiation to induce chemical and biological effects on matter at room temperature, often without chemical additives, has long been commercially exploited, bringing environmental and economic benefits. However, despite the fact that radiation based technologies are a multi-billion dollar industry, their full potential and capabilities remain unfamiliar to a large number of potential stakeholders. A Technical Meeting on the Deployment of Green Radiation Technology for Environmental Remediation was held in Vienna in June, creating a forum for radiation technologists and stakeholders to discuss the potential of radiation technologies in mitigating environmental challenges faced by various industries, and to assess and evaluate the technical and commercial feasibility of applying radiation technologies to address these issues. Meeting participants discussed the application of radiation technologies for the treatment of industrial and municipal wastewater and sludge, emerging toxic pollutants, and gaseous pollutants. The meeting also addressed the use of radiation technologies to develop sustainable advanced materials and products.

A large number of patients need regenerative medicine to treat wounds, damaged tissues and organs. Organ transplants and synthetic biomaterial based prosthetics are commonly used, but often there are complications. Tissue engineering, whereby tissues and organs are grown in a bioreactor, has great potential to provide effective regenerative treatment while minimizing the risk of complications. Radiation technology plays a key role in facilitating and accelerating the development of engineered tissues by optimizing the instructive scaffolds needed to support them. Research groups in a number of Member States are actively exploring the possibility of growing, healing or regenerating tissues to restore impaired organ functions in the body. To support these activities, a new CRP entitled Instructive Surfaces and Scaffolds for Tissue Engineering Using Radiation Technology began in 2014, with the aim of engineering instructive scaffolds and surfaces using radiation technology to create tissues from the body's cells, thus decreasing the need for human donors.

Radiotracers and radiation based techniques are widely used for optimization as well as trouble-shooting in industrial processes. Optimized design and scale-up of multiphase flow systems, which are widely used in industrial and environmental processes, are important for ensuring enhanced performance, economic viability and environmental acceptability. A CRP entitled Radiometric Methods for Measuring and Modelling of Multiphase Systems towards Industrial Process Management, focusing on the development of advanced and integrated nuclear techniques, is under way to address the needs of Member States in developing safer and more efficient industrial systems. As part of the CRP, in 2014 new computed tomography systems became available to more effectively study and optimize industrial processes.

An e-learning tool to support capacity building in the use of radiation techniques for the optimization of industrial processing was launched in 2014. A first regional training course was held in Seibersdorf at the Nuclear Science and Instrumentation Laboratory with the participation of ten Member States. This training course, the first of its kind, includes both theoretical and practical training, with an examination at the end qualifying the participants in the training method and technique. Such courses complement traditional regional training courses, and it is planned to extend their use to improve training efficiency and to ensure sustainability of the technologies in Member States.

"An e-learning tool to support capacity building in the use of radiation techniques for the optimization of industrial processing was launched in 2014."

Nuclear Safety and Security

Incident and Emergency Preparedness and Response

Objective

To maintain and enhance effective and compatible Agency, national and international emergency preparedness and response capabilities and arrangements for early warning of and effective response to incidents and emergencies, independent of whether they arise from an accident, natural disaster, negligence or criminal act. To improve provision/sharing of information on nuclear or radiological incidents and emergencies among Member States, international stakeholders and the public/media.

Safety Standards and Guidelines

One way the Agency is working to strengthen emergency preparedness and response (EPR) arrangements and capabilities in Member States is by developing comprehensive international standards and guidance. In 2014, the Commission on Safety Standards endorsed the revision of the Safety Requirements publication *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GS-R-2), which will now be submitted to the Board of Governors for its approval. The revision of these requirements was based on experience gained in exercises and responses to actual emergencies, including the response to the accident at the Fukushima Daiichi nuclear power plant. It marks a significant milestone in the enhancement of the Agency's safety standards on EPR, providing a comprehensive set of generic criteria for implementing protective actions.

Recognizing the continuing importance of properly communicating to the public the safety significance of nuclear and radiological events, the Agency published *The Use of the International Nuclear and Radiological Event Scale (INES) for Event Communication: Guidelines and Good Practices for Setting up a National Framework on the Effective Use of INES for Event Communication* (INES-Event Communication). The publication provides guidance to Member States on developing or improving their national framework to ensure the effective use of the International Nuclear and Radiological Event Scale as an integral part of the public communication strategy, as well as the harmonized application of this scale worldwide.

Communication with Member States

To improve reporting and information sharing, the Agency provides experts in Member States with guidance on reporting nuclear or radiological incidents and emergencies, including the strategy, criteria and practical steps involved. In 2014, the *Operations Manual for Incident and Emergency Communication* (EPR-IEComm 2012) was issued in Arabic and Spanish; it is now available to Contact Points for nuclear or radiological incidents and

emergencies in all six official Agency languages. The Agency also conducted several exercises to test communication channels, as well as exercises on parts or all of the international response procedures. In particular, the newly developed assessment and prognosis process was tested in several bilateral exercises and one international exercise with Member States.

The Agency also enhanced the communication and international assistance features of its Unified System for Information Exchange in Incidents and Emergencies (USIE), a secure web site for reporting nuclear and radiological incidents and emergencies irrespective of their cause. It continued to promote the adoption and use of the International Radiological Information Exchange (IRIX) standard, reaching an important milestone with the release of 'USIE Connect'. This upgraded version of USIE has new IRIX based features that allow Contact Points to have their own emergency information systems connected to USIE for faster and more reliable transmission of information during an emergency. Based on the feedback from Member States, the USIE features supporting the process for international assistance were enhanced; for example, the form for requesting assistance was updated and a new form for offering assistance was introduced.

In 2014, the Agency conducted several Convention Exercises (ConvEx) to practise key response elements such as the use of USIE and the process for provision of international assistance to a Member State. The Agency also introduced a new type of emergency response exercise to practise the assessment and prognosis process with Member States during their national exercises. During the year, six exercises were conducted using accident scenarios at light water reactors, pressurized heavy water reactors, and water cooled, water moderated power reactors.

"the newly developed assessment and prognosis process was tested in several bilateral exercises and one international exercise with Member States."

The Agency also held an International Experts Meeting on Severe Accident Management in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant. The meeting, held in March at the Agency's Headquarters, explored the accident management and emergency response challenges posed by severe accidents. The participants identified important lessons on the need for joint coordination, communication, and training and exercises for all emergency personnel, and on the need for greater regulatory oversight of operating organizations to respond to severe emergencies.

Response to Events

In 2014, the Agency was directly informed, or indirectly became aware, of 240 events involving or suspected to involve ionizing radiation (Fig. 1). It took response actions in 39 of these events. Seventeen offers of good offices were made, 11 of which were related to events triggered by earthquakes and tsunamis.

Response and Assistance Network

During an emergency, the Agency uses the Response and Assistance Network (RANET) as a mechanism for providing requested assistance to States. RANET comprises Member States that have registered their national assistance capabilities. In 2014, four additional Member States — Belgium, China, Israel and Switzerland — registered their capabilities in RANET, increasing the total number of RANET member countries to 27. In addition, the Agency conducted a RANET workshop for exercising assistance compatibility arrangements with nine Member States at the Agency's RANET Capacity Building Centre in Fukushima Prefecture, Japan.

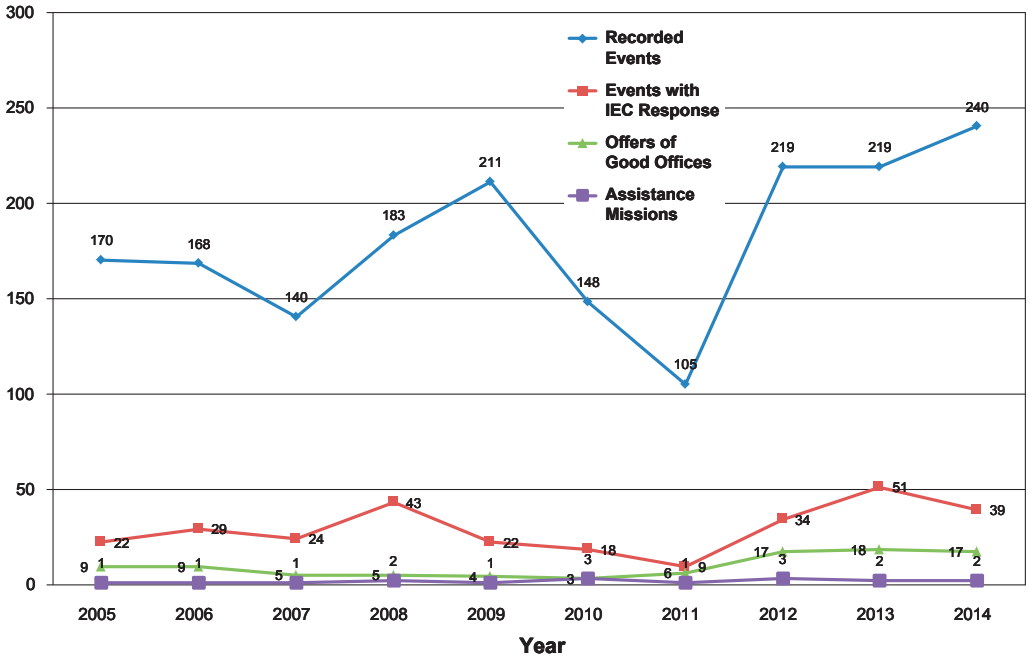

FIG. 1. Number of radiation events the Agency became aware of, and Agency responses, since 2005.

In-house Preparedness and Response

To further enhance the skills and knowledge of the Agency response staff, a comprehensive programme of training, drills and exercises was conducted in 2014. The programme offered approximately 160 person-hours of training during the year, including a total of 11 exercises conducted and evaluated with the participation of Agency staff members — and in some cases with the participation of Member States as well. The exercises tested many of the elements of the international response arrangements, including the notification and exchange of official information, the provision of international assistance, and the assessment and prognosis process.

Strengthening Emergency Preparedness Arrangements

The Agency continued to assist Member States in strengthening their emergency preparedness arrangements through Emergency Preparedness Review (EPREV) and Integrated Regulatory Review Service (IRRS) missions. In 2014, the Agency conducted three EPREV missions — to South Africa, Tajikistan and the United Republic of Tanzania — as well as EPREV preparatory missions to Kenya, Kuwait, Nigeria, the United Republic of Tanzania and the United Arab Emirates.

In July, the Agency hosted a Technical Meeting on Lessons Learned from Past Emergency Preparedness Review (EPREV) Missions. Fifty-four representatives of 42 Member States participated, providing valuable insight and advice for the continued enhancement of the EPREV process and methodology, including, for example, the need to include experts with a broad range of operational experience in EPR.

In 2014, the Agency also began development of its Emergency Preparedness and Response Information Management System (EPRIMS), aimed at increasing the availability of key information on Member State EPR arrangements, improving access to relevant EPR information by the Agency during an emergency (in line with the Agency's expanded role with regard to assessment and prognosis) and facilitating information exchange on national EPR arrangements among Member States. When completed, EPRIMS will give

Member States the opportunity to update key information on their EPR capabilities, share knowledge with other Member States on the application of Agency safety standards dealing with EPR and exchange ideas with the Agency on aspects of their EPR profile. It will also greatly facilitate national self-assessments against Agency safety standards, thereby providing information on the current status of the implementation of safety standards worldwide.

In December, during a Workshop on Lessons Learned from Integrated Regulatory Review Service (IRRS) Missions held in Moscow, representatives of over 25 Member States discussed the newly enhanced approach to the review of national regulatory arrangements for EPR and expressed their support for the improved methodology. This methodology provides better insight into whether national regulatory bodies and processes adequately ensure that licensees' EPR arrangements are consistent with Agency safety standards.

Capacity Building in Member States

In 2014, as part of its ongoing efforts to support capacity building in Member States, the Agency, in cooperation with the World Health Organization, published a revised and enhanced training materials publication entitled *Medical Preparedness and Response for a Nuclear or Radiological Emergency* (EPR-MEDICAL/T-2014/CD). This publication provides Member States with the tools needed to deliver focused training to EPR professionals involved in the different phases of emergency response; namely, pre-hospital response, critical care at the hospital and advanced medical treatment of overexposed victims of radiological accidents.

To address the growing needs of Member States embarking on a nuclear power programme, the Agency developed a series of interactive e-learning modules for such countries (Fig. 2). The EPR module in this series, published in 2014, provides Member States with a distance learning option that addresses the key EPR infrastructure and functional capability requirements, and improves the effectiveness of the Agency's EPR training programme.

FIG. 2. EPR module in e-learning series for countries embarking on a nuclear power programme.

During the year, the Agency conducted over 40 training events covering all aspects of EPR for nuclear and radiological emergencies. This included a new regional course on aspects related to both accident management and response to severe emergencies, held in China in July. Of particular note was the increased Member State interest in training and education on public communication during an emergency. Three training workshops were held on this key aspect of EPR: two regional courses, in Viet Nam in February and Thailand in August, and one national course, in the Philippines in October.

In 2014, the Agency implemented over 20 expert missions aimed at providing advice to Member States on the enhancement of EPR capabilities. The Agency also supported the development and implementation of a regional preparedness and response plan for nuclear and radiological emergencies. Regional cooperation is an effective and efficient way to create synergies between existing EPR resources within a region, and regional harmonization is a powerful factor in ensuring the compatibility of responses of different Member States at the global level and in enhancing the effectiveness of national responses to emergencies.

During the 58th regular session of the Agency's General Conference in September, the Agency launched the Emergency Preparedness Network (EPnet). This web based, collaborative platform reaches a broad audience of EPR professionals at all levels, offering an effective tool for sharing knowledge between Member States and with the Agency.

"In 2014, the Agency implemented over 20 expert missions aimed at providing advice to Member States on the enhancement of [emergency preparedness and response] capabilities."

Inter-Agency Coordination

In November, the United Nations Development Programme became the 18th member of the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE), a mechanism for ensuring coordinated and harmonized international response to nuclear or radiological emergencies. At the Regular IACRNE Meeting in November, the Committee initiated the revision of the *Joint Radiation Emergency Management Plan of the International Organizations* (EPR-JPLAN 2013) and endorsed five JPLAN standard operating procedures on: the review of the web sites of IACRNE organizations; IACRNE video-teleconference meetings; the review of protective and other actions in an emergency; public communication; and joint public–media statements of the IACRNE Working Group on Air and Maritime Transportation (WG-AMT). Two ad hoc IACRNE working groups were also established to contribute to the development of Safety Guides on the transition from emergency to existing exposure situations, including much needed information on when and how to terminate an emergency, and on arrangements for public communications on preparedness and response for a nuclear or radiological emergency.

Safety of Nuclear Installations

Objective

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

Safety Standards

In 2014, the Agency published *Safety of Nuclear Fuel Cycle Facilities* (IAEA Safety Standards Series No. NS-R-5 (Rev. 1)), establishing the requirements that need to be satisfied to ensure safety during all stages of the lifetime of a nuclear fuel cycle facility — from siting to decommissioning, including design, construction, commissioning and operation. Three Safety Guides were also published during the year: *Safety Classification of Structures, Systems and Components in Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-30); *Commissioning for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-28); and *Criticality Safety in the Handling of Fissile Material* (IAEA Safety Standards Series No. SSG-27).

Nuclear Safety Infrastructure

Through its Integrated Regulatory Review Service (IRRS) missions, the Agency continued to assist Member States in strengthening their governmental, legal and regulatory framework. In 2014, the Agency carried out a record ten missions in a single year, conducting six IRRS missions, to Cameroon, France, Jordan, the Netherlands, Pakistan and Zimbabwe, and four IRRS follow-up missions, to the Republic of Korea, Slovenia, the United States of America and Viet Nam. Data from IRRS missions carried out from 2006 through 2013 were used to analyse common regulatory issues among Member States as well as lessons learned. The results were presented in a Workshop on Lessons Learned from Integrated Regulatory Review Service (IRRS) Missions, held in Moscow in December and attended by 47 senior regulatory officials from 25 Member States. The workshop provided an important opportunity to strengthen the international peer review process and enhance the effectiveness of IRRS missions. The Agency also organized its second Basic IRRS Training Course for potential reviewers. Held at Agency Headquarters in October, the course attracted over 65 participants from 39 Member States and the European Commission, who received essential information on the IRRS process and on serving as potential reviewers for future IRRS missions. Safety relevant findings and other lessons learned from IRRS missions to Member States were also shared during the course.

To enhance the effectiveness and efficiency of the IRRS, the Agency issued the Self-Assessment for the Integrated Review of Infrastructure for Safety (IRIS) Guidelines, a methodology and software supporting self-assessments for countries embarking on a nuclear power programme. Like the Self-Assessment of Regulatory Infrastructure for Safety (SARIS) software introduced in 2013, the new tool enables Member States to carry out self-assessments of their national safety framework against Agency safety standards. SARIS and IRIS were used together in the preparation of the 2014 IRRS missions; however, each can also be used as a stand-alone self-assessment tool.

Assessing and addressing the competency needs of regulatory bodies in countries with emerging or expanding nuclear power programmes continues to be an important Agency priority. The Agency conducted over 30 workshops and training courses on regulatory topics, and promoted knowledge sharing through regional, thematic networks in the areas of governmental, legal and regulatory infrastructure for safety; leadership and management for safety; communication; and regulatory safety culture. Among these were national and regional workshops supporting the establishment of safety infrastructure by Member States embarking on a new nuclear power programme, held in Belarus in December, Malaysia in November and December, Turkey in July, and the United States of America in October. A national workshop on the application and methodology of the IRIS self-assessment tool was held in Viet Nam in October.

In December, the Agency, together with members of the Regulatory Cooperation Forum (RCF), facilitated a high level mission to Belarus involving the country's Deputy Prime Minister, the Minister of Emergency Situations and the Deputy Minister of Energy, among other participants. The aim of the mission was to convey the importance of developing a strong safety culture. A workshop on safety culture was also conducted for the regulatory body's personnel. The mission, the first of its kind, may serve as a model for other countries embarking on a nuclear power programme.

"The Agency conducted over 30 workshops and training courses on regulatory topics"

Convention on Nuclear Safety

The Sixth Review Meeting of the Contracting Parties to the Convention on Nuclear Safety (CNS) was held at the Agency's Headquarters from 24 March to 4 April 2014. Sixty-nine of the 76 Contracting Parties participated in the Review Meeting, with 65 providing National Reports that were presented and discussed in the six Country Group sessions. In April, Paraguay became a Contracting Party to the CNS, increasing the membership to 77 Contracting Parties.

During the Review Meeting, the Contracting Parties considered a set of proposals submitted by a group of Contracting Parties to amend the CNS guidance documents[1], and to make recommendations for actions to the Secretariat, the Contracting Parties and other organizations based on the final report of the Working Group on Effectiveness and Transparency, established during the Second Extraordinary Meeting held in August 2012. The proposed amendments and nine recommendations for actions to other bodies were agreed. The amendments provide clearer guidance on actions to be taken by the Contracting Parties to meet the objectives of the CNS and enhance the preparation of National Reports. They also introduce improvements to the review process, enhance international cooperation and provide more transparency in communication with the public.

At the meeting, the Contracting Parties also decided by a two-thirds majority to submit a proposal by Switzerland to amend Article 18 of the CNS to a diplomatic conference

[1] Comprising the Guidelines Regarding the Review Process Under the Convention on Nuclear Safety (INFCIRC/571/Rev.6), the Guidelines Regarding National Reports under the Convention on Nuclear Safety (INFCIRC/ 572/Rev.4), and the Convention on Nuclear Safety: Rules of Procedure and Financial Rules (INFCIRC/573/Rev.5).

to be convened within one year. The proposed amendment addressed the design and construction of both existing and new nuclear power plants.

During the final plenary session of the Review Meeting, a special session was held to report on actions carried out by the Contracting Parties in the light of the Fukushima Daiichi accident. The Contracting Parties agreed to continue to report in their National Reports on actions taken with regard to lessons learned from the accident. It was also proposed to convene a Topical Meeting in 2015 to allow the Contracting Parties the opportunity to discuss enhancing the safety of existing installations in the light of lessons learned from the accident. Also at the Sixth Review Meeting, the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO) held a special side event to present results of the stress test assessments conducted in FORO Member States.

