IAEA ANNUAL REPORT 2013

IAEA
International Atomic Energy Agency

IAEA Annual Report 2013

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 2013.

GC(58)/3

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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 2013)

160 Member States.

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

56 years of international service.

2556 professional and support staff.

€330 million total regular budget for 2013.[1] Extrabudgetary expenditures in 2013 totalled **€62.7 million.**

€71.4 million target in 2013 for voluntary contributions to the Agency's Technical Cooperation Fund, supporting projects involving **3509** expert and lecturer assignments, **5331** meeting participants and other project personnel, **3041** participants in **209** regional and interregional training courses and **2005** fellows and scientific visitors.

124 Member States participating in the Agency's technical cooperation programme, including **31** least developed countries.

791 active technical cooperation projects at the end of 2013.

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

12 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.

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

104 active CRPs involving **1563** approved research, technical and doctoral contracts and research agreements. In addition, **74** Research Coordination Meetings were held.

17 national donors, **1** multinational donor (European Union) and **1** private company donor to the voluntary Nuclear Security Fund.

180 States in which safeguards agreements were being implemented,[2,3] of which **122** States had additional protocols in force, with **1971** safeguards inspections performed in 2013. Safeguards expenditures in 2013 amounted to **€122.5 million** in regular budget and **€14.5 million** in extrabudgetary resources.

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

11.9 million pages read by more than **3.6 million** people on the Agency's *iaea.org* site, and **120 000** subscribers to the Agency's social media channels on Twitter and Facebook.

3.6 million records in the International Nuclear Information System (INIS), the Agency's largest database, with over **481 000** full texts and an average of **57 000** INIS searches and **4100** downloads performed each month.

1.1 million documents, technical reports, standards, conference proceedings, journals and books in the IAEA Library and **14 300** visitors to the Library in 2013.

202 publications, including newsletters, issued in 2013 (in print and electronic formats).

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1 At the UN average rate of exchange of $1.3245 to €1.00. The total regular budget was €346.3 million at the $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.

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

In the area of nuclear technologies, the Board considered the *Nuclear Technology Review 2013*.

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 2013* and also debated the *Nuclear Security Report 2013* and approved the *Nuclear Security Plan 2014–2017*.

As regards verification, the Board considered the *Safeguards Implementation Report for 2012*. 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, and the issues of 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 2012* and approved the Agency's technical cooperation programme for 2014.

Composition of the Board of Governors (2013–2014)

Chairperson:

HE Mr. Thiep NGUYEN
Ambassador
Governor from Viet Nam

Vice-Chairpersons:

HE Mr. Jan PETERSEN
Ambassador
Governor from Norway

HE Mr. Przemyslaw GRUDZIŃSKI
Ambassador
Governor from Poland

Algeria
Argentina
Australia
Austria
Bosnia and Herzegovina
Brazil
Canada
China
Costa Rica
Finland
France
Germany
Greece
India
Japan
Kenya
Libya
Nigeria
Norway
Pakistan
Peru
Poland
Qatar
Russian Federation
Slovakia
South Africa
Sudan
Sweden
Thailand
United Arab Emirates
United Kingdom of Great Britain and Northern Ireland
United States of America
Uruguay
Venezuela
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 2013, the Conference approved the Board's appointment of Yukiya Amano as Director General of the Agency for a further term of office of four years, until 30 November 2017.

The Conference — upon the recommendation of the Board — approved Brunei Darussalam and the Commonwealth of the Bahamas for membership of the Agency. At the end of 2013, the Agency's membership was 160.

Notes

- The *IAEA Annual Report 2013* aims to summarize only the significant activities of the Agency during the year in question. The main part of the report, starting on page 15, generally follows the programme structure as given in *The Agency's Programme and Budget 2012–2013* (GC(55)/5).

- The introductory chapter, 'The Year in Review', 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 Technology Review*, *Technical Cooperation Report* and the *Safeguards Statement for 2013 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.*

- Except where indicated, all sums of money are expressed in United States dollars.

- 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.