As requested during the Sixth Review Meeting, a Consultation Meeting for the CNS Diplomatic Conference was held in October. At the meeting, Contracting Parties exchanged views and prepared for the adoption of the rules of procedure of the diplomatic conference. In addition, meetings of the Informal Working Group for the CNS Diplomatic Conference were held to facilitate conference preparation.

Safety Assessment of Nuclear Installations

The Agency conducted two International Probabilistic Safety Assessment Review Team (IPSART) missions, to Armenia and Switzerland; two Safety Assessment Advisory Programme (SAAP) missions, to Bangladesh and Jordan; one Review of Accident Management Programmes (RAMP) pre-mission to Mexico; and two Generic Reactor Safety Review (GRSR) missions, one for a Russian design and one for a Chinese design.

In March, approximately 170 experts from around 40 Member States and international organizations gathered at Agency Headquarters for the International Experts Meeting on Severe Accident Management in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant. Participants discussed how best to further strengthen their ability to provide a coordinated response during a severe accident. The meeting resulted in a set of recommendations, including those addressing the need for robust training and flexibility in response strategies.

In supporting countries embarking on a nuclear power programme, the Agency continued to enhance its Safety Assessment Education and Training (SAET) Programme, including improvements to the SAET Programme curriculum and the development of comprehensive training materials on nuclear safety assessment, including severe accident phenomenology and fuel safety criteria. Within the framework of the SAET Programme curriculum, more than 15 workshops and training courses were delivered to around 200 trainees from six Member States, including training on inspection techniques (Fig. 1) and on the practical application of thermohydraulic analysis software.

Site Safety and Design Against Internal and External Hazards

The Agency's Site and External Events Design (SEED) review service provides guidance on evaluating potential building sites for nuclear power plants to ascertain site specific external and internal hazards and the proposed plant's ability to safely withstand them. In 2014, the Agency carried out three SEED missions, to Bangladesh, Indonesia and Viet Nam. Such missions assist Member States throughout the different stages of site selection, site evaluation and design of structures, systems and components, providing an independent review of each stage.

The Agency also delivered nine workshops and training courses to around 200 trainees from 19 Member States, aimed at supporting Member States embarking on or expanding

FIG. 1. SAET Programme participants enter the reactor containment during a walkdown of the never-commissioned Zwentendorf nuclear power plant in Austria.

a nuclear power programme in acquiring the necessary competence for nuclear site and design safety. A new training approach was piloted in Indonesia in 2014, in which participants from the nuclear energy programme implementing organization as well as from other institutions performed a simulated safety review of seismic hazard characterization. The new approach provided the participants with a better understanding of how the Agency safety standards are used when conducting a safety review mission.

Operational Safety and Experience Feedback

In 2014, the Agency conducted five OSART missions — to Flamanville (France); Paks (Hungary); Borssele (Netherlands); Kola (Russian Federation) (Fig. 2); and Clinton (United States of America) — as well as seven OSART follow-up missions — to Angra 1 (Brazil); Kozloduy (Bulgaria); Temelin (Czech Republic); Gravelines (France); Rajasthan (India); Laguna Verde (Mexico); and Muehleberg (Switzerland). Together with reviewers from Member States, the Agency conducted a Corporate OSART mission to Électricité de France, the second such mission conducted. The Corporate OSART mission is designed to review corporate functions (e.g. corporate management, human resources, communication and independent oversight) that have an impact on safety at nuclear power plants owned or operated by utilities.

The Agency continued to promote a strong nuclear safety culture in Member States during the year, holding four workshops on leadership and management for safety — in Egypt, France and the Netherlands, and at Agency Headquarters. Other meetings on safety culture and security culture were held in Member States embarking on a nuclear power programme, including Belarus and the United Arab Emirates.

At a Workshop on Global Safety Culture — National Factors Relevant to Safety Culture, held at Agency Headquarters in April and attended by 45 representatives of 24 Member States, participants explored the many factors that influence safety culture and presented

FIG. 2. Members of an OSART mission with staff of the Russian Federation's Kola nuclear power plant in the plant's main control room.

"The Agency conducted three Safety Aspects of Long Term Operation (SALTO) missions…and two follow-up missions"

approaches taken by the aviation and oil and gas industries to address them. A Technical Meeting on Integration of Safety Culture into Regulatory Practices and the Regulatory Decision Making Process, held at Agency Headquarters in October with participants from 25 Member States, explored how safety culture can be developed within a regulatory body, taking into consideration the regulatory interfaces that can influence an operating organization.

The Agency conducted three Safety Aspects of Long Term Operation (SALTO) missions — to Dukovany (Czech Republic), Tihange 1 (Belgium) and Ringhals (Sweden) — and two follow-up missions — to Borssele (Netherlands) and Wolsong 1 (Republic of Korea). Also in 2014, phase two of the International Generic Ageing Lessons Learned (IGALL) for nuclear power plants project was launched. The objectives of this phase are to support Member States in implementing the guidance on ageing management programmes (AMPs) and time-limited ageing analysis (TLAA) developed during phase one of the project, and to enhance the different areas within the IGALL project by developing new AMPs and TLAAs and improving existing ones. A new technological obsolescence programme was prepared and approved by the IGALL Steering Committee. Moreover, *Approaches to Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL) Final Report* (IAEA-TECDOC-1736) was published, presenting a summary of the national approaches taken by Member States during phase one of the IGALL project.

Safety of Research Reactor and Fuel Cycle Facilities

In support of Member State efforts to enhance research reactor safety, the Agency held a number of meetings and workshops on the safety of research reactor and fuel cycle facilities. In June, the Agency hosted an International Meeting on Application of the Code of Conduct on the Safety of Research Reactors, with 60 participants from 40 Member States. The meeting participants noted progress in application of the Code by

Member States and provided recommendations for further improvements in regulatory supervision, safety analysis, ageing management and consideration of human factors at different stages of a research reactor's lifetime. In December, Algeria hosted the Eighth Africa Conference on Research Reactor Utilization and Safety, with 61 participants from 16 Member States. The meeting provided recommendations for further enhancing research reactor safety, including safety aspects of utilization programmes. In December, the Agency held a Technical Meeting on Decommissioning Plans and Managing the Transition between Operation and Decommissioning of Research Reactors at its Headquarters, with the participation of 20 Member States. The meeting provided a forum for the exchange of experience and information, and provided recommendations on further safety improvements in decommissioning.

The Agency also conducted four workshops at Agency Headquarters on Safety Analysis and Safety Documents for Research Reactors, in May; Operating Programmes for Research Reactors, in April; Implementation of a Management System for Operating Organizations of Research Reactors, in September; and Specific Considerations and Milestones for a Research Reactor Project, in May. Safety issues of common concern in specific regions were discussed in workshops on fire safety (Asia), regulatory inspection programmes (Africa and Arab regions), and safety aspects of utilization programmes (Africa). In total, more than 300 participants from 64 Member States operating or planning research reactors took part in these activities.

To improve networking among Member States with research reactors, the Agency provided administrative support to the Regional Advisory Safety Committee for Research Reactors in Africa (RASCA), the Regional Advisory Safety Committee for Research Reactors in Asia and the Pacific (RASCAP), and the European Advisory Safety Committee for Research Reactors (EURASC). Also during the year, the Agency issued *Project Experiences in Research Reactor Ageing Management, Modernization and Refurbishment* (IAEA-TECDOC-1748).

Safety missions were undertaken to research reactors in Bangladesh, Congo, Egypt, Ghana, the Islamic Republic of Iran, Malaysia, Morocco, Peru, Poland, Slovenia and Turkey (Fig. 3). These missions provided guidance on and recommendations for safety improvements concerning regulatory supervision, safety analysis and safety documents,

FIG. 3. Agency staff and reactor personnel reviewing safety systems in the reactor building during an INSARR mission to the Maria Research Reactor in Poland.

"the Agency held the biennial Joint Technical Meeting of the IAEA/NEA Fuel Incident Notification and Analysis System (FINAS) National Coordinators"

operating programmes, ageing, radiological safety, and decommissioning planning. Missions on infrastructure for new research reactor projects were also conducted to Jordan, Kuwait, Nigeria, Saudi Arabia, Tunisia and the United Republic of Tanzania.

To support Member State efforts to enhance the safety of fuel cycle facilities, the Agency held the biennial Joint Technical Meeting of the IAEA/NEA Fuel Incident Notification and Analysis System (FINAS) National Coordinators at Agency Headquarters in September. The meeting, attended by participants from 19 Member States, provided a forum for the exchange of operating experience and recommendations on further enhancing the effectiveness of FINAS. In February, the Agency held a Workshop on Criticality Safety in the Handling of Fissile Material for Fuel Cycle Facilities, with the participation of 19 Member States. The workshop provided the participants with practical information on application of Agency safety standards and on the prevention and control of criticality in fuel cycle facilities.

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, including Agency staff, against the harmful effects of radiation.

Protection of the Public

Protection of people and the environment from ionizing radiation is an important focus of Agency activities. As part of its efforts in this area, within the framework of the IAEA Action Plan on Nuclear Safety, the Agency hosted an International Experts Meeting on Radiation Protection after the Fukushima Daiichi Accident: Promoting Confidence and Understanding, with over 220 participants from 68 Member States and ten international organizations. Participants discussed the technical and social issues related to protecting the public from harmful effects of radiation and how they should be addressed at both the national and the international levels. The meeting also highlighted the importance of stakeholder involvement in decision making during the recovery phase of a large scale nuclear accident. Experience has shown that such decisions are more readily accepted if they are made following consultation among the responsible authorities and those directly affected. The increasingly important role of social media as a source of public information was also discussed, along with the associated challenges and opportunities facing national authorities. Meeting participants concluded that many of the lessons of previous accidents had not been fully addressed by the radiation protection community and urged full implementation of the lessons from the Fukushima Daiichi accident.

Radiation Protection of Patients

Radiation protection and safety in medical imaging and radiotherapy continued to be a priority for the Agency. The focus in 2014 was on strengthening the justification of medical exposure and improving safety in radiotherapy. In March, 65 participants from 49 Member States and four international organizations participated in a Technical Meeting at Agency Headquarters to discuss how the medical community can adopt and adapt existing clinical imaging guidelines for improving justification in medical imaging around the world. At the 58th General Conference in September, the Agency promoted the 'AAA approach', an approach to reduce unnecessary imaging that is based on awareness, appropriateness and audit. The AAA approach aims to improve the awareness of risks from unnecessary exposure, the need to use appropriate examinations and the need to perform clinical audits to ensure that medical exposure is justified.

FIG. 1. The Agency's Safety in Radiation Oncology (SAFRON) web site, available at: https://rpop.iaea.org/safron/.

Safety in radiotherapy remained an important area of the Agency's work in 2014 (Fig. 1). Through Technical Meetings and regional training throughout the year, the Agency continued its efforts to promote awareness and understanding of the importance of learning from medical errors and near misses, and of implementing changes in radiotherapy practice that will prevent these types of errors from reoccurring. In October, more than 40 international experts participated in a Technical Meeting on Patient Safety in Radiotherapy held at Agency Headquarters. The meeting was aimed at determining the path forward for enhancing safety in radiotherapy; the outcomes of this meeting will be used to develop Agency initiatives in radiotherapy education, communication and awareness of patient safety.

Occupational Radiation Protection

As the use of nuclear and radiation technologies increases in numerous sectors around the world, the number of workers exposed to ionizing radiation is also increasing worldwide, and thus occupational radiation protection continues to be an important focus of the Agency's work. In December, the International Conference on Occupational Radiation Protection: Enhancing the Protection of Workers — Gaps, Challenges and Developments was held at Agency Headquarters. The conference was organized by the Agency and co-sponsored by the International Labour Organization, in cooperation with 15 other international organizations and associations. Attended by 470 participants from 79 countries and 21 organizations, the conference fostered the exchange of information and experience, reviewed advances, challenges and opportunities since the first conference on this topic in 2002, and identified areas for future improvement. Nine key areas of focus for improvement in occupational radiation protection were identified, including implementation of the existing international safety standards; development and implementation of new international safety guidelines for occupational radiation protection; enhancement of

assistance to Member States with less developed programmes; and enhancement of training and education in occupational radiation protection to equip workers with the necessary knowledge, skills and competencies to implement protection measures.

As part of the Agency's Occupational Radiation Protection Appraisal Service (ORPAS), peer review missions were conducted to Peru, the United Republic of Tanzania and the Bolivarian Republic of Venezuela in 2014. The results of these missions will help the national authorities to improve the protection of workers occupationally exposed to radiation.

The Agency published *The Information System on Occupational Exposure in Medicine, Industry and Research (ISEMIR): Industrial Radiography* (IAEA-TECDOC-1747) in 2014. ISEMIR addresses the need to establish networks for the exchange of information on experience, lessons learned and best practices for occupational dose reductions.

Regulatory Infrastructure

Use of the Agency's Integrated Regulatory Review Service (IRRS) is standard practice for the regulatory bodies of Member States with nuclear installations. It is now increasingly being used by the regulatory bodies of States without nuclear installations, whose national regulatory frameworks also benefit from this type of international peer review. In 2014, IRRS missions to States without a nuclear power programme were conducted to Cameroon, Jordan, Viet Nam and Zimbabwe. Preparatory work for upcoming missions began for Chile, Croatia, Estonia, Guatemala, Indonesia, Ireland, Lithuania, Malaysia, Malta and the United Republic of Tanzania. The effectiveness of the regulatory infrastructure for radiation, transport and waste safety was also reviewed in IRRS missions to States with a nuclear power programme, including France, the Republic of Korea, the Netherlands, Pakistan and Slovenia. The Agency also organized 17 advisory missions on strengthening national regulatory infrastructure for radiation safety.

"the Agency's Integrated Regulatory Review Service (IRRS) is….now increasingly being used by the regulatory bodies of States without nuclear installations"

A meeting was convened in May at Agency Headquarters in which international experts developed, for the Secretariat's further consideration, a proposal for a strategic approach which may be used by Member States in establishing and strengthening national infrastructure for radiation, transport and waste safety in accordance with Agency safety standards. This approach proposes that each Member State take a holistic approach to strengthening radiation safety by developing its own tailor-made national strategy based on identified needs, while at the same time considering all nationally and internationally available resources in order to maximize synergies and reduce overlaps.[1]

Five regional training courses organized under the technical cooperation programme were held throughout 2014, the first to the Philippines in January, followed by courses in Mauritius in April, Sudan in August, Qatar in October and Tunisia in December. They included recently developed training courses on authorization and inspection of uranium mining activities, organization and competence of the regulatory body, and enforcement of regulatory decisions.

In 2014, the Agency published *Model Regulations for the Use of Radiation Sources and for the Management of the Associated Radioactive Waste: Supplement to IAEA Safety Standards Series No. GS-G-1.5* (IAEA-TECDOC-1732). The publication provides guidance on establishing an appropriate set of regulations covering all aspects of the use of radiation sources and the safe management of the associated radioactive waste. The Agency also published *Control of Transboundary Movement of Radioactive Material Inadvertently Incorporated into Scrap Metal and Semi-finished Products of the Metal Recycling Industries: Results of the Meetings Conducted to Develop a Draft Code of Conduct* (IAEA/CODEOC/METRECYC), containing the results of discussions conducted from 2010 to 2013 in the development of a draft metal recycling code

1 See: *https://www.iaea.org/newscenter/news/new-strategic-approach-enhance-radiation-safety*.

of conduct. This publication offers guidance to States and industry on the development of harmonized approaches with regard to the discovery, safe handling and management of radioactive material inadvertently present in a consignment of scrap metal.

In October, the Agency held an Open-ended Meeting of Legal and Technical Experts to Develop Internationally Harmonized Guidance for Implementing the Recommendations of the Code of Conduct on the Safety and Security of Radioactive Sources in Relation to the Long Term Management of Disused Radioactive Sources. The meeting, held at the Agency's Headquarters, was attended by 162 experts from 73 Member States, one non-Member State and four international organizations. The Chairman's report[2] supported the initiative to develop guidance on the management of disused sources as supplementary guidance under the Code of Conduct.

Transport Safety

The Agency continued to pursue a strategic approach of regional capacity building, designed to enhance transport safety in individual Member States in Africa, Asia and the Pacific, Latin America, the Mediterranean, and the Caribbean and Pacific Islands, while meeting regional needs through Member State collaboration. Through ten events hosted by the Agency in 2014, representatives of over 70 Member States completed self-assessments of their regulatory infrastructure for transport safety, developed and refined their national action plans, and worked together to define regional actions to improve safety.

"representatives of over 70 Member States completed self-assessments of their regulatory infrastructure for transport safety"

The Transport Safety Standards Committee (TRANSSC), comprising representatives of 51 Member States plus observers, met twice in 2014 to review issues related to the *Regulations for the Safe Transport of Radioactive Material: 2012 Edition* (IAEA Safety Standards Series No. SSR-6) in preparation for the 2015 review cycle. In 2014, the Agency published the *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)* (IAEA Safety Standards Series No. SSG-26) and *Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2009 Edition)* (IAEA Safety Standards Series No. TS-G-1.6 (Rev. 1)).

The report of the Working Group on Best Practices for Voluntary and Confidential Government-to-Government Communications on the Transport of MOX Fuel, High Level Radioactive Waste and, as appropriate, Irradiated Nuclear Fuel by Sea was released in May as INFCIRC/863. The report was the result of a collaborative effort by numerous Member States and provides guidance on communication between Member State governments related to maritime shipments.

Education and Training in Radiation Safety

The Agency's activities in the area of education and training in radiation safety continued to focus on building sustainable competence through the establishment of national strategies for education and training in radiation, transport and waste safety. In regional workshops held in Bosnia and Herzegovina, Côte d'Ivoire, Cuba, Kazakhstan, Malaysia and the United Republic of Tanzania, participants drafted work plans to establish a national radiation safety education and training strategy, and conducted a preliminary analysis of their education and training needs. In some cases, participants designed a national education and training programme based on their assessed needs.

More than 130 students from around the world attended the Agency's Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources in 2014.

2 See: *http://www-ns.iaea.org/downloads/rw/code-conduct/info-exchange/chair-report-open-ended-meet-oct14.pdf*.

The course was held in Algeria, Argentina, Ghana, Greece, Malaysia and Morocco. In 2014, on-line pre-training was made available to the students participating in the course via a new e-learning platform. The pre-training aims to refresh the students' basic knowledge of biology, mathematics, chemistry and health physics prior to the start of the course.

Radiation Safety Information Management System

The Radiation Safety Information Management System (RASIMS) is a collaborative, web based platform designed to assist Member States in monitoring the status and implementation of their radiation safety infrastructure in line with the Agency's safety standards. The information in RASIMS is used in evaluations of requests for procurement of radiation sources for use in Member States and is taken into consideration prior to submitting technical cooperation projects to the Agency's Policy-Making Organs for approval.

RASIMS's functionality was improved throughout 2014 by upgrading the e-learning module with additional topics to assist users. During the year, nationally appointed RASIMS coordinators from 107 Member States accessed RASIMS to update their radiation safety information, thus helping to ensure that the information in RASIMS is comprehensive, accurate and up to date.

"During the year, nationally appointed RASIMS coordinators from 107 Member States accessed RASIMS to update their radiation safety information"

Management of Radioactive Waste

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.

Waste and Environmental Safety

Radioactive waste and spent fuel management

In 2014, the Agency launched a new service aimed at assisting Member States in establishing a global nuclear safety framework. The Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) is a peer review service intended for facility operators and implementing organizations responsible for radioactive waste management, decommissioning of nuclear facilities and remediation of contaminated sites, as well as for regulators, government agencies and national policy/decision makers. In 2014, work began on developing guidelines for ARTEMIS, and initiation of the first review is expected in 2015.