Abbreviations

AFRA	African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
AFRA-NEST	AFRA Network for Education in Nuclear Science and Technology
ARCAL	Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean
COP19	19th session of the Conference of the Parties (UNFCCC)
CRP	coordinated research project
Euratom	European Atomic Energy Community
FAO	Food and Agriculture Organization of the United Nations
FORATOM	European Atomic Forum
HEU	high enriched uranium
ICRP	International Commission on Radiological Protection
ICT	information and communication technology
ICTP	Abdus Salam International Centre for Theoretical Physics
IDB	Islamic Development Bank
IEA	International Energy Agency
IEC	Incident and Emergency Centre (IAEA)
INFCIRC	Information Circular (IAEA)
INIR	Integrated Nuclear Infrastructure Review
INIS	International Nuclear Information System
INPRO	International Project on Innovative Nuclear Reactors and Fuel Cycles
INTERPOL	International Criminal Police Organization–INTERPOL
IPCC	Intergovernmental Panel on Climate Change
IRRI	International Rice Research Institute
Joint Division	Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture
JRC	Joint Research Centre (European Commission)
LEU	low enriched uranium

NEMS	Nuclear Energy Management School
NESA	Nuclear Energy System Assessment
NPC	National Participation Cost
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
OA-ICC	Ocean Acidification International Coordination Centre
OIC	Organisation of Islamic Cooperation
OECD	Organisation for Economic Co-operation and Development
OECD/NEA	OECD Nuclear Energy Agency
PACT	Programme of Action for Cancer Therapy (IAEA)
PAHO	Pan American Health Organization
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
RSA	Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA
TCF	Technical Cooperation Fund
UNCCD	United Nations Convention to Combat Desertification
UNCT	United Nations Country Team
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UPSAT	Uranium Production Site Appraisal Team
WHO	World Health Organization
WMO	World Meteorological Organization

THE YEAR IN REVIEW

In 2013, the International Atomic Energy Agency continued its wide range of technical and scientific activities, with the goal of making a sustained contribution to the needs of Member States. This report provides a review of developments in 2013 related to nuclear issues as seen from the perspective of the Agency and in the light of the Agency's own programme. The Agency's diverse programmatic work focused, in a balanced manner, on nuclear technology and its applications, nuclear safety and security, nuclear verification, and technical cooperation. The Agency continued its efforts to increase the synergy between the scientific and technical parts of its programme and its technical cooperation activities.

This review is not intended to be comprehensive, but instead follows a number of selected themes: the current situation regarding nuclear power; the application of nuclear related techniques in food and agriculture, human health, water resources management and environmental monitoring; the Agency's efforts to strengthen global nuclear safety culture and enhance nuclear security; the implementation of Agency safeguards; and outreach to stakeholders and partners in Member States to gain a better understanding of the needs of Member States and to ensure a more efficient and effective response to these needs.

NUCLEAR TECHNOLOGY

Nuclear Power

Status and trends

With 434 nuclear power reactors in operation worldwide, the total generating capacity of nuclear energy was 371.7 gigawatts-electric (GW(e)) at the end of 2013. During the year, four nuclear power reactors were connected to the grid, construction started on ten new reactors and Belarus became the second country in the past three decades to start building its first nuclear power plant.

In total, 72 reactors were under construction at the end of 2013, the highest number since 1989. Of these, 48 were in Asia, which remains the centre of near and long term growth prospects. Of the 30 countries currently using nuclear power, 25 are either expanding or planning to expand their fleet.

According to the 2013 Agency projections for 2030, the world's nuclear power generation capacity is expected to grow by 17% in the low case and by 94% in the high case. These figures are slightly lower than the projections made in 2012, reflecting the continuing impact of the accident at the Fukushima Daiichi nuclear power plant (the Fukushima Daiichi accident), the low price of natural gas and the increasing use of renewable energy.

Major conferences in 2013

Two major international conferences on nuclear energy were held in 2013. The International Ministerial Conference on Nuclear Power in the 21st Century, held in St. Petersburg, concluded that for many countries nuclear power remains an important option to improve energy security, provide energy for sustainable development and fight climate change. The conference was attended by over 500 delegates from 87 countries and 7 international organizations. Participants included many heads of organizations and other high level experts, with over 50 at the ministerial or similar level.

The International Conference on Fast Reactors and Related Fuel Cycles: Safe Technologies and Sustainable Scenarios (FR13), held in Paris, focused on strategic and technical options for deploying fast reactors operating with a closed fuel cycle in a safe, proliferation resistant and economical way.

"With 434 nuclear power reactors in operation worldwide, the total generating capacity of nuclear energy was 371.7 gigawatts-electric (GW(e)) at the end of 2013."

Climate change and sustainable development

The 19th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP19) and the 9th session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP9) were held in Warsaw in November. Participants worked toward an agreement on long term commitments to reduce greenhouse gas emissions; however, progress on reaching a universal climate agreement in 2015 was limited. The potential role of nuclear power in mitigating the effects of climate change is highlighted in the 2013 edition of *Climate Change and Nuclear Power*, which was made available to COP19 participants. The publication looks in particular at the importance of nuclear energy in reducing carbon dioxide emissions from the electricity sector.

Support to existing nuclear power programmes

Many countries have given high priority to licensing plants to operate beyond the 30–40 years originally anticipated. Identifying materials and components that may degrade over time in the demanding operating environment is an important aspect of the safe and secure operation of reactors. In this and other technical areas, the Agency continued to provide guidance to,

and to facilitate knowledge sharing among, countries with existing nuclear power programmes. Over 80 participants from 29 countries discussed current issues and future challenges of material degradation at a Technical Meeting in Vienna, organized jointly with the European Commission Joint Research Centre (JRC).

"The Agency continued to help interested Member States strengthen their capabilities in analysing and planning appropriate national energy systems to meet national development needs and provide sustainable modern energy services."

Launching nuclear power programmes

Over 30 countries are considering a nuclear power programme or are introducing nuclear power into their energy mix. In 2013, two countries were constructing their first nuclear power plants: the United Arab Emirates (UAE) poured the first concrete for the second unit at the Barakah site, and Belarus began construction of the first unit at the Ostrovets site. In addition, Bangladesh, Jordan, Turkey and Viet Nam made significant 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. In 2013, INIR missions were conducted to Poland, South Africa and Turkey. The INIR mission to South Africa was the first to a country that already generates nuclear power and is preparing new build projects.

Energy assessment services

The Agency continued to help interested Member States strengthen their capabilities in analysing and planning appropriate national energy systems to meet national development needs and provide sustainable modern energy services. About 600 energy analysts and planners from 72 countries were trained in using the Agency's analytical tools in 2013.

Capacity building

The preservation and management of nuclear knowledge continues to be a high priority for many Member States. In 2013, the Agency conducted knowledge management assist visits and workshops in the Islamic Republic of Iran (Iran), Malaysia and Thailand. Nuclear Energy Management and Nuclear Knowledge Management Schools were held in Italy, Japan and the United States of America (USA).

The development of human resources and the impact of human behaviour on nuclear power programmes continue to be important areas of focus for the Agency. Participants in the International Experts Meeting on Human and Organizational Factors in Nuclear Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant, held in May in Vienna, strongly encouraged the promotion of further activities supporting a systemic approach to nuclear safety and the relationship between individuals, technology and organizations.

Assurance of supply

The Secretariat, in cooperation with the Government of Kazakhstan, continued to make progress in the establishment of the IAEA low enriched uranium (LEU) bank, the proposed site of which is the Ulba Metallurgical Plant in Ust-Kamenogorsk. During 2013, work focused on the financial, legal and technical arrangements, and on assessing the proposed site of the LEU bank. Pledges have been fully paid by Kuwait ($10 million), Norway ($5 million), the Nuclear Threat Initiative ($50 million), the UAE ($10 million) and the USA (approximately $50 million); the EU has paid €20 million of its pledged €25 million. In addition to hosting the LEU bank, Kazakhstan also made a contribution of $150 000 to the Agency for the project.