Experience from past nuclear and radiological accidents, such as at the Fukushima Daiichi nuclear power plant, highlights the importance of proper planning for a successful recovery effort following such events. The Agency has established a dedicated activity to assist Member States in identifying safe management strategies and practices for large amounts of radioactive waste generated from nuclear or radiological emergencies.

Safe management of spent fuel arising from nuclear power production is a key issue for the sustainable development of nuclear energy. The volume of spent fuel continues to grow, and additional storage capacity is required. Several Member States are utilizing dual purpose casks (DPCs) that can be safely stored and transported. As part of the Agency's activities in this area, an International Workshop on the Development and Application of a Safety Case for Dual Purpose Casks for Spent Nuclear Fuel was held at Agency Headquarters in May, with 54 participants from 19 States and the European Commission. The workshop enhanced the participants' understanding of DPCs through analyses of current practices and discussions of ways to further improve application of the DPC concept.

Assessment and management of environmental releases

To develop and maintain capabilities in the field of environmental modelling and radiological assessment of radiation exposures of people and the environment in planned, existing and emergency exposure situations, the Agency set up the environmental model test and comparison programme MODARIA (Modelling and Data for Radiological Impact

Assessments). The third Technical Meeting on MODARIA was held in November and was attended by 150 participants from more than 40 Member States. The meeting focused on: remediation of areas affected by enhanced levels of natural or human-made radionuclides; testing and development of methodologies for assessing radiological impacts of routine discharges of radionuclides to the environment; analysis and organization of data required for radiological impact assessments; modelling of radiation exposures and effects on biota; and dispersion of radionuclides in the marine environment.

The Agency contributes to the safe management of radioactive materials released to the environment through its work with the International Maritime Organization (IMO) and through various conventions, including the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention). In 2014, the Agency updated the inventory of human-made radioactive materials at sea (Fig. 1) and the radiological assessment procedure to ensure that radioactivity levels of candidate materials for dumping are low enough to preclude radiological impact on the marine environment. This procedure was considered by the Contracting Parties to the London Convention for inclusion in the IMO's guidelines for the Convention with the assistance of the Agency.

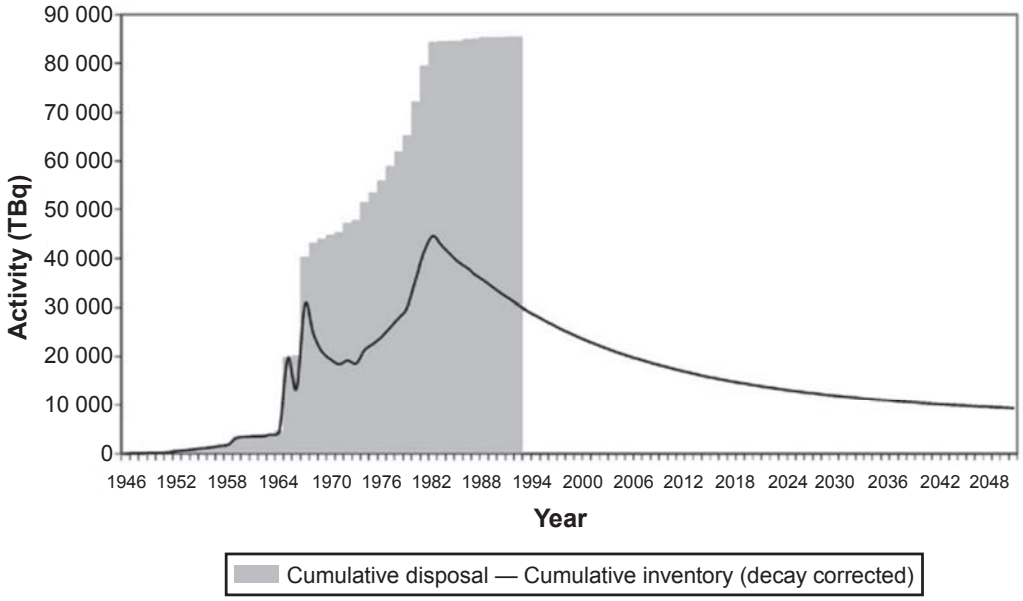

FIG. 1. Inventory of human-made radionuclides at sea due to historical dumping.

"In 2014, the Agency updated the inventory of human-made radioactive materials at sea"

During the year, the Agency worked with the IMO's Marine Environment Protection Committee and through the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (the Hong Kong Convention) to develop recommendations on threshold levels of radioactive materials for the safe recycling of vessels. These recommendations were developed to assist the identification of radioactive sources widely used in ships, such as lightning rods and industrial gauges. The identification and separation of such sources prior to recycling of ships avoids contamination of recycled steel and the associated risk to workers, the public and the environment. The recommendations were approved for incorporation into the Hong Kong Convention's Guidelines for the Development of the Inventory of Hazardous Materials.

Decommissioning and remediation safety

In 2014, the Agency published the revised Safety Requirements for the decommissioning of facilities. The revised requirements, established in *Decommissioning of Facilities* (IAEA Safety Standards Series No. GSR Part 6), provide a framework for the regulatory requirements and conditions to be incorporated into individual authorizations, and inform

Member States on how best to integrate Agency safety standards for decommissioning into a national regulatory framework.

In cooperation with Magnox (United Kingdom), the Agency organized an International Workshop on Lessons Learned from Planning and Implementation of the Deferred Dismantling Strategy for Decommissioning, held in London in June and attended by 40 participants from 18 Member States. The workshop reviewed the state of the art of policy, planning and implementation aspects of deferred dismantling; discussed and shared lessons learned from experience gained in this area to date; and identified challenges ahead. The outcomes of the workshop will provide invaluable input to the ongoing revision of Agency Safety Guides on decommissioning.

In 2014, the existing training materials on the safety of remediation activities were consolidated into a single syllabus of some 130 lectures, organized into seven modules to enable better delivery of training to Member States. The modules include a general overview and cover the following topics: prospection, exploration, construction and operation of uranium production sites; decommissioning and closure of uranium production sites; remediation of uranium production sites; authorization and inspection of uranium mining and milling; practical intervention techniques to reduce public doses at uranium mining and milling legacy sites; and review of remediation plans and activities for uranium mining and milling sites. This new structure also provides a flexible means for the Agency to organize training events addressing the safety of uranium production activities, the remediation of legacy uranium production sites, and regulatory oversight of legacy and operating uranium production facilities.

"In 2014, the existing training materials on the safety of remediation activities were consolidated into a single syllabus of some 130 lectures"

Good Practices and Technologies for Radioactive Waste Management, Decommissioning and Environmental Monitoring

The first stage of the Connecting the Network of Networks for Enhanced Communication and Training (CONNECT) project was completed in 2014. CONNECT is an Internet based platform aimed at promoting wider learning in the field of radioactive waste management. The official launch took place in October, when the platform and initial content were made available to users. The CONNECT platform interconnects existing radioactive waste networks and makes available additional sources of information through e-learning as a complement to face-to-face training.

Management of radioactive waste and spent fuel

To address the challenges faced by all Member States in managing relatively small amounts of radioactive waste, the Agency recently published two books on relevant waste processing systems: *Modular Design of Processing and Storage Facilities for Small Volumes of Low and Intermediate Level Radioactive Waste including Disused Sealed Sources* (IAEA Nuclear Energy Series No. NW-T-1.4) and *Mobile Processing Systems for Radioactive Waste Management* (IAEA Nuclear Energy Series No. NW-T-1.8). The publications will aid operators in designing a waste processing and storage facility that is tailored to their specific needs and that provides for the safe, cost effective management of these small inventories.

In 2014, the Agency launched a new International WWER [water cooled water moderated power reactor] Radioactive Waste Operations Benchmarking System that promotes good practices and provides guidelines on waste minimization. The new system enables participating organizations to share data anonymously and determine how they rank among all participants in terms of commonly agreed and accepted waste management parameters.

Also in 2014, the Agency published *Planning and Design Considerations for Geological Repository Programmes of Radioactive Waste* (IAEA-TECDOC-1755). The publication is the

latest in a suite of reports designed to assist Member States in all aspects of disposal facilities. The publication presents practical information on defining and planning a geological repository programme for radioactive waste, with special attention given to all aspects having an impact on the timing of the different programme phases.

Decommissioning of Nuclear Facilities and Environmental Remediation of Sites

Twenty-six participants from 23 Member States attended the Third Annual Meeting of the Data Analysis and Collection for Costing of Research Reactor Decommissioning (DACCORD) project, held in Vienna in November. The meeting provided tools, guidance and assistance in preparing preliminary cost estimates for decommissioning small nuclear facilities, as well as detailed analyses of data on more than 20 participating research reactors.

A follow-up mission to the Lynas rare earth processing facility near Kuantan, Malaysia, was completed in 2014. The mission, carried out at the request of the Malaysian Government, reviewed progress made since the previous mission, conducted in June 2011, in the area of radiation safety at the facility, which generates very low level radioactive waste. The mission noted that good progress had been made in implementing the 2011 recommendations, which focused on the near and long term management of the waste residues.

Management of Disused Sealed Radioactive Sources

During 2014, the Agency conducted missions to Costa Rica and Morocco for the repatriation and recycling of ten Category 1 and 2 disused sealed radioactive sources (DSRSs) (Fig. 2). Missions to Fiji, Malaysia and Montenegro resulted in the conditioning and placing into safe and secure storage of more than 240 Category 3 to 5 DSRSs. To address final DSRS disposal, the Agency continued development of the borehole disposal concept, working closely with several Member States on projects to implement this cost efficient disposal method.

FIG. 2. Agency mission to Morocco to repatriate a Category 1 disused sealed radioactive source.

Joint Convention Meetings

During the Second 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, held in May, the Contracting Parties agreed on a number of changes to the Rules of Procedure and Financial Rules for the Joint Convention (INFCIRC/602/Rev.5),

the Guidelines regarding the Review Process (INFCIRC/603/Rev.6), and the Guidelines regarding the Form and Structure of National Reports (INFCIRC/604/Rev.3). The Contracting Parties also agreed to invite to the Workshop for Incoming and Outgoing Officers of the Joint Convention the president and two vice presidents of the last Review Meeting of the Convention on Nuclear Safety (CNS), and, where necessary, additional experienced officers, to informally share experience and lessons learned under the review processes of the CNS.

The Organizational Meeting for the Fifth Review Meeting of the Contracting Parties to the Joint Convention was also held in May. The meeting, inter alia, elected officers, decided on the establishment and composition of seven Country Groups, and discussed the timetable for the Fifth Review Meeting.

General Conference Scientific Forum: "Radioactive Waste: Meeting the Challenge"

At the Scientific Forum 2014, entitled "Radioactive Waste: Meeting the Challenge — Science and Technology for Safe and Sustainable Solutions", Director General Yukiya Amano highlighted the many benefits for people worldwide from nuclear technologies and the fact that many Member States already use nuclear tools and applications in many forms. He also stated that "it is the responsibility of each country to safely and securely dispose of its waste", and that "if a country decides to use nuclear technologies, from day one it must consider how to deal with its waste."

Nuclear Security

Objective

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

In 2014, the Agency continued to assist national efforts to improve nuclear security through the implementation of the *Nuclear Security Plan 2014–2017*. In response to requests from States, greater attention was given to security during transport, nuclear security culture and computer security.

"In response to requests from States, greater attention was given to security during transport, nuclear security culture and computer security."

Promotion of the Nuclear Security Framework

The nuclear security framework comprises both binding and non-binding instruments adopted under the auspices of the Agency and other entities. The Agency facilitates adherence to and implementation of the legal framework by assisting States, upon request, in effectively implementing their obligations under the relevant international instruments.

The primary legally binding instrument adopted under Agency auspices is the Convention on the Physical Protection of Nuclear Material (CPPNM) and its 2005 Amendment. Despite being adopted in 2005, the Amendment has yet to enter into force. During 2014, 12 States ratified, accepted or approved the Amendment; however, by the end of the year the Amendment still required ratification by an additional 17 States Party to the Convention for it to enter into force.

The Agency organized a Seminar on the Promotion of the Entry into Force of the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material, held in Vienna in June and attended by more than 60 participants from 27 States. The seminar raised awareness of the Amendment among Contracting Parties to the Convention and provided details of assistance available to facilitate their adherence to the Amendment and its implementation. In addition, the Agency organized one regional workshop — held in Mexico in April — and two national workshops — held in the Philippines and Serbia — to promote the Amendment.

Guidance published in the IAEA Nuclear Security Series assists States in better implementing the legally binding and non-binding instruments that make up the nuclear security framework. In 2014, the Agency published an Implementing Guide entitled

Radiological Crime Scene Management (IAEA Nuclear Security Series No. 22-G), which was jointly developed by the Agency, the International Criminal Police Organization – INTERPOL and the United Nations Interregional Crime and Justice Research Institute.

In 2012, the Director General established the Nuclear Security Guidance Committee (NSGC) as a standing committee of senior experts in nuclear security in order to provide greater Member State input to the production of publications in the IAEA Nuclear Security Series. The NSGC met twice during the year. In 2014, a road map for publications in the Nuclear Security Series was agreed.

Transport Security

The transport of nuclear and other radioactive material poses unique security challenges because it takes place in the public domain, outside secured facilities, and involves multiple security interfaces among national authorities, operators and response forces. The Agency assists States in implementing effective transport security arrangements through the development of internationally agreed recommendations and guidance, practical support through training and workshops, transport security exercises, and, upon request, peer review and assessment missions. During the year, at the request of Member States, the Agency delivered one international training course in Germany, one regional training course in India (Fig. 1) and three national training courses on transport security, in Kazakhstan, Madagascar and the United Arab Emirates.

FIG. 1. A set-up for a pre-shipment security verification exercise in which participants inspect and assess security measures before allowing the transport to commence. The exercise was part of a regional training course on security in the transport of radioactive material held in India in 2014.

Nuclear Security Culture

Nuclear security culture is essential to ensure and sustain the security of nuclear and other radioactive material during its use, storage, transportation and disposal, because human behaviour determines the effectiveness of the management and operations of the overall security system.

During 2014, the Agency completed the development of a comprehensive methodology for assessing nuclear security culture practices in a nuclear facility or organization and analysing the strengths and weaknesses. The Agency provided support for the pilot implementation of the methodology at the Kozloduy nuclear power plant in Bulgaria.

A side event was held during the 58th regular session of the Agency's General Conference in September focusing on nuclear security culture in practice and the Agency's global approach. The event highlighted the Agency's tools and activities for promoting nuclear security culture. Particular emphasis was placed on the importance of practical application of the guidance provided in *Nuclear Security Culture* (IAEA Nuclear Security Series No. 7).

Computer Security

A number of high profile cyberattacks at the end of the year demonstrated the need for States to have robust computer security in place to protect against attacks on nuclear facilities. In response to increased Member State requests for assistance, the Agency enhanced computer security related activities, in particular through the development of regular expert meetings to facilitate information exchange and the development of guidance. The Agency also carried out national training courses on computer security — in Hungary, Japan, Romania and the United Arab Emirates — as well as five regional training courses on the topic — in Brazil, India, Jordan, the Republic of Korea and the Republic of Moldova (Fig. 2).

"the Agency enhanced computer security related activities, in particular through the development of regular expert meetings to facilitate information exchange and the development of guidance."

FIG. 2. An Agency expert on computer security at a national training course on basic awareness of computer security threats and adversary tactics held in 2014.

Incident and Trafficking Database

In 2014, Chad, Mozambique and Senegal joined the Incident and Trafficking Database (ITDB), bringing the total membership to 128 States. During 2014, States confirmed 186 incidents. While most of these incidents involved radioactive sources and radioactively contaminated material, States confirmed 22 incidents involving nuclear material to the ITDB in 2014. An extensive analysis of ITDB incidents was provided electronically to ITDB

Points of Contact in 2014. The pattern of incidents in 2014 was generally similar to that observed during the latest six year period. At the request of the ITDB Points of Contact at their meeting with the Agency in July 2012, a 2007–2012 analysis report was prepared in 2014, which will be discussed in the Points of Contact meeting scheduled for July 2015. The report highlighted, among other things, the proportion of incidents that were detected at, or just across, international borders, as well as the volume of radioactively contaminated material, particularly in scrap metal, in international transit. The importance of police and investigative operations in combatting trafficking in nuclear material was also highlighted.

Peer Reviews and Advisory Services

Member States have repeatedly recognized the value of Agency peer reviews and advisory services in General Conference resolutions. In 2014, the Agency carried out six International Nuclear Security Advisory Service (INSServ) missions — to Cameroon, the Lao People's Democratic Republic, Qatar, Romania, South Africa and Sri Lanka — as well as a preparatory mission to Viet Nam. In addition, the Agency carried out four International Physical Protection Advisory Service (IPPAS) missions, to Armenia, Belgium, Indonesia and the Republic of Korea.

"In the course of the year, the Agency conducted over 100 training events and workshops, which covered all aspects of nuclear security and involved around 3400 participants from 126 States."

Building Capacity

Human resource capacity building remains key to the maintenance of a sustainable national nuclear security regime. In the course of the year, the Agency conducted over 100 training events and workshops, which covered all aspects of nuclear security and involved around 3400 participants from 126 States. In addition, the Agency published five on-line e-learning modules on the topics of transport security, computer security, nuclear material accounting and control for security purposes, radiological crime scene management and physical protection. The on-line modules are designed to better enable Member States to implement the guidance in the IAEA Nuclear Security Series.

International Conference on Advances in Nuclear Forensics

The importance of nuclear forensics has been recognized by Member States in numerous forums. In response, the Agency organized an International Conference on Advances in Nuclear Forensics: Countering the Evolving Threat of Nuclear and Other Radioactive Material out of Regulatory Control, held in July at the Agency's Headquarters. This first international conference focusing exclusively on nuclear forensics attracted more than 280 participants from 76 Member States and eight international organizations. The conference identified nuclear forensics as a key element of a State's nuclear security infrastructure.

A new training course was developed in 2014 emphasizing the role of forensic best practices in the prevention of, and response to, a nuclear security event. The new training course was delivered as a pilot project in Hungary.

Needs Assessments

The Agency gives high priority to the development and implementation of Integrated Nuclear Security Support Plans (INSSPs) to assist Member States, upon request, in applying a structured and holistic approach to nuclear security capacity building and enabling

increased coordination between the Agency, the State concerned and potential donors. The INSSP programme grew significantly in 2014. To promote the systematic development of INSSPs, the Agency held three regional meetings, in Ghana, Indonesia and the Republic of Moldova. During the year, 14 Member States formally approved their INSSPs, an additional eight Member States finalized new INSSPs and are in the process of approving them, and nine Member States with existing INSSPs held joint review meetings with the Agency. With the increased number of Member States having established INSSPs, the Agency is able to gain a more comprehensive understanding of nuclear security priorities and address the real nuclear security needs of Member States in a systematic, prioritized and sustainable manner.

Some 70 Member States have nominated points of contact for the Nuclear Security Information Management System (NUSIMS). The Agency held seven subregional meetings in 2014, during which NUSIMS was introduced to points of contact or candidate points of contact from 85 Member States. Efforts were also made to integrate NUSIMS with INSSPs. The first national workshop on NUSIMS and review of INSSPs took place in the Philippines in late November.

"To promote the systematic development of [Integrated Nuclear Security Support Plans], the Agency held three regional meetings, in Ghana, Indonesia and the Republic of Moldova."

Nuclear Security Fund

In the course of the year, financial pledges to the Nuclear Security Fund were accepted by the Agency in the amount of €24.4 million. The €24.4 million comprised financial contributions from Australia, Canada, China, Denmark, Estonia, Finland, France, Germany, Japan, the Republic of Korea, Kazakhstan, the Netherlands, New Zealand, Norway, the Russian Federation, Spain, the United Kingdom and the United States of America. In kind contributions of €352 072 were also received.

Nuclear Verification

Nuclear Verification

Objectives

To deter the proliferation of nuclear weapons by early detection of the misuse of nuclear material or technology, and by providing credible assurances that States are honouring their safeguards obligations. To contribute to nuclear arms control and disarmament by responding to States' requests for verification and other technical assistance associated with related agreements and arrangements. To continually improve and optimize operations and capabilities to effectively carry out the Agency's verification mission.

Implementation of Safeguards in 2014

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 that: first, 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, 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.

For those States for which the broader conclusion has been drawn, the Agency implements 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 2014 integrated safeguards were implemented for 53 States[1,2].

In 2014, safeguards were applied for 180 States[3,4] with safeguards agreements in force with the Agency [5]. Of the 118 States that had both a CSA and an AP in force, the Agency concluded that *all* nuclear material remained in peaceful activities in 65 States[6]; for 53 States, as the necessary evaluation regarding the absence of undeclared nuclear material and activities for each of these States remained ongoing, the Agency was unable to draw the same conclusion. For these 53 States, and for the 54 States with a CSA but with no AP in force, the Agency concluded only that *declared* nuclear material remained in peaceful activities.

Safeguards were also implemented with regard to nuclear material in selected facilities in the five nuclear-weapon States 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.

"The Agency continued to facilitate the conclusion of safeguards agreements and [additional protocols]…and the amendment or rescission of small quantities protocols"

As of 31 December 2014, 12 non-nuclear-weapon States party to the NPT had yet to bring CSAs into force pursuant to Article III of the Treaty. For these States, the Agency could not draw any safeguards conclusions.

Conclusion of safeguards agreements and APs, and amendment and rescission of SQPs

The Agency continued to facilitate the conclusion of safeguards agreements and APs (Fig. 1), and the amendment or rescission of small quantities protocols (SQPs)[7]. During 2014, two APs entered into force[8]. The status of safeguards agreements and APs as of 31 December 2014 is shown in Table A6 in the Annex to this report. During the year, one

1 Armenia, Australia, Austria, Bangladesh, Belgium, 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, Republic of Korea, Latvia, Libya, Lithuania, Luxembourg, Madagascar, Mali, Malta, Monaco, Netherlands, Norway, Palau, Peru, Poland, Portugal, Romania, Seychelles, Singapore, Slovakia, Slovenia, Spain, Sweden, The former Yugoslav Republic of Macedonia, Ukraine, Uruguay and Uzbekistan.

2 And Taiwan, China.

3 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.

4 And Taiwan, China.

5 The status with regard to the conclusion of safeguards agreements, APs and small quantities protocols (SQPs) is given in the Annex to this report.

6 And Taiwan, China.

7 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.

8 India, and Saint Kitts and Nevis.

State[9] signed an AP, and an AP was approved by the Board for another State[10]. By the end of 2014, safeguards agreements were in force with 181 States and APs were in force with 124 States.

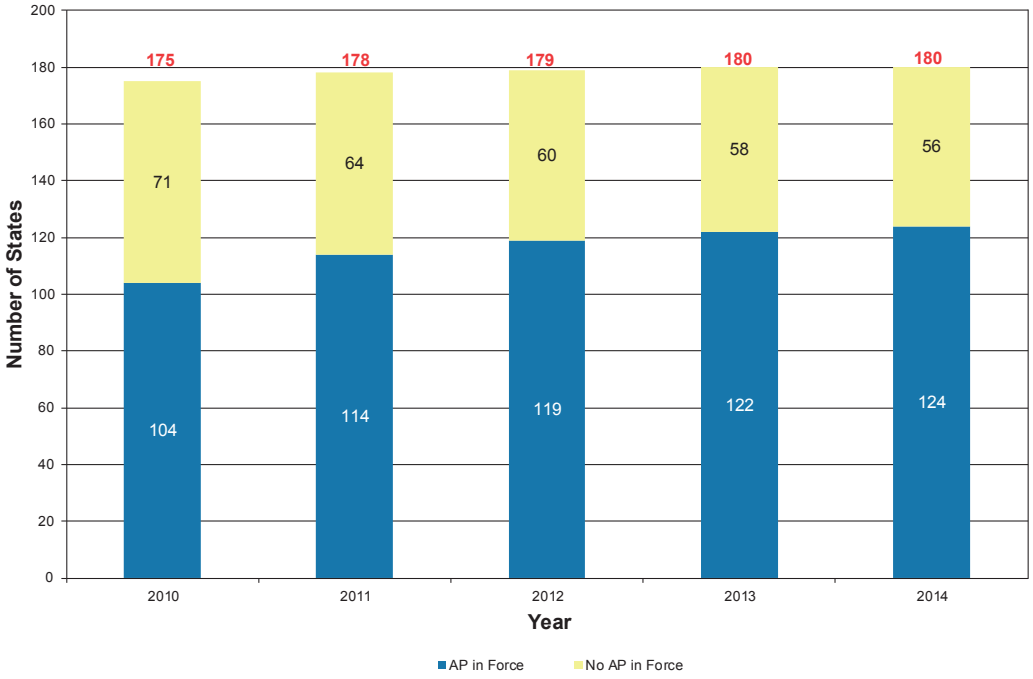

FIG. 1. Number of APs for States with safeguards agreements in force, 2010–2014 (the Democratic People's Republic of Korea is not included).

The Agency continued to implement the *Plan of Action to Promote the Conclusion of Safeguards Agreements and Additional Protocols*[11], which was updated in September 2014. The Agency organized national events on safeguards for Brunei Darussalam in June, and for Myanmar in December, at which the Agency encouraged these States to conclude APs and to amend their SQPs. In addition, consultations on the conclusion of safeguards agreements and APs were held throughout the year with representatives from various States in Geneva, New York and Vienna, as well as during training events organized in Vienna and elsewhere by the Agency.

Amendment and rescission of SQPs

The Agency continued to communicate with States in order to implement the Board's 2005 decisions regarding SQPs, with a view to amending or rescinding such protocols to reflect the revised standard text. During the year, two operational SQPs[12] were amended. This means that, by the end of 2014, 60 States of some 100 States had accepted the revised SQP text (which was in force for 53 of these States) and four States have rescinded their SQPs.

9 Lao People's Democratic Republic.

10 Cambodia.

11 Available at: *http://www.iaea.org/OurWork/SV/Safeguards/documents/sg_actionplan.pdf*.

12 Cambodia and New Zealand.

Islamic Republic of Iran (Iran)

During 2014, the Director General submitted four reports to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions in the Islamic Republic of Iran* (GOV/2014/10, GOV/2014/28, GOV/2014/43 and GOV/2014/58 and Corr.1).

In 2014, contrary to the relevant binding resolutions of the Board of Governors and the United Nations Security Council, Iran did not: implement the provisions of its Additional Protocol; implement the modified Code 3.1 of the Subsidiary Arrangements General Part to its Safeguards Agreement; suspend all enrichment related activities; or suspend all heavy water related activities. Neither did Iran resolve the Agency's concerns about possible military dimensions to Iran's nuclear programme. This resolution is necessary to establish international confidence in the exclusively peaceful nature of that programme.

In the Framework for Cooperation, the Agency and Iran, between November 2013 and May 2014, agreed on a total of 18 practical measures to be implemented by Iran in three sequential steps as part of an approach to resolve all present and past issues[13]. As of the end of 2014, Iran had implemented 16 of these practical measures; two practical measures related to possible military dimensions to Iran's nuclear programme, agreed for the third step of the Framework for Cooperation, remained to be implemented. The Agency also invited Iran to propose new practical measures to address the concerns over possible military dimensions to Iran's nuclear programme, to be implemented in the next step of the Framework for Cooperation. As of 31 December 2014, Iran had not proposed any such measures.

Since 20 January 2014, the Agency has undertaken monitoring and verification in relation to the nuclear-related measures set out in the Joint Plan of Action agreed between China, France, Germany, the Russian Federation, the United Kingdom, the United States of America and Iran, the aim of which is to reach a "mutually-agreed long-term comprehensive solution that would ensure Iran's nuclear programme will be exclusively peaceful". The initial duration of the Joint Plan of Action was six months. On 24 July 2014, the Joint Plan of Action was extended until 24 November 2014, when it was further extended until 30 June 2015. The Agency's work in relation to the Joint Plan of Action has required an approximate doubling of its verification activities compared with those the Agency had already been carrying out pursuant to Iran's Safeguards Agreement and the relevant resolutions of the Board of Governors and the Security Council.

While the Agency continued throughout 2014 to verify the non-diversion of declared nuclear material at the nuclear facilities and locations outside facilities declared by Iran under its Safeguards Agreement, the Agency was not in a position to provide credible assurance about the absence of undeclared nuclear material and activities in Iran and, therefore, was unable to conclude that all nuclear material in Iran was in peaceful activities.[14]

Syrian Arab Republic (Syria)

In September 2014, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic* (GOV/2014/44). According to the report, 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

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[13] The initial six practical measures were agreed on 13 November 2013; another seven practical measures were agreed on 9 February 2014; and a further five practical measures were agreed on 20 May 2014.

[14] As, for example, Iran did not implement its Additional Protocol, as required in the binding resolutions of the Board of Governors and the United Nations Security Council.

been declared to the Agency by Syria remained unchanged.[15] In 2014, 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.

In 2014, Syria indicated its readiness to receive Agency inspectors, and to provide support, for the purpose of performing a physical inventory verification (PIV) at the Miniature Neutron Source Reactor in Damascus. The Agency — after considering the United Nations Department of Safety and Security's assessment of the prevailing security level in Syria and the small amount of nuclear material declared by Syria to be at the reactor — decided to postpone the PIV at the reactor until the security level has sufficiently improved. By the end of 2014, the assessment of the security level in Syria had not changed.

Based on the evaluation of information provided by Syria and other safeguards relevant information available to it, the Agency found no indication of the diversion of declared nuclear material from peaceful activities. For 2014, the Agency concluded for Syria that declared nuclear material remained in peaceful activities.

Democratic People's Republic of Korea (DPRK)

In September 2014, 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/2014/42–GC(58)/21), which provided an update of developments since the Director General's report of August 2013.

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, could not draw any safeguards conclusion regarding the DPRK.

Since April 2009, the Agency has not implemented any measures under the ad hoc monitoring and verification arrangement agreed between the Agency and the DPRK and foreseen in the Initial Actions agreed at the Six-Party Talks. Statements by the DPRK concerning its conducting of a third nuclear test, reiterating its "right" to conduct further nuclear tests, and its intention to readjust and restart its nuclear facilities at Yongbyon, together with its previous statements about uranium enrichment activities and the construction of a light water reactor, are deeply regrettable.

No verification activities were implemented in the field in 2014, but the Agency continued to monitor the DPRK's nuclear activities by using open source information (including satellite imagery and trade information). Using satellite imagery, the Agency continued to observe signatures which were consistent with the operation of the 5 MW(e) reactor at Yongbyon throughout 2014, and renovation or expansion of other buildings was also seen within the Yongbyon site. However, without access to the site, the Agency cannot confirm the operational status of the reactor or the purpose of the other observed activities. The Agency continued to further consolidate its knowledge of the DPRK's nuclear programme with the objective of maintaining operational readiness to resume safeguards implementation in the DPRK.

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[15] The Board of Governors, in its resolution GOV/2011/41 of June 2011 (adopted by a vote), had, inter alia, called on Syria to remedy urgently 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 assurances as to the exclusively peaceful nature of Syria's nuclear programme.

Enhancing Safeguards

Evolving safeguards implementation

In 2014, the Agency continued to strengthen the effectiveness and improve the efficiency of safeguards by continuing to improve the way in which they are implemented. This evolution is essential, given the Agency's increasing verification workload due to the growth in both the number of nuclear facilities and the quantity of nuclear material under safeguards. Recent developments in the continuing evolution of safeguards implementation were described in a report submitted by the Director General to the Board of Governors in August entitled *Supplementary Document to the Report on The Conceptualization and Development of Safeguards Implementation at the State Level (GOV/2013/38)*. This report was provided following an extensive consultation process with Member States and provided clarifications and additional information on the State-level concept.[16] The report described the State-level concept's application to States with CSAs, item-specific safeguards agreements and voluntary offer agreements; outlined the way forward regarding its implementation; and set out the expected impact on the effectiveness and efficiency of safeguards implementation.

To continue to ensure consistency and non-discrimination in the implementation of safeguards for States with the same type of safeguards agreements, and to generate further efficiencies, the Agency continued to improve associated processes and procedures, making them more uniform.

"the Agency continued to investigate new tools and methodologies to streamline and prioritize workflows and processes."

Information analysis

The analysis of safeguards relevant information is an essential part of evaluating a State's nuclear activities and drawing safeguards conclusions. In drawing its safeguards conclusions, the Agency processes, evaluates and conducts consistency analysis of State declarations, the results of Agency verification activities and other safeguards relevant information available to the Agency. In support of this process, the Agency draws on an increasing amount of data from verification activities performed at Headquarters and in the field, including the results of non-destructive assay (NDA), destructive assay, environmental sample analyses and remotely monitored equipment, and from a diverse range of information sources, including open source information (e.g. commercial satellite imagery, trade data) and other sources of safeguards relevant information. Throughout 2014, the Agency continued to investigate new tools and methodologies to streamline and prioritize workflows and processes.

To continuously improve the quality of the information on which it must rely, the Agency monitored laboratory and measurement system performance and organized international technical meetings, training and workshops for various States on nuclear material accounting, including measurement data analysis, statistical methodologies and material balance evaluation concepts.

Cooperation with State and regional authorities

To assist States with SQPs in building capacity for implementing their safeguards obligations, the Agency published an updated version of the *Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols* (IAEA Services Series 21). In addition, the first of four planned Safeguards Implementation Practices Guides was

[16] The State-level concept refers to the general notion of implementing safeguards in a manner that considers a State's nuclear and nuclear-related activities and capabilities as a whole, within the scope of the State's safeguards agreement.

published in December, entitled *Safeguards Implementation Practices Guide on Facilitating IAEA Verification Activities* (IAEA Services Series 30). The Agency also conducted three IAEA SSAC Advisory Service (ISSAS) missions, to Kyrgyzstan, United Arab Emirates and Uzbekistan, and held seven international, regional and national training courses for personnel responsible for overseeing and implementing the State systems of accounting for and control of nuclear material (SSACs). Within the framework of the interactive e-learning series, the Agency also developed the first e-learning course on safeguards, explaining the Agency's Milestones approach to introducing a nuclear power programme.

Safeguards equipment and tools

Throughout 2014, the Agency ensured that its instrumentation and monitoring equipment, vital to the implementation of effective safeguards around the world, continued to function as required. During the year, 2082 separate pieces of equipment (compared with 1974 pieces of equipment in 2013) were prepared and assembled into 969 (compared with 891 in 2013) portable and resident NDA systems. By the end of 2014, a total of 153 unattended monitoring systems were in operation worldwide, and the Agency had 1354 cameras connected to 785 systems operating at 263 facilities in 35 States[17]. In addition, the Agency is responsible for maintaining approximately 200 cameras used jointly with regional/State authorities. The total number of electronic seals transmitting remote data to Headquarters was 207. By the end of 2014, there were 285 safeguards systems remotely connected to Headquarters installed at 127 facilities in 23 States.[18]

The Agency continued with the next generation surveillance system (NGSS) replacement campaign, replacing large numbers of old and obsolete pieces of surveillance equipment (DCM-14) (Fig. 2). In 2014, more than 200 old DCM-14 cameras and systems were

"the Agency also developed the first e-learning course on safeguards, explaining the Agency's Milestones approach to introducing a nuclear power programme."

FIG. 2. Next generation surveillance system (NGSS) cameras undergo testing prior to installation in nuclear facilities.

[17] And Taiwan, China.

[18] And Taiwan, China.

replaced by NGSS technology (Fig. 3). This replacement campaign is currently partially funded through a dedicated item in the Agency's Major Capital Investment Fund. In 2014, cooperative efforts continued with the European Commission (EC) and the Brazilian–Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) for the procurement, acceptance testing, training, installation and maintenance of jointly used surveillance systems. Agreements related to the joint use of the NGSS were finalized, and joint field implementation of equipment owned by the EC and ABACC began.

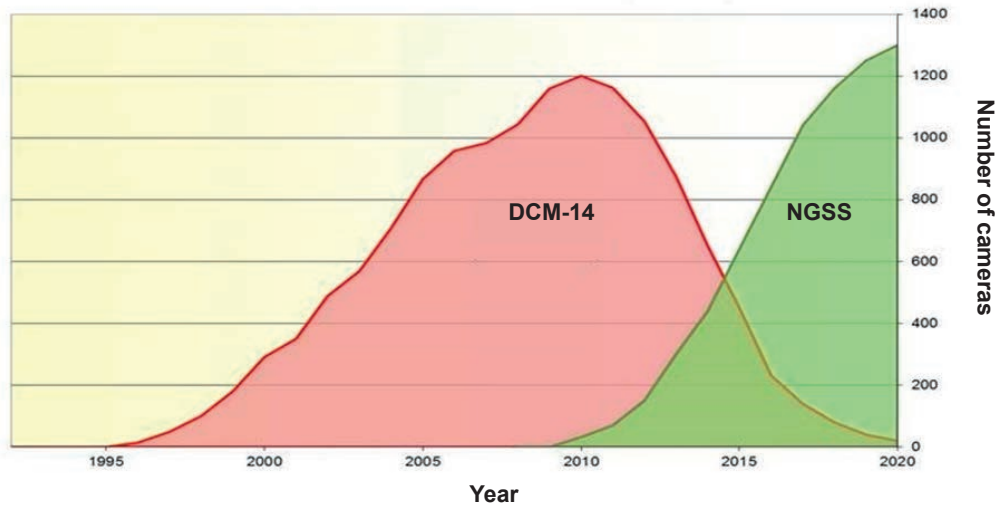

FIG. 3. The schedule for the introduction of the new NGSS cameras to replace the old DCM-14 cameras.

The instrumentation technology foresight activities are aimed at identifying and evaluating emerging technologies that could benefit the Agency. Two workshops were organized focusing on the evaluation of emerging technologies in the area of indoor positioning and on portable instrumentation for identification of non-radioactive material in support of complementary access and design information verification activities.

The Agency's Network of Analytical Laboratories (NWAL) consists of the Agency's Safeguards Analytical Laboratories (SAL) and 20 other qualified laboratories in Australia, Brazil, 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 are in the process of qualification in Argentina, Belgium, Canada, China, the Czech Republic, Germany, Hungary, the Republic of Korea, the Netherlands and the United States of America. In 2014, SAL analysed all 506 nuclear material samples collected by inspectors in the field, and 949 sub-samples from environmental swipe sampling were analysed in the NWAL (including at SAL). Proficiency tests and quality procedures were applied to ensure the correctness and accuracy of all results.

Support

Developing the safeguards workforce

In 2014, the Agency continued updating the Introductory Course on Agency Safeguards. New training materials were developed, with an emphasis on enhancing teaching methods by delivering training in a more interactive manner. During the year, the Agency conducted over 140 safeguards training courses to provide safeguards staff with the necessary technical and behavioural competencies. Some of these courses were held at nuclear facilities to enhance safeguards inspectors' and analysts' practical knowledge of collecting

and processing safeguards relevant information, in the field and at Headquarters, in a consistent and integrated manner. Several new training courses were also developed in line with the evolution of safeguards implementation and the development of new types of facility. The Agency has also been engaged with Member State Support Programmes (MSSPs) in the development of tools for training. The Safeguards Traineeship Programme, involving six trainees from Cambodia, Ghana, Myanmar, Nepal, Tajikistan and Tunisia, was successfully completed.

Standing Advisory Group on Safeguards Implementation

The Standing Advisory Group on Safeguards Implementation (SAGSI) held two series of meetings in 2014, at which, inter alia, it considered: dialogue with States on the State-level concept; internal guidance on preparing State-level safeguards approaches for States with CSAs, performing acquisition path analysis and preparing annual implementation plans; the *Safeguards Implementation Report*; and a new Agency initiative on performance indicators.