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

Uranium resources

The global total of identified, conventional uranium resources recoverable at a cost of less than $260 per kilogram of uranium (kg U) is estimated at about 7.1 million tonnes of uranium (Mt U). Uranium production is estimated to have reached 54 039 tonnes of uranium (t U) in 2013. Final figures are available in the joint IAEA–OECD/NEA publication *Uranium 2014: Resources, Production and Demand*, also referred to as the 'Red Book'.

Through services such as Uranium Production Site Appraisal Team (UPSAT) reviews, the Agency helped Member States to strengthen the operational performance and safety of uranium mining across all phases of the uranium production cycle. In 2013, an UPSAT mission was undertaken to the United Republic of Tanzania.

INPRO

The Agency's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) provides a methodology for, and training and assistance in, conducting Nuclear Energy System Assessments (NESAs). This past year, the results of the NESA for Belarus were published, and the assessments in Indonesia, Romania and Ukraine continued.

INPRO's membership grew to 39 in 2013 with the addition of Kenya as a new member. Two INPRO Dialogue Forums brought together technology holders and users to address licensing and safety issues for small and medium sized reactors and the safety performance of evolutionary power reactors.

International remediation and decommissioning missions to Japan

The report on the Follow-up IAEA International Mission on Remediation of Large Contaminated Areas Off-Site the Fukushima Daiichi Nuclear Power Plant highlighted important progress made since the first mission, in 2011. It provided guidance in a number of areas to further improve current practices, taking into account both international standards and the experience of remediation programmes in other countries.

Two Agency decommissioning missions reviewed the *Mid-and-Long-Term Roadmap towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station Units 1–4*. The second mission also examined Japan's efforts to monitor radiation conditions in the marine environment. The missions concluded that Japan has made good progress in improving its decommissioning strategy and plans, initiated promptly after the accident, as well as in allocating the necessary resources towards the plant's safe decommissioning. However, the situation and challenges of ensuring the plant's long term stability remain complex.

Research reactors

Agency activities to improve research reactor utilization, foster international cooperation, and enable access by experts and students from countries without research reactors or such facilities continued. Significant improvements in analytical capability based on neutron activation were achieved through collaborative proficiency exercises and expert assistance involving more than 30 research reactors.

The Agency provided technical expertise in the conversion of research reactors from high enriched uranium (HEU) to LEU and in the repatriation of spent HEU research reactor fuel to the country of its origin. In this respect, HEU to LEU conversion of research reactors in the Czech Republic, Hungary and Viet Nam and repatriation of spent HEU fuel to the Russian Federation were successfully concluded.

Nuclear data

The Agency continued to update, gather and supply accurate nuclear and atomic data, which are crucial for all nuclear research and innovation. In 2013, an Android app, 'Isotope Browser', was released to help disseminate data to users with limited Internet connectivity.

"In 2013, an Android app, 'Isotope Browser', was released to help disseminate data to users with limited Internet connectivity."

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 is engaged in various activities to introduce the benefits of accelerators to its Member States. In 2013, it helped establish a beam line in the synchrotron facility at Elettra, in Trieste, Italy, to assist Member States in carrying out experiments.

Applications of Nuclear Technology

Appropriate technology is vital to sustainable development. In 2013, the Agency continued to assist Member States in reaching their development objectives, based on their national priority development needs. In this regard, the Agency also contributes to the achievement of the Millennium Development Goals by helping Member States to build, strengthen and maintain capacities in the safe, peaceful and secure use of nuclear technology in areas where nuclear techniques offer advantages over other approaches.

SCIENTIFIC FORUM 2013: THE BLUE PLANET

Nuclear techniques have an important role to play in the management of the marine, terrestrial and atmospheric environments. This was demonstrated by the Scientific Forum 2013 on 'The Blue Planet — Nuclear Applications for a Sustainable Marine Environment', held during the 57th General Conference in September. The Agency's Director General, HSH Prince Albert II of Monaco, and other dignitaries and experts highlighted how nuclear and isotopic applications are unique tools to better understand and develop adaptation strategies in the fields of environmental and climate change, management of pollution, and integrated ecosystem management of the terrestrial and marine environments.

The Agency's scientific and technical activities and its objectives in the field of nuclear sciences and applications were supported by 19 IAEA Collaborating Centres in 2013. At the end of the year, there were 104 active coordinated research projects (CRPs) in various fields, comprising more than 1550 research, technical or doctoral contracts, and research agreements with institutions in more than 100 Member States.