Significant Safeguards Projects

Enhancing Capabilities of the Safeguards Analytical Services (ECAS)

Transition activities needed to move into the newly completed Nuclear Material Laboratory (NML) continued throughout 2014 (Fig. 4), including the procurement and receipt of equipment required for both the chemical and instrumentation laboratories. At the end of 2014, approvals to operate the new facility were being sought from both the Agency's Internal Regulator and the Host Government.

Overall, the activities of the Enhancing Capabilities of the Safeguards Analytical Services (ECAS) project had reached 84% completion as of 31 December 2014. During the course of the year, procurement was undertaken for the construction of the new main gate facility, which includes vehicle parking, pedestrian and vehicular gate facilities, a goods receiving

FIG. 4. The new Nuclear Material Laboratory in Seibersdorf.

area and a dedicated environmental samples screening room. Construction of the new facility began in the autumn and proceeded on schedule. In addition, the ECAS team completed the new active wastewater line from the new NML to the off-site treatment facility in the adjacent Austrian Institute of Technology site, as well as the electrical power system upgrade providing a more reliable power distribution system through the Agency's Seibersdorf site.

Information technology: MOSAIC

The Agency's safeguards information technology modernization needs are being addressed through the Modernization of Safeguards Information Technology (MOSAIC) project. The project is aimed at strengthening information security and at enhancing existing, and introducing new, tools and applications. In 2014, work on defining the full scope of MOSAIC was completed, with identification of projects, resource needs and a timeline for completion.

Preparing for the Future

"In October…the Agency held the Symposium on International Safeguards: Linking Strategy Implementation and People"

The Secretariat undertakes strategic planning to ensure that safeguards will continue to be both effective and efficient into the future. This planning addresses the conceptual framework for safeguards implementation, legal authority, technical capabilities (expertise, equipment and infrastructure), and the human and financial resources necessary for the Agency's verification activities. It also considers communication, cooperation and partnerships with the Agency's stakeholders. In 2014, the Agency continued its implementation of the Agency's *Medium Term Strategy 2012–2017.*

Research and development are essential to meet the safeguards needs of the future. During 2014, the Agency continued implementing the *Department of Safeguards Long-Term Research and Development Plan, 2012–2023* with the assistance of MSSPs. To address near term development objectives and to support the implementation of its verification activities, the Agency continued to rely on MSSPs in implementing its *Development and Implementation Support Programme for Nuclear Verification 2014–2015*. At the end of 2014, 20 States[19] and the European Commission had formal support programmes with the Agency.

Safeguards Symposium

In October at its Headquarters in Vienna, the Agency held the Symposium on International Safeguards: Linking Strategy Implementation and People, attended by over 600 registered participants from 54 States and 11 international organizations. The objective of the symposium, the twelfth in a series of safeguards symposia, was to foster dialogue, exchange information and promote cooperation among the Secretariat, Member States, the nuclear industry and members of the broader safeguards and nuclear non-proliferation community. During the symposium, the Secretariat and other participants presented over 300 papers highlighting the breadth of activities required to achieve the Agency's near and longer term verification objectives. The symposium also featured an extensive exhibition, with 35 exhibitors demonstrating a broad range of achievements and new technologies.

[19] 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 the technical cooperation programme by planning and implementing a need based and responsive technical cooperation programme and by enhancing the technical capacities of Member States in the peaceful application of nuclear technologies.

The Technical Cooperation Programme

The Agency's technical cooperation programme builds capacities in Member States to support the peaceful application of nuclear technology, helping them to address development priorities in 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 to improve nuclear safety and security worldwide, including by providing legislative assistance. The programme aims to achieve tangible socioeconomic impact through its projects and, inter alia, to contribute to the achievement of the Millennium Development Goals (MDGs) and subsequent post-2015 development goals.

"In 2014, Country Programme Frameworks (CPFs) were signed by 13 Member States"

Country Programme Frameworks and Revised Supplementary Agreements

In 2014, Country Programme Frameworks (CPFs) were signed by 13 Member States — Argentina, Cameroon, Chile, Croatia, Cuba, Lao People's Democratic Republic, Madagascar, Mauritania, Mauritius, Montenegro, Mozambique, Namibia and Slovakia.

Efforts to strengthen the analytical content of CPFs continued throughout the year, with a focus on assisting Member State authorities in identifying and developing partnership frameworks for both their CPF and their project designs. The aim is to help Member States to identify opportunities for collaboration and to build partnerships with relevant technical, operational and financial organizations that could support their country programmes and the achievement of technical cooperation project objectives. Strengthened CPFs, with a stronger focus on partnership identification and development, could be used by Member States to support more effective resource mobilization efforts and to facilitate longer term partnerships for country programmes. Such an approach would also allow the identification of key partners for additional areas of cooperation, and could support a move away from mostly small scale, short duration national projects to programmes of larger scope and scale that offer greater opportunities for social and economic benefits and longer term national development impact.

In 2014, the Board of Governors, at its September meeting, endorsed the recommendation by the Working Group on Financing the Agency's Activities that "Member States should approve guidelines for supplementary resource mobilization and partnership with all relevant partners, in particular the private sector, for the Technical Cooperation Programme, to assist the Secretariat in engaging in a coherent and systematic manner with those partners." In response, the Secretariat has begun preparing draft strategic guidelines for consideration and approval by Member States at the June session of the Board of Governors.

Managing the Agency's Technical Cooperation Programme

Member State priorities in 2014, as reflected in programme disbursements, were health and nutrition, safety and security, and food and agriculture, with some variations in emphasis across regions (Fig. 1). By the end of the year, 1092 projects were active. During the course of the year, 146 projects were closed, of which one was cancelled. An additional 237 projects were in the process of being closed. Five Programme Reserve projects were implemented, in Ethiopia, Liberia (two projects), Myanmar and Sierra Leone.

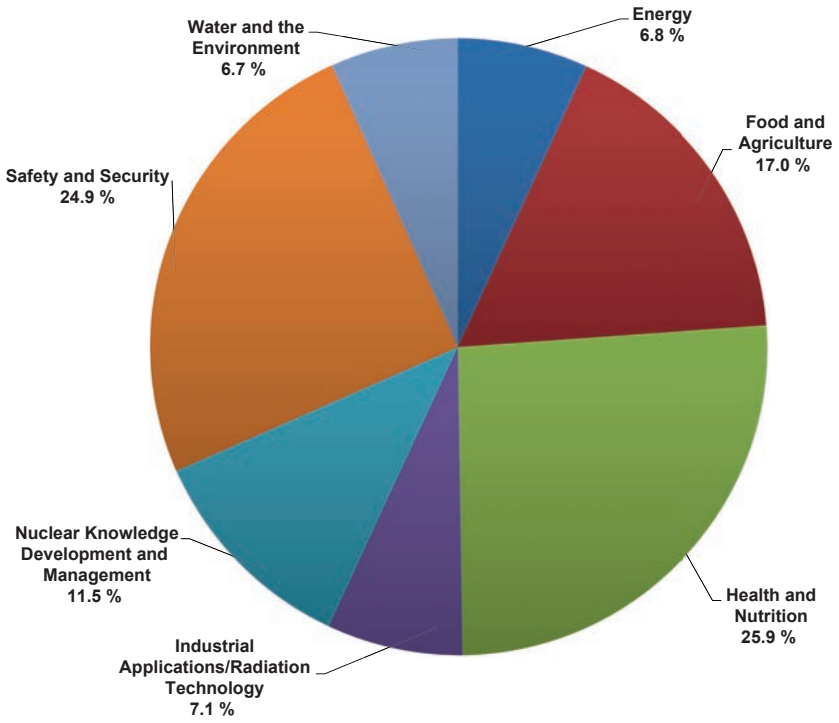

FIG. 1. Actuals by technical field for 2014. (Percentages do not add up to 100% owing to rounding.)

Financial Highlights

Payments against the 2014 Technical Cooperation Fund (TCF) totalled €62 million (not including National Participation Costs (NPCs) and assessed programme cost (APC) arrears), against the target of €69.2 million, with the rate of attainment on payments at the end of 2014 standing at 89.5% (Fig. 2). The use of these resources resulted in a TCF implementation rate of 78%.

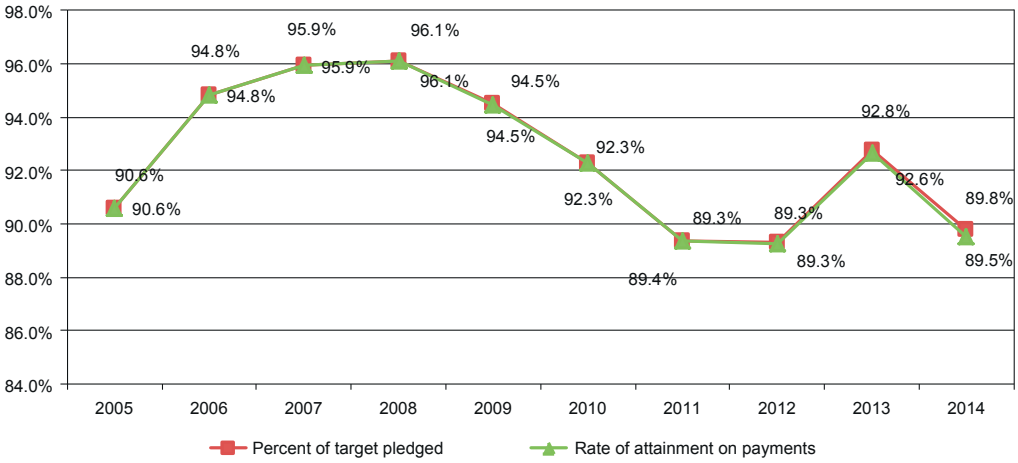

FIG. 2. Trends in the rate of attainment, 2005–2014.

Improving the Quality of the Technical Cooperation Programme

As part of its ongoing efforts to enhance the quality of the technical cooperation programme, the Agency continued to provide support to Member States to ensure that the projects developed for the 2016–2017 technical cooperation cycle would be linked to the Agency's Medium Term Strategy 2012–2017, and be of high quality, with measurable, attainable and timely objectives. Workshops and training events were provided on the technical cooperation programme, the logical framework approach (LFA), project design and technical cooperation monitoring tools (Fig. 3). Furthermore, programme briefings and meetings were organized for a range of technical cooperation stakeholders, including counterparts, National Liaison Officers, Programme Management Officers and Technical Officers.

FIG. 3. Throughout 2014, the Agency made a concerted effort to provide training in the logical framework approach to stakeholders in the technical cooperation programme, both within the Secretariat and in Member States.

Training events also took place in the field at the national, subregional and regional levels, providing opportunities for a solid exchange of ideas and for developing synergies in the programming process. For example, for the Africa region, two practical training workshops were held on designing technical cooperation projects using the LFA — one in Cameroon for Francophone countries and one in Vienna for Anglophone countries.

Monitoring and Evaluating Technical Cooperation Projects

A streamlined template for the Project Progress Assessment Report (PPAR) was developed in 2014, based on the results of an ad hoc working group's review of the PPAR's format and content. The revised template is expected to further integrate a comprehensive system of programme and project monitoring and evaluation into the technical cooperation programme cycle. In addition, guidelines on completing the PPAR were developed, and guidelines on self-assessment at the project and programme levels as well as a process for outcome monitoring were prepared.

Identifying and Disseminating Best Practices

The technical cooperation best practice mechanism identified three best practices in 2014, which were shared through a Best Practices Dissemination Meeting held in February. The best practices were: (i) technological transfer on in situ leaching (ISL) mining for a more sustainable alternative for uranium production in Argentina; (ii) enabling sustainable uranium production in a global context; and (iii) drip irrigation technology for improved tea production for small scale farmers in the United Republic of Tanzania.

Coordination with the United Nations and Other International Organizations

The management approach to engaging the United Nations and other international organizations, as well as non-governmental organizations (NGOs) and the private sector, is focused on field level coordination and partnership building in support of country programmes. Partnerships with relevant collaborators, programmes and funding organizations can be a means to fill technical, operational and financial gaps. During 2014, Member States were assisted in acquiring capabilities to effectively build partnerships that could positively influence the achievement of project objectives. The CPF is the key mechanism for upstream analysis. This leads to improved project design downstream, where the analytical tools of the LFA are then used to identify partner opportunities. In 2014, steps were taken to revise and update the LFA methodology to produce a partnership matrix, and to develop new materials and training. The Agency is increasingly involved in United Nations Development Assistance Framework (UNDAF) development processes using the in-country presence of partner organizations such as the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the United Nations Industrial Development Organization and the World Health Organization (WHO). This allows the Agency to identify areas where joint programming with United Nations stakeholders can achieve greater socioeconomic impact. The forthcoming agreement on the post-2015 sustainable development agenda and its accompanying sustainable development goals (SDGs) is an important opportunity for the Agency to align the technical cooperation programme with common development priorities. The 17 new SDGs succeed the eight 2000–2015 MDGs that have guided the United Nations system and many bilateral programmes and NGOs in coordinated and focused support

for national MDG targets and plans. Many, if not most, of these goals relate directly to the Agency's technical programmes, and are areas where nuclear science and technology can make a unique contribution.

A Practical Arrangement was completed with UNEP in 2014. With approval of this Practical Arrangement, the Agency is making good progress towards its vision of a Thematic Partnership Framework for climate change involving the current partners — FAO, the United Nations Convention to Combat Desertification and UNEP — and will seek agreements in 2015 with the United Nations Framework Convention on Climate Change and eventually CGIAR and the Global Environment Facility, which is managing the Special Climate Change Fund. At the regional level, in the Africa region, the Agency participated in the collective response of the United Nations system to national development priorities and worked to strengthen efforts to establish operational partnerships through active participation in, inter alia, the UNDAF process in Ghana, the United Republic of Tanzania and Zambia. In 2014, the Agency co-signed UNDAFs for Madagascar, Niger and Sierra Leone. Efforts are being made to involve the Agency in UNDAF activities in Lesotho, Malawi, Rwanda and Zimbabwe. The Agency also participated in the elaboration of the United Nations Partnership Framework for Angola, which is now pending signature. Close cooperation with the United Nations Country Teams (UNCTs) in Mauritius and Seychelles was established, aimed at developing and formalizing strategic partnership agreements that are planned for signature in 2015.

"in the Africa region, the Agency participated in the collective response of the United Nations system to national development priorities"

In the Asia and the Pacific region, significant initiatives were taken to strengthen interorganizational partnerships and cooperation with development agencies, including through active participation in UNDAF processes at the country level. For the coordination of efforts between different United Nations organizations in non-UNDAF countries, the Agency is engaging in inter-agency dialogue for the development of the strategic partnership framework of Malaysia and the United Nations Partnership for Development Framework of Indonesia.

The Agency continues to cooperate with numerous United Nations and non–United Nations institutions in the Europe region, and has also participated in all UNDAF processes there. Two centres in the region supported the implementation of postgraduate training programmes in radiation protection: the Greek Atomic Energy Commission, in Athens, and the International Sakharov Environmental University, in Minsk. The Agency also maintained agreements with the European Society for Radiotherapy and Oncology and the European Association of Nuclear Medicine for the management of training courses in radiotherapy and nuclear medicine. A Mutual Understanding was signed with the State Atomic Energy Corporation 'Rosatom' (Russian Federation) regarding cooperation for capacity building in the area of medical physics in radiation oncology in the Commonwealth of Independent States. Practical Arrangements are also in place to facilitate training activities under technical cooperation projects in some ten institutes and research centres in France, Italy, the Netherlands, Poland, the Russian Federation and the United States of America (USA).

In the Latin America region, the Agency is interacting closely with UNCTs to ensure that the resident United Nations agencies are fully informed of the nature and scope of the technical cooperation programme. In 2014, the Agency followed closely the implementation of the UNDAFs co-signed by the Agency for Belize, the Plurinational State of Bolivia, Cuba, the Dominican Republic, Jamaica, Mexico, Nicaragua and Panama, and worked with the UNCTs of the countries where the UNDAF rollout year arrived in 2014 or earlier, namely Argentina, Brazil, El Salvador, Guatemala, Panama, Paraguay, Uruguay and the Bolivarian Republic of Venezuela, in order to include the Agency's input in the upcoming UNDAF. The Agency has also started to work in cooperation with the UNCTs of the new Member States of the region — the Bahamas, Dominica, and Trinidad and Tobago — to ensure that CPFs prepared for cooperation with the Agency's technical cooperation programme take into account available UNDAFs or any other United Nations cooperation frameworks.

Also in Latin America, the Agency has continued to expand its cooperation with traditional United Nations and non–United Nations partners, and to explore opportunities for cooperation in support of sustainable development with new partners in the region. In 2014, cooperation with the National Center for Electron Beam Research of Texas A&M University was successfully integrated into the framework of a technical cooperation project relating to food irradiation. The Agency has maintained a strategy of involving relevant partners early in upstream work to formulate regional projects for the 2016–2017 technical cooperation cycle. For example, the United States Nuclear Regulatory Commission, the United States Department of State, the Spanish Nuclear Safety Council and the Joint Research Centre of the European Commission participated in a workshop to design a project on the control of radioactive sources in the Caribbean region, in which the Pan American Health Organization will also be involved.

Efforts to intensify engagement with European Union (EU) institutions continued. A number of contribution agreements are in place between the two organizations for collaboration on projects related to, for example, nuclear safety, waste management, environmental remediation, strengthening regulatory authorities, emergency preparedness and response, and cradle to grave control of radioactive sources. A mechanism of joint portfolio review was established in 2013 for the discussion of all Agency projects receiving financial support from the EU's Instrument for Nuclear Safety Cooperation. In this context, the second and third project review meetings took place in 2014, with the aim of reviewing project implementation progress and discussing potential additional projects for funding in 2015.

"The Agency has maintained a strategy of involving relevant partners early in upstream work to formulate regional projects for the 2016–2017 technical cooperation cycle."

Regional Agreements and Programming

Regional agreements and other Member State groups promote horizontal cooperation, self-reliance and sustainability. Agency collaboration with these groups has led to stronger regional technical cooperation programmes that are focused on priorities identified at the regional level.

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 39 State Parties. In preparing for the 2016–2017 technical cooperation cycle, efforts were made to align the proposed AFRA regional projects with the major themes of the AFRA Regional Strategic Cooperative Framework. With the objective of rationalizing its programme through the development of larger, more comprehensive projects, in line with the guidance provided in the General Conference resolution on Strengthening of the Agency's technical cooperation activities (GC(58)/RES/12), AFRA has submitted six project concepts in different fields of activity. The new AFRA programme continues to place a high priority on enhancing human resource development and on strengthening existing infrastructure in the region.

Implementation of the AFRA strategy for partnership building and resource mobilization continued in December through a series of meetings of the AFRA Chair with the Vienna-based African Group and the Permanent Missions in Vienna. In 2014, the total contribution of AFRA State Parties to the AFRA Fund was approximately US $1 million in support of unfunded AFRA technical cooperation projects. This is a significant increase compared with previous years. The Fund was used, inter alia, to partly support Agency efforts to combat the Ebola virus disease, further demonstrating the commitment of the AFRA State Parties to the Fund and their willingness to further enhance regional ownership of the programme.

AFRA celebrated its 25th anniversary in 2014, with a public exhibition and a scientific forum on human health and food and agriculture during the AFRA Technical Working

Group Meeting in Lesotho, and an exhibition and a panel discussion during the 58th regular session of the Agency's General Conference. Also in 2014, the first meeting of Focal Points of AFRA Regional Designated Centres and Project Scientific Consultants took place in Vienna, aimed at further enhancing their contributory role in managing the programme and promoting technical cooperation among developing countries and regional self-reliance.

With the accession of Cambodia and Fiji to the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) in 2014, Contracting Parties to the RCA now total 16 countries. During the 43rd RCA General Conference Meeting, working groups deliberated on the RCA's medium term strategic priorities, the future role of the RCA Regional Office, and the possible amendment of the Agreement.

The Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA), which promotes and coordinates activities for training, research, development and applications of nuclear science and technology, was extended for the second time for an additional period of six years, effective as of 29 July 2014. With Agency support, the Guidelines and Operating Rules for the ARASIA programme were revised and adopted, which will contribute to strengthening the implementation of the Agreement and ensuring high quality in the development and delivery of the ARASIA programme.

Efforts to strengthen cooperation among Member States in Europe continued in line with the strategy for technical cooperation in the Europe region, building on discussions on the implementation of the strategy during previous technical cooperation cycles. This is done through, inter alia, meetings of Member State National Liaison Officers and the Secretariat. One of the key features of the regional programme in the Europe region is cooperation between advanced and less advanced Member States, with built-in mentoring where applicable. Member States cooperated with the Secretariat in the preparation of regional project proposals for 2016–2017 in line with the Europe Regional Profile, the medium term plan for 2014–2017.

During 2014, the Agency, in close cooperation with States Parties to the Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) and other stakeholders, completed the preparation of the new 2016–2021 Regional Strategic Profile for Latin America and the Caribbean (RSP). The RSP is a strategic programmatic framework to identify and prioritize the most pressing regional challenges in the ARCAL countries of Latin America that can be addressed using nuclear technologies. The 39 needs identified are categorized in six thematic areas, representing priority areas for nuclear related cooperation in the region. These areas are food security and agriculture, human health, environment, energy, radiation technology, and radiation safety.

The new RSP is accompanied by a working document containing strategic guidance to facilitate the planning of the technical cooperation cycles covered by the new RSP. This working document will be updated periodically as progress is made in achieving the set objectives and goals. It is expected that it will facilitate approaches to strategic partners, both within the region and outside, in pursuit of projects with larger scope, and greater benefits and impact.

Programme of Action for Cancer Therapy (PACT)

The integration of the Programme of Action for Cancer Therapy (PACT) into the Agency's technical cooperation programme was fully implemented and operationalized in 2014.

Through PACT, the Agency continued to support low and middle income countries (LMICs) in strengthening national cancer control capacities while advocating the sustainable integration of radiation medicine in comprehensive national cancer control strategies. The

global visibility and recognition of PACT as a key player in cancer control was increased through active participation in important cancer related global events including: the 67th session of the World Health Assembly in Switzerland; WHO Regional Committee Meetings for the Eastern Mediterranean, European and Western Pacific Regions; the International Medical Physics Symposium: Increasing Access to Medical Physics Education/Training and Research Excellence, organized by the American Association of Physicists in Medicine in the USA; the Eighth Stop Cervical, Breast and Prostate Cancer in Africa Conference, organized by the Forum of African First Ladies Against Breast and Cervical Cancer in Namibia; a side event entitled 'Investing in Our Future' at the US–Africa Leaders' Summit in the USA; the International Conference on the Burden of Cancer in the Gulf Region, held in Saudi Arabia; the World Oncology Forum, held in Switzerland; and the World Cancer Leaders' Summit and the World Cancer Congress, both held in Australia.

A major highlight of partnership efforts was the signing of a Partnership Agreement between the Agency and Pink Ribbon Red Ribbon, an initiative of the George W. Bush Institute, a leading public–private partnership aimed at catalysing the global community to reduce deaths from breast and cervical cancer in sub-Saharan Africa.

Partnerships with WHO, the International Agency for Research on Cancer (IARC) and the Union for International Cancer Control were reaffirmed, through intensified interactions and the initiation of jointly planned projects and events. The Agency participated in the United Nations Interagency Task Force on the Prevention and Control of Non-communicable Diseases.

"Since PACT's inception, a total of 69 Member States have received comprehensive cancer control capacity and needs assessments, known as imPACT reviews."

Since PACT's inception, a total of 69 Member States have received comprehensive cancer control capacity and needs assessments, known as imPACT reviews. Conducted in collaboration with WHO and IARC, these missions provide Member States with a situation analysis of their national cancer control capacity and recommendations for comprehensive cancer control programmes. Ten imPACT review missions were conducted in 2014, to Costa Rica, Croatia, Fiji, Georgia, Lao People's Democratic Republic, Mozambique, Panama, Peru, Rwanda and Uzbekistan. The effectiveness of these missions was enhanced through the systematic participation of Programme Management Officers and radiation safety experts.

During the year, the PACT Model Demonstration Sites in Ghana, Mongolia, Nicaragua, Sri Lanka, the United Republic of Tanzania and Viet Nam were supported through expert missions and the provision of training and equipment. For example, Viet Nam launched a breast and cervical cancer early diagnosis project to raise public awareness about cancer related signs and symptoms, and diagnosis at earlier stages. The implementation of a cervical and breast cancer diagnosis project in Nicaragua was supported through an evaluation of mammography services and of related staff training in May. An expert assessed the status of Mongolia's radiation oncology and medical physics infrastructure and services. The country also upgraded its radiotherapy treatment planning system at the National Cancer Centre of Mongolia in Ulaanbaatar with extrabudgetary funds.

Work on the pilot project for a Virtual University for Cancer Control (VUCC) in East Africa advanced in 2014. The participating countries — Ghana, Uganda, the United Republic of Tanzania and Zambia — collaborated closely, with a view to establishing an integrated regional entity, supported by Egypt and South Africa. Three e-learning modules were finalized and offered to the first cadre of students through the VUCC Network (VUCCnet) e-learning platform.

The fifth meeting of the Advisory Group on Increasing Access to Radiotherapy Technology (AGaRT) was convened in Vienna in October. The group developed guidelines to ensure basic radiotherapy solutions with guaranteed long term functionality for LMICs, which, once finalized and published, will provide guidance to countries embarking on establishing or expanding their radiotherapy services. The guidelines are aimed at establishing best practices for facility maintenance, life cycle costing, comprehensive procurement processes and continued professional training, and describe the radiotherapy package recommended for a basic radiotherapy clinic. The guidelines will also support LMICs in improving the

sustainability of their radiotherapy investments, and thereby contribute to increasing access to affordable and appropriate radiotherapy treatment.

With the increased global focus on cancer and other non-communicable diseases, donors have remained steadfast in their support of strengthening national cancer control capacities. In 2014, PACT mobilized €719 000 in contributions from Agency Member States and partners for cancer control activities.

Outreach and Communication

Agency outreach to the international development community was strengthened through participation in a number of international events, including the 33rd Congress of the European Society for Radiotherapy and Oncology in Austria, the AFRA 25th anniversary celebrations in Lesotho, and the 55th annual meeting of the Institute of Nuclear Materials Management in the USA. The Agency used these opportunities to showcase its work in specific thematic areas and to raise awareness of the technical cooperation programme among potential partners.

Exhibitions focusing on technical cooperation activities were organized for World Cancer Day, the Agency's International Symposium on Understanding Moderate Malnutrition in Children for Effective Interventions and the 58th regular session of the Agency's General Conference. The Agency also took advantage of special 'UN Days' to implement targeted information campaigns, using social media and the web, to promote relevant technical cooperation activities. Support was also provided to the exhibitions of several Member States at the 58th General Conference, highlighting technical cooperation activities. The Fifth Annual Seminar on Technical Cooperation for Diplomats, designed to provide Permanent Missions with a comprehensive overview of the programme, was held in October in Vienna.

The technical cooperation web site was updated with 99 web articles, five photo essays and 15 videos during 2014, and now has some 6400 visitors a month. In 2014, the site received over 110 000 visits. More than 400 tweets were sent out from the @IAEATC Twitter account, which now has over 2000 followers. A number of new outreach products were issued, including 20 new technical cooperation project success stories, a new flyer on industrial waste management and persistent organic pollutants, and project specific exhibition material.

"Country specific bilateral legislative assistance was provided to 15 Member States through written comments and advice on drafting national nuclear legislation."

Legislative Assistance

In 2014, the Agency continued to provide legislative assistance to its Member States through the technical cooperation programme. Country specific bilateral legislative assistance was provided to 15 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 fourth session of the Nuclear Law Institute in Baden, Austria, from 6 to 17 October 2014. 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 representatives from 51 Member States participated. The Agency also continued to contribute to the activities organized at the World Nuclear

University and the International School of Nuclear Law by providing lectures and sponsoring participants through appropriate technical cooperation projects.

Two workshops on nuclear law for Member States in the Latin America region were organized in Jamaica in March and the Dominican Republic in December. Forty participants from 20 Member States attended the workshops, which addressed all aspects of nuclear law and created a forum for an exchange of views on topics relating to the international legal instruments. The workshops also allowed for the planning of future legislative assistance activities in participating Member States based on an assessment of their needs.

The fourth IAEA Treaty Event took place during the 58th regular session of the Agency's 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. The special focus of this year's Treaty Event was the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material. Representatives of several Member States were also briefed on the conventions adopted under the Agency's auspices.

Awareness missions to Kenya, Mongolia, Peru and the Philippines were dispatched in 2014 to raise the awareness of national policy makers about the importance of adhering to relevant international legal instruments adopted under the Agency's auspices.

Annex

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Note: Tables A25–A30 are available on the attached CD-ROM.

Table A1. Regular Budget allocation and utilization of resources in 2014 by Programme and Major Programme (in euros)

Major Programme (MP)/Programme	Original budget $1/€1	Adjusted budget $1/€0.7510	Expenditure	Resource utilization	Unobligated balances
	a	b	c	d = c/b	e = b – c
MP1 — Nuclear Power, Fuel Cycle and Nuclear Science					
Overall management, coordination and common activities	1 242 596	1 198 006	1 262 129	105.4%	(64 123)
Nuclear Power	7 929 763	7 624 375	7 372 154	96.7%	252 221
Nuclear Fuel Cycle and Materials Technologies	3 491 867	3 384 650	3 123 201	92.3%	261 449
Capacity Building and Nuclear Knowledge for Sustainable Energy Development	10 326 485	9 995 252	9 271 259	92.8%	723 993
Nuclear Science	10 088 797	9 832 665	9 484 794	96.5%	347 871
Corporate shared services	1 399 295	1 359 975	1 454 011	106.9%	(94 036)
Total Major Programme 1	**34 478 803**	**33 394 923**	**31 967 548**	**95.7%**	**1 427 375**
MP2 — Nuclear Techniques for Development and Environmental Protection					
Overall management, coordination and common activities	3 106 417	3 012 086	2 405 788	79.9%	606 298
Food and Agriculture	11 295 034	10 989 645	11 104 353	101.0%	(114 708)
Human Health	8 176 873	7 936 950	7 726 583	97.3%	210 367
Water Resources	3 437 018	3 340 702	3 300 498	98.8%	40 204
Environment	6 201 177	6 008 588	5 955 017	99.1%	53 571
Radioisotope Production and Radiation Technology	2 223 928	2 164 985	2 076 952	95.9%	88 033
Corporate shared services	4 042 555	3 998 438	3 797 534	95.0%	200 904
Total Major Programme 2	**38 483 002**	**37 451 394**	**36 366 725**	**97.1%**	**1 084 669**
MP3 — Nuclear Safety and Security					
Overall management, coordination and common activities	2 615 542	2 510 163	2 332 506	92.9%	177 657
Incident and Emergency Preparedness and Response	3 772 821	3 647 348	3 638 739	99.8%	8 609
Safety of Nuclear Installations	9 915 952	9 487 539	9 460 872	99.7%	26 667
Radiation and Transport Safety	6 997 627	6 722 227	6 699 086	99.7%	23 141
Management of Radioactive Waste	6 969 365	6 700 398	6 679 084	99.7%	21 314
Nuclear Security	5 089 980	4 861 002	4 737 493	97.5%	123 509
Corporate shared services	1 752 701	1 704 581	1 642 476	96.4%	62 105
Total Major Programme 3	**37 113 988**	**35 633 258**	**35 190 256**	**98.8%**	**443 002**
MP4 — Nuclear Verification					
Overall management, coordination and common activities	5 581 288	5 339 155	4 626 683	86.7%	712 472
Safeguards Implementation	108 512 207	104 682 162	101 455 008	96.9%	3 227 154
Other Verification Activities	530 249	502 803	345 426	68.7%	157 377
Development	8 697 933	8 274 938	10 681 823	129.1%	(2 406 885)
Corporate shared services	7 707 201	7 567 499	7 253 742	95.9%	313 757
Total Major Programme 4	**131 028 878**	**126 366 557**	**124 362 682**	**98.4%**	**2 003 875**
MP5 — Policy, Management and Administration Services					
Policy, Management and Administration Services	73 276 253	71 626 843	70 568 708	98.5%	1 058 135
Corporate shared services	3 667 742	3 550 914	3 463 244	97.5%	87 670
Total Major Programme 5	**76 943 995**	**75 177 757**	**74 031 952**	**98.5%**	**1 145 805**
MP6 — Management of Technical Cooperation for Development					
Management of Technical Cooperation for Development	22 502 644	21 660 732	20 631 858	95.3%	1 028 874
Corporate shared services	1 058 369	1 022 499	1 001 304	97.9%	21 195
Total Major Programme 6	**23 561 013**	**22 683 231**	**21 633 162**	**95.4%**	**1 050 069**
Total Operational Regular Budget	**341 609 679**	**330 707 120**	**323 552 325**	**97.8%**	**7 154 795**
Major Capital Investment Funding Requirements					
MP1 — Nuclear Power, Fuel Cycle and Nuclear Science	–	–	–	–	–
MP2 — Nuclear Techniques for Development and Environmental Protection	2 672 800	2 672 800	–	–	2 672 800
MP3 — Nuclear Safety and Security	–	–	–	–	–
MP4 — Nuclear Verification	2 261 600	2 261 600	2 240 300	99.1%	21 300
MP5 — Policy, Management and Administration Services	3 289 600	3 289 600	2 458 215	74.7%	831 385
MP6 — Management of Technical Cooperation for Development	–	–	–	–	–
Total Capital Regular Budget	**8 224 000**	**8 224 000**	**4 698 515**	**57.1%**	**3 525 485**
Total Agency Programmes	**349 833 679**	**338 931 120**	**328 250 840**	**96.8%**	**10 680 280**
Reimbursable work for others	2 840 340	2 840 340	2 834 430	99.79%	5 910
Total Regular Budget	**352 674 019**	**341 771 460**	**331 085 270**	**96.9%**	**10 686 190**

Column a: General Conference resolution GC(57)/RES/5 of September 2013 — adjusted to reflect the share of corporate shared services under each operational Major Programme.

Column b: Original budget revalued at the United Nations average rate of exchange of $1 to €0.7510 in 2014.

Table A2. Extrabudgetary regular programme fund resource utilization in 2014 by Programme and Major Programme (in euros)

Major Programme (MP)/Programme	2014 expenditure
MP1 — Nuclear Power, Fuel Cycle and Nuclear Science	
Overall management, coordination and common activities	99 373
Nuclear Power	3 534 749
Nuclear Fuel Cycle and Materials Technologies	2 277 675
Capacity Building and Nuclear Knowledge for Sustainable Energy Development	504 222
Nuclear Science	902 262
Total Major Programme 1	**7 318 281**
MP2 — Nuclear Techniques for Development and Environmental Protection	
Overall management, coordination and common activities	471 753
Food and Agriculture	2 480 811
Human Health [a]	(81 442)
Water Resources	329 376
Environment	997 334
Radioisotope Production and Radiation Technology	–
Total Major Programme 2	**4 197 832**
MP3 — Nuclear Safety and Security	
Overall management, coordination and common activities	6 334 621
Incident and Emergency Preparedness and Response	435 104
Safety of Nuclear Installations	6 597 689
Radiation and Transport Safety	1 802 820
Management of Radioactive Waste	1 912 863
Nuclear Security	16 631 696
Total Major Programme 3	**33 714 793**
MP4 — Nuclear Verification	
Overall management, coordination and common activities	1 485 484
Safeguards Implementation	10 907 397
Other Verification Activities	–
Development	9 436 503
Total Major Programme 4	**21 829 384**
MP5 — Policy, Management and Administration Services	
Policy, Management and Administration Services	1 250 452
Total Major Programme 5	**1 250 452**
MP6 — Management of Technical Cooperation for Development	
Management of Technical Cooperation for Development	11 624
Total Major Programme 6	**11 624**
Total extrabudgetary programme funds	**68 322 366**

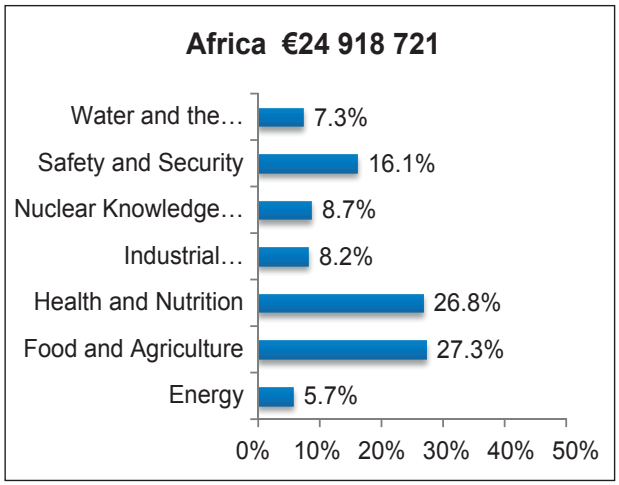
[a] The Human Health Programme shows minus €81 442 because financial commitments of €366 197 from the prior year related to the Programme of Action for Cancer Therapy (PACT) were transferred from extrabudgetary regular programme funds to the technical cooperation programme's extrabudgetary funds.

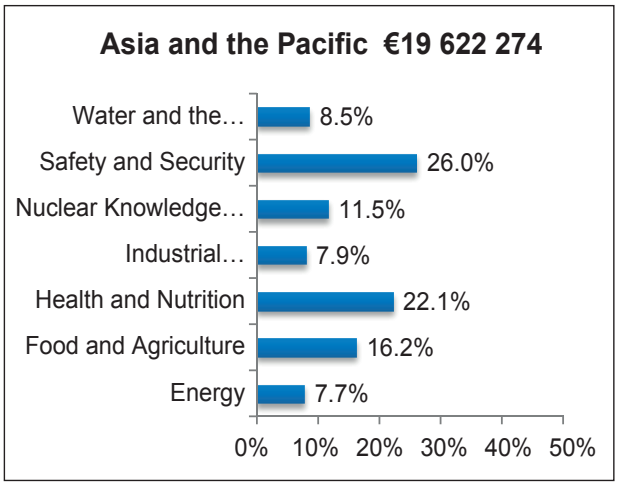
Table A3(a). Disbursements (actuals) by technical field and region in 2014

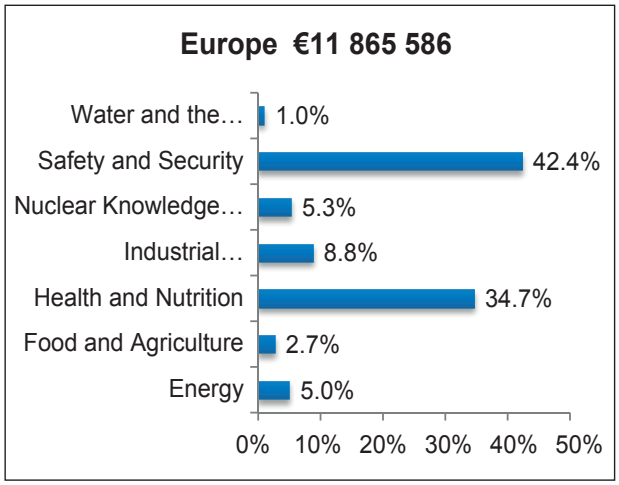
Summary of all regions (in euros)							
Technical field	**Africa**	**Asia and the Pacific**	**Europe**	**Latin America**	**Global/ interregional**	**PACT[a]**	**Total**
Energy	1 415 769	1 509 029	597 959	557 015	984 845		**5 064 617**
Food and Agriculture	6 794 076	3 169 848	321 501	2 079 422	244 191		**12 609 037**
Health and Nutrition	6 669 679	4 342 703	4 111 717	2 958 612	165 399	902 610	**19 150 720**
Industrial Applications/ Radiation Technology	2 039 381	1 557 044	1 046 451	635 766			**5 278 642**
Nuclear Knowledge Development and Management	2 156 170	2 266 133	633 356	1 729 378	1 737 779		**8 522 816**
Safety and Security	4 016 027	5 109 131	5 030 835	2 620 205	1 652 775		**18 428 973**
Water and the Environment	1 827 619	1 668 385	123 766	1 221 704	111 989		**4 953 464**
Total	**24 918 721**	**19 622 274**	**11 865 586**	**11 802 102**	**4 896 977**	**902 610**	**74 008 270**

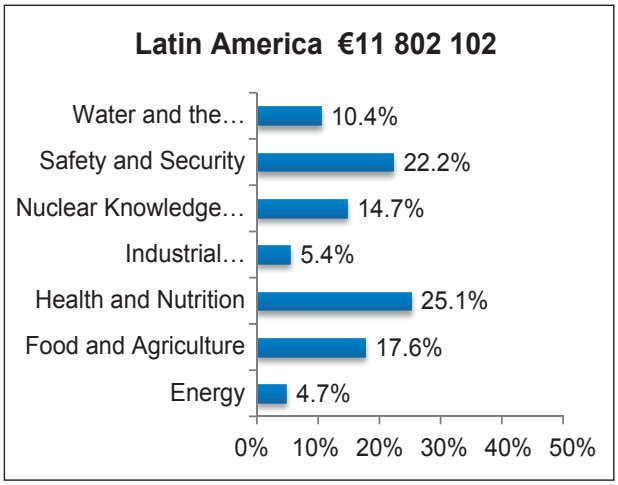
[a] PACT: Programme of Action for Cancer Therapy.