"The geographical coverage of monitoring stations in the Agency's global isotope monitoring networks for precipitation…was expanded with the addition of 32 newly active stations in Africa, South East Asia and Latin America."

The Board of Governors approved a regular budget provision for the Renovation of the Nuclear Applications Laboratories (the ReNuAL project) for the 2014–2015 biennium. The ReNuAL project addresses the evolving range and complexity of demands from Member States for the use of nuclear sciences to support socioeconomic development. Specific elements of the project include upgrading the infrastructure and improving the efficiency and effectiveness of laboratory operations and services, as well as acquiring new equipment to replace ageing or obsolete hardware and to enable the Agency to respond to emerging issues and changes in technology. A number of preparatory activities and assessments were carried out during 2013 to prepare a solid strategy for bringing the ReNuAL project to the implementation phase by mid-2014.

With the help of information and communication technologies (ICTs), the Agency's distance learning for professionals working with nuclear technologies has evolved and now takes a number of forms, from on-line and mobile learning to real time webinars in various languages. Owing to its cost effectiveness and ease of access, distance learning has become a major part of human resource capacity building in most Member States. In 2013, a syllabus for training radiopharmacists and technologists was developed as the foundation for a collaborative e-learning programme that will enable participating universities in Member States to issue diploma or master level training certificates.

Environment

Several major international events held in 2013, including the Scientific Forum 2013, highlighted the work of the Ocean Acidification International Coordination Centre (OA-ICC), a Peaceful Uses Initiative (PUI) project that has been operated at the IAEA Environment Laboratories in Monaco since January 2013. The OA-ICC project promotes and supports international efforts aimed at developing response strategies to the growing threat of ocean acidification. The project serves all stakeholders concerned with ocean acidification, including scientists and researchers, policy makers and academics, the media and the general public. In the framework of its technical cooperation programme, the Agency, through the IAEA Environment Laboratories in Monaco, is also actively involved in supporting the transfer of technology and expertise related to climate change and ocean acidification.

Water resources

As water remains one of the key issues on the development agenda of Member States, in 2013 the Agency continued to advance the use of nuclear and isotope techniques to better assess and manage water resources and to develop strategies for adapting to climate change impacts. The geographical coverage of monitoring stations in the Agency's global isotope monitoring networks for precipitation — a key resource for understanding past climate changes and improving predictive models — was expanded with the addition of 32 newly active stations in Africa, South East Asia and Latin America.

A compact, safe and easy to operate system for measuring low level, environmental tritium in groundwater samples was developed. This system will help overcome a major limitation in Member States — lack of laboratory capacity — and facilitate the wider use of isotope hydrology.

Food and agriculture

The Niayes area of Senegal in the Sahel Zone has a coastal microclimate favourable to farming and cattle breeding. These activities are, however, hampered by the presence of the tsetse fly *Glossina palpalis gambiensis*. A comprehensive feasibility study carried out with the support of the Agency and the International Cooperation Centre of Agricultural Research for Development (CIRAD) concluded that tsetse eradication would bring significant socioeconomic benefits to the farmers of the Niayes area. Significant funding received through the PUI made it possible to move, in 2012, from the feasibility to the operational eradication phase of the study, consisting of suppression of the tsetse fly population followed by systematic area-wide aerial releases of sterile male flies produced in Burkina Faso. One year after the start of the sterile male releases, the northern-most zone of the project area is considered free of tsetse.

In February, several provinces in China were affected by an outbreak of a novel form of avian influenza. The disease did not cause any symptoms in poultry, but when transmitted to humans it caused severe respiratory problems. According to genetic analysis and experimental infection studies, this new H7N9 strain can infect mammalian hosts more easily than the H5N1 highly pathogenic avian influenza (HPAI) virus. This suggests that the H7N9 virus has the potential to become pandemic. Initially, the new H7N9 strain could not be detected by conventional nuclear and nuclear related molecular diagnostic technologies. The entire animal

health network of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and the avian influenza research community responded immediately by working on the identification, characterization and tracing of this new avian influenza variant, and were involved in the development and validation of diagnostic procedures, the transfer of technologies and the provision of expert support to Member States.