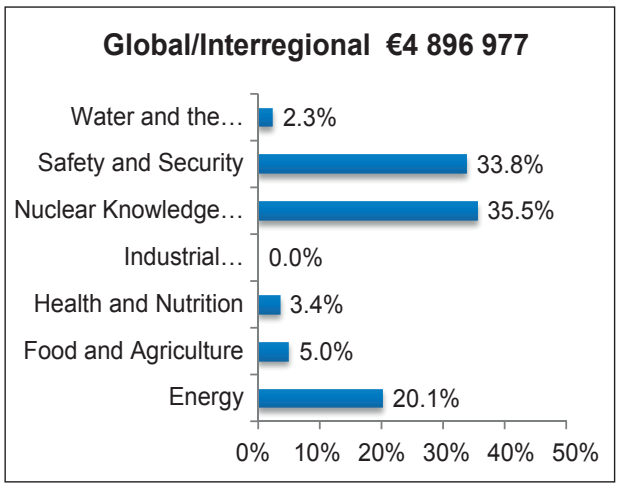
Table A3(b). Graphical representation of the information in Table A3(a)

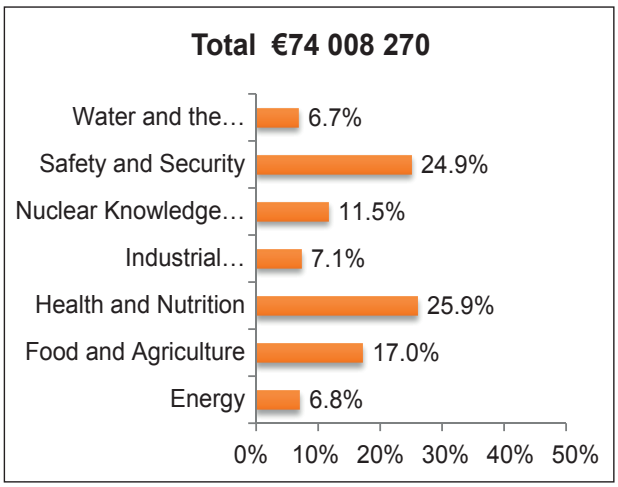












Note: See Table A3(a) for the full titles of the technical fields.

Table A4. Amount of nuclear material at the end of 2014 by type of agreement

Nuclear material	Comprehensive safeguards agreement[a]	INFCIRC/66-type agreement[b]	Voluntary offer agreement	Quantity in significant quantities (SQs)
Plutonium[c] contained in irradiated fuel and in fuel elements in reactor cores	128 462.2	2 223.4	18 598.3	149 283.9
Separated plutonium outside reactor cores	1 981.5	5.0	10 342.9	12 329.4
High enriched uranium (equal to or greater than 20% U-235)	191.3	1.1	0.3	192.7
Low enriched uranium (less than 20% U-235)	17 115.8	198.2	1 291.0	18 605.0
Source material[d] (natural and depleted uranium and thorium)	9 985.1	609.4	2 443.2	13 037.7
U-233	18.1	0.0	0.0	18.1
Total SQs without heavy water	**157 754.0**	**3 037.2**	**32 675.6**	**193 466.8**

Amount of heavy water at the end of 2014 by type of agreement

Non-nuclear material[e]	Comprehensive safeguards agreement[f]	INFCIRC/66-type agreement[g]	Voluntary offer agreement	Quantity in tonnes
Heavy water (tonnes)	**0.7[h]**	**430.9**		**431.6**

[a] Covering safeguards agreements pursuant to the NPT and/or the Treaty of Tlatelolco and other comprehensive safeguards agreements; including facilities in Taiwan, China; excluding facilities in the Democratic People's Republic of Korea.

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

[c] The quantity includes an estimated amount (11 110.250 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.

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

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

[f] Covering safeguards agreements pursuant to the NPT and/or the Treaty of Tlatelolco and other comprehensive safeguards agreements; including facilities in Taiwan, China.

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

[h] In Taiwan, China.

Table A5. Number of facilities and material balance areas outside facilities under safeguards during 2014

Type	Comprehensive safeguards agreement[a]	INFCIRC/66-type agreement[b]	Voluntary offer agreement	Total
Power reactors	237	12	1	250
Research reactors and critical assemblies	150	3	1	154
Conversion plants	18	0	0	18
Fuel fabrication plants	42	2	1	45
Reprocessing plants	9	0	1	10
Enrichment plants	17	0	3	20
Separate storage facilities	125	2	4	131
Other facilities	76	0	0	76
Facility subtotals	674	19	11	704
Material balance areas containing locations outside facilities[c]	562	1	0	563
Total	**1236**	**20**	**11**	**1267**

[a] Covering safeguards agreements pursuant to the NPT 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 53 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 2014)

State	Small quantities protocols[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Afghanistan	X	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	Amended: 20 Nov. 2006	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
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	Approved: 3 June 2014

Table A6. Conclusion of safeguards agreements, additional protocols and small quantities protocols (as of 31 December 2014) (cont.)

State	Small quantities protocols[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Cameroon	X	In force: 17 Dec. 2004	641	Signed: 16 Dec. 2004
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, Republic of the	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	Signed: 22 Oct. 2008
Croatia	Amended: 26 May 2008	In force: 19 Jan. 1995	463	In force: 6 July 2000
Cuba[2]		In force: 3 June 2004	633	In force: 3 June 2004
Cyprus[9]		Accession: 1 May 2008	193	Accession: 1 May 2008
Czech Republic[10]		Accession: 1 Oct. 2009	193	Accession: 1 Oct. 2009
Dem. Rep. of the Congo		In force: 9 Nov. 1972	183	In force: 9 April 2003
Denmark[11]		In force: 1 March 1972	176	In force: 22 March 2013
		In force: 21 Feb. 1977	193	In force: 30 April 2004
Djibouti	*Signed: 27 May 2010*	*Signed: 27 May 2010*		*Signed: 27 May 2010*
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
D.P.R.K.		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*		
Eritrea				
Estonia[12]		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[13]		Accession: 1 Oct. 1995	193	In force: 30 April 2004

Table A6. Conclusion of safeguards agreements, additional protocols and small quantities protocols (as of 31 December 2014) (cont.)

State	Small quantities protocols[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
France		In force: 12 Sept. 1981	290*	In force: 30 April 2004
	X	In force: 26 Oct. 2007[14]	718	
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[15]		In force: 21 Feb. 1977	193	In force: 30 April 2004
Ghana	Rescinded: 24 Feb. 2012	In force: 17 Feb. 1975	226	In force: 11 June 2004
Greece[16]		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	Signed: 7 July 2005
Hungary[17]		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		In force: 30 Sept. 1971	211	
		In force: 17 Nov. 1977	260	
		In force: 27 Sept. 1988	360	
		In force: 11 Oct. 1989	374	
		In force: 1 March 1994	433	
		In force: 11 May 2009	754	In force: 25 July 2014
Indonesia		In force: 14 July 1980	283	In force: 29 Sept. 1999
Iran, Islamic Republic of		In force: 15 May 1974	214	Signed: 18 Dec. 2003
Iraq		In force: 29 Feb. 1972	172	In force: 10 Oct. 2012
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

Table A6. Conclusion of safeguards agreements, additional protocols and small quantities protocols (as of 31 December 2014) (cont.)

State	Small quantities protocols[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Jamaica[2]	Rescinded: 15 Dec. 2006	In force: 6 Nov. 1978	265	In force: 19 March 2003
Japan		In force: 2 Dec. 1977	255	In force: 16 Dec. 1999
Jordan	X	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 P.D.R.	X	In force: 5 April 2001	599	Signed: 5 Nov. 2014
Latvia[18]		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				
Libya		In force: 8 July 1980	282	In force: 11 Aug. 2006
Liechtenstein		In force: 4 Oct. 1979	275	Signed: 14 July 2006
Lithuania[19]		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[20]		Accession: 1 July 2007	193	Accession: 1 July 2007
Marshall Islands		In force: 3 May 2005	653	In force: 3 May 2005
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[21]		In force: 14 Sept. 1973	197	In force: 4 March 2011
Micronesia, Fed. States				
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

Table A6. Conclusion of safeguards agreements, additional protocols and small quantities protocols (as of 31 December 2014) (cont.)

State	Small quantities protocols[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Montenegro	In force: 4 March 2011	In force: 4 March 2011	814	In force: 4 March 2011
Morocco	Rescinded: 15 Nov. 2007	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[14]	229	
		In force: 21 Feb. 1977	193	In force: 30 April 2004
New Zealand[22]	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	Rescinded: 14 Aug. 2012	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	34	
		In force: 17 June 1968	116	
		In force: 17 Oct. 1969	135	
		In force: 18 March 1976	239	
		In force: 2 March 1977	248	
		In force: 10 Sept. 1991	393	
		In force: 24 Feb. 1993	418	
		In force: 22 Feb. 2007	705	
		In force: 15 April 2011	816	
Palau	Amended: 15 March 2006	In force: 13 May 2005	650	In force: 13 May 2005
Panama[8]	Amended: 4 March 2011	In force: 23 March 1984	316	In force: 11 Dec. 2001
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[23]		Accession: 1 March 2007	193	Accession: 1 March 2007

Table A6. Conclusion of safeguards agreements, additional protocols and small quantities protocols (as of 31 December 2014) (cont.)

State	Small quantities protocols[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Portugal[24]		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[25]		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
St Kitts & Nevis[5]	X	In force: 7 May 1996	514	In force: 19 May 2014
Saint Lucia[5]	X	In force: 2 Feb. 1990	379	
St V. & 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	Signed: 15 Dec. 2006
Serbia[26]		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[27]		Accession: 1 Dec. 2005	193	Accession: 1 Dec. 2005
Slovenia[28]		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
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[29]		Accession: 1 June 1995	193	In force: 30 April 2004
Switzerland		In force: 6 Sept. 1978	264	In force: 1 Feb. 2005

Table A6. Conclusion of safeguards agreements, additional protocols and small quantities protocols (as of 31 December 2014) (cont.)

State	Small quantities protocols[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
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	Signed: 22 Sept. 2005
The f.Y.R. 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	X	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	X	In force: 9 Oct. 2003	622	In force: 20 Dec. 2010
United Kingdom		In force: 14 Dec. 1972[30]	175	
		In force: 14 Aug. 1978	263*	In force: 30 April 2004
	X	Signed: 6 Jan. 1993[14]		
United Rep. of Tanzania	Amended: 10 June 2009	In force: 7 Feb. 2005	643	In force: 7 Feb. 2005
United States of America		In force: 9 Dec. 1980	288*	In force: 6 Jan. 2009
	X	In force: 6 April 1989[14]	366	
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
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 August 2011	In force: 26 June 1995	483	

Key	
Bolded States	States not party to the Treaty of the Non-Proliferation of Nuclear Weapons (NPT) whose safeguards agreements are of INFCIRC/66-type.
Italicized States	Non-nuclear-weapon States (NNWSs) that are party to the NPT but 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 protocol' column indicates that the State has an operative SQP. 'Amended' indicates that the operative SQP is based on the revised SQP standardized 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] 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)), non-nuclear-weapon States have the option to conclude a 'small quantities protocol' (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 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.

[b] 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 & Nevis and Saint Vincent & 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] The 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 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.

[10] 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.

[11] 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.

[12] 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.

[13] 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.

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

[15] 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.

[16] 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.

[17] 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.

[18] 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.

[19] 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.

[20] 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.

[21] 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.

[22] Whereas the NPT safeguards agreement and small quantities protocol 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 small quantities protocol entered into force only for New Zealand on 24 February 2014 (INFCIRC/185/Mod.1).

[23] 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.

[24] 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.

[25] 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.

[26] 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.

[27] 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.

[28] 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.

[29] 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.

[30] 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 depositary, conclusion of Revised Supplementary Agreements and acceptance of amendments to Articles VI and XIV.A of the Agency's Statute (status as of 31 December 2014)

	State/Organization	P&I	VC	CPPNM	CPPNM-AM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Afghanistan			P		Sr	Sr						P	X	
*	Albania	P		P	CS	P	P		P	P			P	X	X
*	Algeria			Pr	CS	Pr	Pr		S				P	X	X
	Andorra			Pr											
*	Angola					P							P		
	Antigua and Barbuda			P	CS										
*	Argentina	P	P	Pr	CS	Pr	Pr	S	P	P	P	CS	P	X	X
*	Armenia		P	P	CS	P	P		P	P			P		
*	Australia	P		P	CS	Pr	Pr		P	P		S			
*	Austria			Pr	CS	P	Pr		Pr	P				X	X
*	Azerbaijan			Pr									P		
*	Bahamas			Pr		S									
*	Bahrain			Pr	CS	Pr			P				P		
*	Bangladesh			P		P	P		P				P		
	Barbados														
*	Belarus	Pr	P	Pr		Pr	Pr		P	P	P		P	X	X
*	Belgium	Pr		Pr	CSr	P	P	S	P	P					
*	Belize												P		
*	Benin	P											P		
	Bhutan														
*	Bolivia	P	P	P		Pr	Pr						P		
*	Bosnia and Herzegovina	Pr	P	P	CS	P	P		P	P	P		P	X	X
*	Botswana			P		P	P						P		
*	Brazil	P	P	P		P	P		P	P			P	X	X
*	Brunei Darussalam														
*	Bulgaria	Pr	P	P	CS	P	P	P	P	P			P	X	X
*	Burkina Faso			P	CS	P	P						P		
*	Burundi												P		
	Cabo Verde			P											

Table A7. Participation in multilateral treaties for which the Director General is depositary, conclusion of Revised Supplementary Agreements and acceptance of amendments to Articles VI and XIV.A of the Agency's Statute (status as of 31 December 2014) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNM-AM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Cambodia			P		P			P				P		
*	Cameroon	P	P	P		P	P	P					P		
*	Canada	Pr		P	CSr	Pr	Pr		P	P		S		X	X
*	Central African Republic			P											
*	Chad												P		
*	Chile	Pr	Pr	P	CS	P	P	P	P	P			P		
*	China	Pr		Pr	CS	Pr	Pr		P	Pr			P		
*	Colombia	P	S	P	CS	P	Pr						P		
	Comoros			P											
*	Congo														
*	Costa Rica			P		P	P						P		
*	Côte d'Ivoire			P		S	S						P		
*	Croatia	P	P	P	CS	P	P	P	P	P			P	X	X
*	Cuba	Pr	P	Pr	CS	Pr	Pr		S				P		
*	Cyprus	P		Pr	CS	P	P		P	P			P	X	X
*	Czech Republic	P	P	P	CS	P	P	P	P	P	S	S	P	X	X
	Dem. People's Rep. of Korea					Sr	Sr								
*	Dem. Rep. of the Congo	P		P		S	S						P		
*	Denmark	Pr		P	CSr	P	Pr	P	Pr	Pr				X	X
	Djibouti			P	CS										
*	Dominica			P											
*	Dominican Republic			P	CS	P							P		
*	Ecuador	P		P									P		
*	Egypt	P	P			Pr	Pr	P	S				P		
*	El Salvador			Pr		Pr	Pr						P	X	
	Equitorial Guinea			P											
*	Eritrea														
*	Estonia	P	P	P	CS	P	P	P	P	P			P	X	X
*	Ethiopia												P	X	

Table A7. Participation in multilateral treaties for which the Director General is depositary, conclusion of Revised Supplementary Agreements and acceptance of amendments to Articles VI and XIV.A of the Agency's Statute (status as of 31 December 2014) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNM-AM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Fiji			P	CS										
*	Finland	P		Pr	CS	P	Pr	P	P	P				X	X
*	France			Pr	CS	Pr	Pr	Pr	P	P				X	X
*	Gabon			P	CS	P	P			P			P		
	Gambia														
*	Georgia			P	CS	P				P			P		
*	Germany	Pr		Pr	CS	Pr	Pr	P	P	P				X	X
*	Ghana	P		P	CS				P	P			P		
*	Greece	P		Pr	CS	Pr	Pr	P	P	P			P	X	X
	Grenada			P											
*	Guatemala			Pr		P	P						P		
	Guinea			P											
	Guinea-Bissau			P											
	Guyana			P											
*	Haiti			S									P		
*	Holy See	P				S	S							X	X
*	Honduras			P									P		
*	Hungary	Pr	P	P	CS	P	P	P	P	P	S		P	X	X
*	Iceland	P		P		P	P		P	P			P	X	X
*	India	P		Pr	CS	Pr	Pr		P			S			
*	Indonesia	Pr		Pr	CS	Pr	Pr		P	P	S	S	P		
*	Iran, Islamic Republic of	P				Pr	Pr						P		X
*	Iraq	P		P		Pr	Pr						P		
*	Ireland	P		Pr	CS	P	Pr		P	P			P	X	X
*	Israel		Sr	Pr	CSr	Pr	Pr		S				P	X	
*	Italy	Pr		Pr		Pr	Pr	P	P	P	S	S		X	X
*	Jamaica	P		P	CS								P		
*	Japan	P		P	CS	P	Pr		P	Pr				X	X
*	Jordan	Pr	P	Pr	CS	P	P		P		Pr		P		

Table A7. Participation in multilateral treaties for which the Director General is depositary, conclusion of Revised Supplementary Agreements and acceptance of amendments to Articles VI and XIV.A of the Agency's Statute (status as of 31 December 2014) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNM-AM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Kazakhstan	P	P	P	CS	P	P		P	P	P		P		
*	Kenya			P	CS								P		X
	Kiribati														
*	Korea, Republic of	Pr		Pr	CS	P	Pr		P	P			P	X	X
*	Kuwait	P		Pr		P	P		P				P		
*	Kyrgyzstan									P			P		
*	Lao People's Dem. Rep.			Pr		P	P						P		
*	Latvia	P	P	P	CS	P	P	P	P	P	P		P	X	X
*	Lebanon		P	P		P	P		P	S	S	S	P		
*	Lesotho			P	CS	P	P						P		
*	Liberia														
*	Libya			P	CS	P	P		P				P	X	
*	Liechtenstein			P	CS	P	P							X	X
*	Lithuania	P	P	P	CS	P	P	P	P	P	S	S	P	X	X
*	Luxembourg	Pr		Pr	CS	P	P		P	P				X	X
*	Madagascar			P									P		
*	Malawi			P									P		
*	Malaysia					Pr	Pr						P		
	Maldives														
*	Mali			P	CS	P	P		P				P		
*	Malta			P	CS				P	P			P	X	X
*	Marshall Islands			P											
*	Mauritania			P	CS	P	P			P			P		
*	Mauritius	P	P			Pr	Pr			P		S	P		
*	Mexico	Pr	P	P	CS	P	P		P				P	X	X
	Micronesia														
*	Monaco			P		Pr	Pr		S					X	X
*	Mongolia	P		P		P	P						P		
*	Montenegro	P	P	P		P	P			P	P		P		

Table A7. Participation in multilateral treaties for which the Director General is depositary, conclusion of Revised Supplementary Agreements and acceptance of amendments to Articles VI and XIV.A of the Agency's Statute (status as of 31 December 2014) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNM-AM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Morocco	Pr	S	P		P	P	S	S	P	P	CS	P	X	
*	Mozambique	P		Pr		P	P						P		
*	Myanmar					Pr							P	X	X
*	Namibia			P									P		
	Nauru			P	CS										
*	Nepal												P		
*	Netherlands	Pr		Pr	CS	Pr	Pr	P	P	P				X	X
*	New Zealand	P		P		P	Pr								
*	Nicaragua	P		P		Pr	Pr		S				P		
*	Niger	P	P	P	CS	S	S						P		
*	Nigeria	P	P	P	CS	P	P		P	P			P		
	Niue			P											
*	Norway	P		Pr	CS	P	Pr	P	P	P				X	X
*	Oman	Pr		Pr		Pr	Pr		P	P			P		
*	Pakistan	Pr		Pr		Pr	Pr		P				P	X	X
*	Palau	P		P									P		
*	Panama			P		P	P						P	X	
*	Papua New Guinea														
*	Paraguay			P		P	P		P				P		
*	Peru		P	Pr	CS	Pr	Pr		P	S	S	S	P	X	X
*	Philippines	P	P	P		P	P	S	S	S	S	S	P		
*	Poland	P	P	P	CS	P	P	P	P	P	P		P	X	X
*	Portugal	Pr		Pr	CS	P	P	S	P	P			P	X	X
*	Qatar			Pr	CS	P	P						P		
*	Republic of Moldova	Pr	P	P	CS	P	P		P	Pr			P	X	X
*	Romania	Pr	P	Pr	CS	Pr	Pr	P	P	P	P	CS	P	X	X
*	Russian Federation	Pr	P	P	CS	Pr	Pr		P	P					
*	Rwanda			P									P		
	St Kitts and Nevis			P											

Table A7. Participation in multilateral treaties for which the Director General is depositary, conclusion of Revised Supplementary Agreements and acceptance of amendments to Articles VI and XIV.A of the Agency's Statute (status as of 31 December 2014) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNM-AM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
	Saint Lucia			Pr	CS										
	St Vincent and the Grenadines		P			P	P	P							
	Samoa														
*	San Marino														
	São Tomé Príncipe														
*	Saudi Arabia		P	Pr	CS	Pr	Pr		P	P	Pr		P		
*	Senegal	P	P	P		P	P		P	P		S	P		
*	Serbia	P	P	P		P	P						P		
*	Seychelles			P	CS								P		X
*	Sierra Leone					S	S						P		
*	Singapore	Pr		Pr	CSr	P	P		P				P		
*	Slovakia	P	P	P	CS	Pr	Pr	P	P	P			P	X	X
*	Slovenia	P		P	CS	P	P	P	P	P			P	X	X
	Solomon Islands														
	Somalia														
*	South Africa	Pr		Pr		Pr	Pr		P	P			P	X	X
*	Spain	P	S	Pr	CS	Pr	Pr	S	P	P			P	X	X
*	Sri Lanka					Pr	Pr		P				P		
*	Sudan			P		S	S		S				P		
	Suriname														
*	Swaziland			P											
*	Sweden	P		Pr	CS	P	Pr	P	P	P				X	X
*	Switzerland	Pr		Pr	CS	P	P	S	P	P				X	X
*	Syrian Arab Republic	P				S	S		S				P		X
*	Tajikistan	P		P	CS	P	P			P			P		
*	Thailand	Pr				Pr	Pr						P		
*	The fYR of Macedonia		P	P	CS	P	P		P	P			P		
	Timor Leste														
*	Togo			P											

Table A7. Participation in multilateral treaties for which the Director General is depositary, conclusion of Revised Supplementary Agreements and acceptance of amendments to Articles VI and XIV.A of the Agency's Statute (status as of 31 December 2014) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNM-AM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
	Tonga			P											
*	Trinidad and Tobago		P	P											
*	Tunisia	P		P	CS	P	P		P				P	X	X
*	Turkey	Pr		Pr		Pr	Pr	P	P				P	X	X
	Turkmenistan			P	CS										
	Tuvalu														
*	Uganda			P									P		
*	Ukraine	Pr	P	P	CS	Pr	Pr	P	Pr	P	S	S	P	X	X
*	United Arab Emirates			P	CS	Pr	Pr	P	P	P	Pr	CSr	P		
*	United Kingdom	P	S	Pr	CS	Pr	Pr	S	P	P				X	X
*	United Republic of Tanzania			P		P	P						P		
*	United States of America			P		Pr	Pr		P	P		CSr			
*	Uruguay		P	P		P	P	P	P	P			P	X	
*	Uzbekistan			P	CS					P			P		
	Vanuatu														
*	Venezuela, Bolivarian Republic of					Pr							P		
*	Viet Nam	P		Pr	CS	Pr	Pr		P	P			P		
*	Yemen			P											
*	Zambia												P		
*	Zimbabwe					S	S						P		
	Euratom			Pr		Pr	Pr		Pr	P					
	FAO					Pr	Pr								
	WHO					Pr	Pr								
	WMO					Pr	Pr								

P&I	Agreement on the Privileges and Immunities of the IAEA
VC	Vienna Convention on Civil Liability for Nuclear Damage
CPPNM	Convention on the Physical Protection of Nuclear Material
CPPNM-AM	Amendment to the Convention on the Physical Protection of Nuclear Material (not yet in force)

Table A7. Participation in multilateral treaties for which the Director General is depositary, conclusion of Revised Supplementary Agreements and acceptance of amendments to Articles VI and XIV.A of the Agency's Statute (status as of 31 December 2014) (cont.)

ENC	Convention on Early Notification of a Nuclear Accident
AC	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
JP	Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention
NS	Convention on Nuclear Safety
RADW	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
PAVC	Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage
CSC	Convention on Supplementary Compensation for Nuclear Damage (not yet in force)
RSA	Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA
VI	Acceptance of Amendment to Article VI of the IAEA Statute
XIV.A	Acceptance of Amendment to Article XIV.A of the IAEA Statute
*	Agency Member State
P	Party
S	Signatory
r	Existing reservation/declaration
CS	Contracting State
X	Accepting State

Table A8. 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 2014, 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 2014, 2 States became Parties to the Convention. By the end of the year, there were 119 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 2014, 1 State became a Party to the Convention. By the end of the year, there were 112 Parties.

Convention on Nuclear Safety (reproduced in INFCIRC/449). Entered into force on 24 October 1996. In 2014, 1 State became a Party to the Convention. By the end of the year, there were 77 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 2014, 1 State became a Party to the Convention. By the end of the year, there were 69 Parties.

Convention on the Physical Protection of Nuclear Material (reproduced in INFCIRC/274/Rev.1). Entered into force on 8 February 1987. In 2014, 3 States became Parties to the Convention, bringing the total to 151 Parties.

Amendment to the Convention on the Physical Protection of Nuclear Material. Adopted on 8 July 2005. In 2014, 12 States adhered to the Amendment, bringing the total to 83 Contracting States.

Vienna Convention on Civil Liability for Nuclear Damage (reproduced in INFCIRC/500). Entered into force on 12 November 1977. In 2014, 1 State adhered to the Convention. By the end of the year, there were 40 Parties.

Optional Protocol Concerning the Compulsory Settlement of Disputes (reproduced in INFCIRC/500/Add.3). Entered into force on 13 May 1999. In 2014, the status remained unchanged with 2 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 2014, 1 State became a Party to the Protocol. By the end of the year, there were 28 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 2014, 1 State became a Party to the Protocol. By the end of the year, there were 12 Parties.

Convention on Supplementary Compensation for Nuclear Damage (reproduced in INFCIRC/567). Opened for signature on 29 September 1997. In 2014, 1 State signed and ratified the Convention. By the end of the year, there were 5 Contracting States and 18 Signatories.

Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA). In 2014, 3 States concluded an RSA. By the end of the year, there were 124 States party to an RSA Agreement.

Fifth Agreement to Extend the 1987 Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) (reproduced in INFCIRC/167/Add.23). Entered into force on 31 August 2011 with effect from 12 June 2012. In 2014, 2 States became Parties to the Agreement. By the end of the year, there were 16 Parties.

African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) (Fourth Extension) (reproduced in INFCIRC/377/Add.19). Entered into force on 4 April 2010. In 2014, 1 State became a Party to the Agreement. By the end of the year, there were 36 Parties.

Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) (reproduced in INFCIRC/582). Entered into force on 5 September 2005. In 2014, the status remained unchanged with 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. By the end of the year, there were 8 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 2014, the status 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 2014, the status remained unchanged with 6 Parties.

Table A9. Nuclear power reactors in operation and under construction in the world (as of 31 December 2014)[a]

Country	Reactors in operation		Reactors under construction		Nuclear electricity supplied in 2014		Total operating experience through 2014	
	No. of units	Total MW(e)	No. of units	Total MW(e)	TW·h	% of total	Years	Months
Argentina	3	1 627	1	25	5.3	4.1	73	2
Armenia	1	375			2.3	30.7	40	8
Belarus			2	2 218				
Belgium	7	5 927			32.1	47.5	268	7
Brazil	2	1 884	1	1 245	14.5	2.9	47	3
Bulgaria	2	1 926			15.0	31.8	157	3
Canada	19	13 500			98.6	16.8	674	6
China	23	19 007	26	25 756	123.8	2.4	181	7
Czech Republic	6	3 904			28.6	35.8	140	10
Finland	4	2 752	1	1 600	22.6	34.7	143	4
France	58	63 130	1	1 630	418.0	76.9	1 990	4
Germany	9	12 074			91.8	15.8	808	1
Hungary	4	1 889			14.8	53.6	118	2
India	21	5 308	6	3 907	33.2	3.5	418	6
Iran, Islamic Republic of	1	915			3.7	1.5	3	4
Japan	48	42 388	2	2 650	0.0	0.0	1 694	4
Korea, Republic of	23	20 717	5	6 370	149.2	30.4	450	1
Mexico	2	1 330			9.3	5.6	45	11
Netherlands	1	482			3.9	4.0	70	0
Pakistan	3	690	2	630	4.6	4.3	61	8
Romania	2	1 300			10.8	18.5	25	11
Russian Federation	34	24 654	9	7 371	169.1	18.6	1 157	3
Slovakia	4	1 814	2	880	14.4	56.8	152	7
Slovenia	1	688			6.1	37.3	33	3
South Africa	2	1 860			14.8	6.2	60	3
Spain	7	7 121			54.9	20.4	308	1
Sweden	10	9 470			62.3	41.5	422	6
Switzerland	5	3 333			26.5	37.9	199	11
Ukraine	15	13 107	2	1 900	83.1	49.4	443	6
United Arab Emirates			3	4 035				
United Kingdom	16	9 373			57.9	17.2	1 543	7
United States of America	99	98 639	5	5 633	798.6	19.5	4 012	4
Total[b, c]	**438**	**376 216**	**70**	**68 450**	**2 410.4**		**16 096**	**10**

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

[b] Note: The total figures include the following data from Taiwan, China:
6 units, 5032 MW(e) in operation; 2 units, 2600 MW(e) under construction;
40.8 TW·h of nuclear electricity generation, representing 18.9% of the total electricity generated.

[c] 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 (200 years, 1 month).

Table A10. Integrated Nuclear Infrastructure Review (INIR) missions in 2014

Type	Country
INIR	Jordan
INIR follow-up	Viet Nam

Table A11. Knowledge Management Assist Visit (KMAV) missions in 2014

Type	Organization/nuclear power plant	Country
KMAV	Rosatom	Russian Federation
KMAV	Tianwan nuclear power plant, CNNP	China
KMAV	Federal Authority of Nuclear Regulation (FANR)	United Arab Emirates

Table A12. Emergency Preparedness Review (EPREV) missions in 2014

Type	Country
EPREV	South Africa, Tajikistan

Table A13. Integrated Regulatory Review Service (IRRS) missions in 2014

Type	Country
IRRS	Cameroon
IRRS	France
IRRS	Jordan
IRRS	Netherlands
IRRS	Pakistan
IRRS	Zimbabwe
IRRS follow-up	Korea, Republic of
IRRS follow-up	Slovenia
IRRS follow-up	United States of America
IRRS follow-up	Viet Nam

Table A14. Operational Safety Review Team (OSART) missions in 2014

Type	Location/nuclear power plant	Country
OSART	Flamanville	France
OSART	Paks	Hungary
OSART	Borssele	Netherlands
OSART	Kola	Russian Federation
OSART	Clinton	United States of America
OSART Corporate	EDF	France
OSART follow-up	Angra 1	Brazil
OSART follow-up	Kozloduy	Bulgaria
OSART follow-up	Temelin	Czech Republic
OSART follow-up	Gravelines	France
OSART follow-up	Rajasthan	India
OSART follow-up	Laguna Verde	Mexico
OSART follow-up	Muehleberg	Switzerland

Table A15. Integrated Safety Assessment of Research Reactors (INSARR) missions in 2014

Type	Location/research reactor	Country
INSARR	Maria research reactor	Poland
INSARR	TRIGA PUSPATI research reactor	Malaysia
Pre-INSARR	TRIGA PUSPATI research reactor	Malaysia
Pre-INSARR	TR-2 research reactor	Turkey

Table A16. Safety expert missions for research reactors based on the INSARR methodology in 2014

Type	Country
Safety mission	Congo, Egypt, Ghana, Morocco, Peru, Slovenia, Turkey

Table A17. Safety Aspects of Long Term Operation (SALTO) missions in 2014

Type	Location/nuclear power plant	Country
SALTO	Dukovany	Czech Republic
SALTO	Tihange 1	Belgium
Pre-SALTO	Ringhals	Sweden
SALTO follow-up	Borssele	Netherlands
SALTO follow-up	Wolsong 1	Republic of Korea

Table A18. Design and Safety Assessment Review Service (DSARS) missions in 2014

Type	Location/design	Country
GRSR	VVER-TOI	Russian Federation
GRSR	ACP1000	China
IPSART	ANPP	Armenia
IPSART	Leibstadt	Switzerland
RAMP	Ocoyoacac	Mexico
SAAP	Amman	Jordan
SAAP	Dhaka	Bangladesh

Table A19. Education and Training Review Service (ETReS) missions in 2014

Type	Country
ETReS	Malaysia

Table A20. Site and External Events Design (SEED) missions in 2014

Type	Location/nuclear power plant	Country
SEED	Dhaka	Bangladesh
SEED	Jakarta	Indonesia
SEED	Hanoi	Viet Nam

Table A21. Occupational Radiation Protection Appraisal Service (ORPAS) missions in 2014

Type	Country
ORPAS	Peru
ORPAS	United Republic of Tanzania
ORPAS	Bolivarian Republic of Venezuela
Pre-ORPAS	United Arab Emirates

Table A22. Advisory missions in 2014

Type	Country
Regulatory Infrastructure for the Control of Radioactive Sources	Colombia, Dominica, Fiji, Iraq (in Vienna), Jordan, Lesotho, Libya (in Vienna), Mauritania, Mozambique, Papua New Guinea, Paraguay, Trinidad and Tobago, Tunisia (in Vienna), Uganda, Uzbekistan, Yemen (in Vienna), Zambia.

Table A23. International Nuclear Security Advisory Service (INSServ) missions in 2014

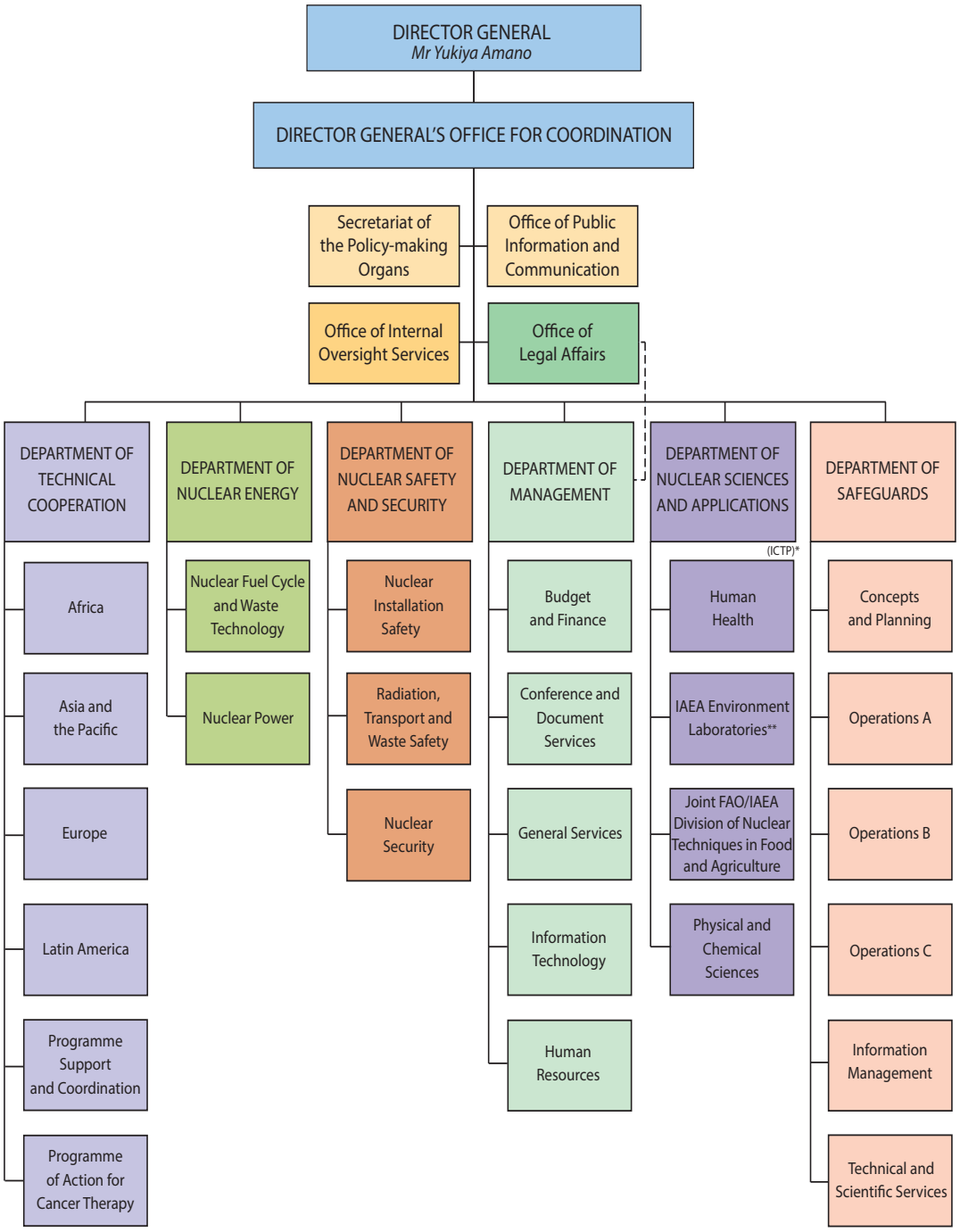
Type	Country
INSServ	Cameroon, Lao People's Democratic Republic, Qatar, Romania, South Africa, Sri Lanka

Table A24. International Physical Protection Advisory Service (IPPAS) missions in 2014

Type	Country
IPPAS	Armenia, Belgium, Indonesia, Republic of Korea

ORGANIZATIONAL CHART

(as of 31 December 2014)



* 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

IAEA

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