Human health

Malnutrition is a major issue on the global health agenda. To address the problem, the Scaling Up Nutrition (SUN) Movement was launched at the United Nations General Assembly in September 2010. The movement is founded on the principle that all people have a right to food and good nutrition, and aims at significantly reducing malnutrition in participating countries. It unites people — from governments, civil society, the United Nations and businesses, and donors and researchers — in a collective effort to improve nutrition, with a core focus on empowering women. Since its launch, 43 countries have joined the SUN Movement. The Agency joined the Movement's United Nations System Network in 2013, participating in its first meeting, held in August in Nairobi.

New approaches to empowering nuclear and diagnostic imaging professionals through the use of ICTs have been adopted. They include capacity building through the use of webinars, interactive on-line modules, and on-line distance assisted training in the use and applications of new technologies. To build capacity in Member States in the areas of nuclear medicine and diagnostic imaging, the Agency, in cooperation with such major international organizations as the Society of Nuclear Medicine and Molecular Imaging and the American Society of Nuclear Cardiology, started a webinar initiative in 2013 that allows the simultaneous dissemination of content to many listeners and viewers, and facilitates access in remote locations. The monthly webinars, with an average participation of 300 people per webinar worldwide, have been made available in English and Spanish.

New interactive learning materials in the form of comprehensive e-learning modules on hybrid imaging for cancer management were made available on the Agency's Human Health Campus[1]. Such developments can enhance self-directed learning, with the potential to improve efficiency in education and expand educational opportunities.

Programme of Action for Cancer Therapy (PACT)

In 2013, the Agency continued its efforts in cancer control, mainly through integrated missions of PACT (imPACT) to address Member State requirements for comprehensive cancer control capacity and needs assessment. Twelve Member States received imPACT missions in 2013. Since PACT's inception, a total of 59 imPACT missions have been carried out and a total of 73 requests for imPACT missions have been received.

The Advisory Group on Increasing Access to Radiotherapy Technology (AGaRT) brings together radiotherapy equipment suppliers and radiotherapy users in developing countries. At the annual AGaRT meeting in 2013, the group endorsed affordable, appropriate and suitable radiotherapy equipment packages for low and middle income (LMI) settings for the first time. These packages aim to assist LMI Member States in implementing sustainable radiotherapy services.

Preparations were completed during the year to integrate PACT into the Agency's technical cooperation programme as of January 2014. This is intended to strengthen the implementation of activities to support cancer control in Member States by placing management of the programme under the Agency's main implementation mechanism.

"Twelve Member States received imPACT missions in 2013."

Radioisotopes and radiation technology

The Agency continued its research on alternative technologies to produce the medical isotope molybdenum-99. As part of a CRP, the use of charged particle accelerators (cyclotrons) for producing medical isotopes, especially technetium-99m (usually obtained from molybdenum-99), is being explored.

Radiation technology can be used to treat natural products that might otherwise be thrown away as waste, producing novel materials that can be used in many different areas. For example, crab shells which are usually thrown away can be processed using radiation to obtain a polymeric material that can be used in the food packaging industry. A Technical Meeting was held in Vienna in 2013 to showcase such applications. As described at the meeting, the results of field tests of plant growth promoters and super water absorbents, as well as the new packaging materials developed, indicate a tremendous potential for these products. Nonetheless, great efforts have to be made to position them in the market by stressing their advantages over other products, their features and expected benefits, and their cost–benefit ratio.

[1] See: *http://humanhealth.iaea.org*.

NUCLEAR SAFETY AND SECURITY

Nuclear Safety

Status and trends

The Agency works to provide a strong and sustainable global nuclear safety framework to protect workers, society and the environment from harmful effects of radiation. It has implemented a number of mechanisms to assist Member States in strengthening their national nuclear safety programmes. Establishing a competent, well functioning regulatory framework as well as an independent, well resourced regulatory body continues to be a challenging focus for newcomers, requiring an increasing level of Agency assistance.

Long term operation of nuclear power plants is an important issue for many countries. Many of the world's nuclear power reactors have been in operation for 30–40 years or longer. Managing these reactors safely in the long term poses challenges that need to be carefully assessed and managed.

"Progress in the implementation of the IAEA Action Plan on Nuclear Safety continued during 2013…"

IAEA Action Plan on Nuclear Safety

Progress in the implementation of the IAEA Action Plan on Nuclear Safety continued during 2013 and was reported to the Board of Governors on a regular basis. In October, the Agency and the OECD/NEA jointly organized and conducted the International Conference on Topical Issues in Nuclear Installation Safety: Defence in Depth — Advances and Challenges for Nuclear Installation Safety, held in Vienna. The Agency organized International Experts Meetings on Decommissioning and Remediation after a Nuclear Accident, and on Human and Organizational Factors in Nuclear Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant.

The Agency published reports on *Preparedness and Response for a Nuclear or Radiological Emergency in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant*[2], *Strengthening Nuclear Regulatory Effectiveness in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant*[3], and *Decommissioning and Remediation after a Nuclear Accident*[4]. In September, the Secretariat published a comprehensive catalogue of services to support Member States in the introduction of a new nuclear power programme.

The review of the IAEA safety standards progressed during 2013, and no significant areas of weakness were identified. However, some revisions have been proposed to strengthen the Safety Requirements and facilitate their implementation. In addition, the results of the Second Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety and the three International Experts Meetings held in 2013 were analysed to identify other potential aspects for further review and revision.

The Agency continued to focus on preparing a report on the Fukushima Daiichi accident, to be finalized in 2014. The report is a major undertaking, with the participation of approximately 180 internationally recognized experts from around 40 Member States and several international organizations.

In September, a joint workshop with the World Association of Nuclear Operators (WANO) on nuclear power plant operating experience was held in Moscow. Other activities included the Follow-up IAEA International Mission on Remediation of Large Contaminated Areas Off-Site the Fukushima Daiichi Nuclear Power Plant in October, and the international expert review of the planning and implementation of the decommissioning of the Fukushima Daiichi nuclear power plant in November.

Improving regulatory effectiveness

In 2013, the Agency held the International Conference on Nuclear Regulatory Effectiveness: Transforming Experience into Regulatory Improvements, in Ottawa, Canada, where nuclear regulators from over 50 countries discussed nuclear regulatory challenges and lessons learned in the light of the Fukushima Daiichi accident. Participants called for action to strengthen nuclear regulatory effectiveness and to increase information sharing.

The Agency conducted four Integrated Regulatory Review Service (IRRS) missions, to Belgium, Bulgaria, the Czech Republic and Poland, and two IRRS follow-up missions, to the Russian Federation and the United Kingdom. Further improvements to the IRRS programme included the development of a training curriculum for future IRRS reviewers and the publication of a manual to assist IRRS experts in conducting these missions.

Operation of nuclear power plants and research reactors

Seven follow-up Operational Safety Review Team (OSART) missions were conducted to review the improvements made since the initial missions, and one full scope mission was conducted to France. The first 'corporate' OSART mission was carried out at the request of the Czech Republic, focusing on the centralized functions of the corporate organization that affect the operational safety aspects of a nuclear power plant.

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[2] Available at: *http://www.iaea.org/newscenter/focus/actionplan/reports/preparedness0913.pdf*.

[3] Available at: *http://www.iaea.org/newscenter/focus/actionplan/reports/regeffectiveness0913.pdf*.

[4] Available at: *http://www.iaea.org/newscenter/focus/actionplan/reports/decommissioning0913.pdf*.

Radioactive waste challenges

In relation to post-accident situations, remediation and decontamination activities in affected areas may, in a short period of time, produce a large amount of waste with relatively low activity concentrations. The management of these large quantities of radioactive waste and materials remains a challenge. The Agency set up working groups to prepare guidance documents on analysing these important aspects of remediation and decontamination activities following emergency situations. To provide advice on topics related to remediation and the management of waste generated during remediation activities, two missions to Fukushima Prefecture were carried out in 2013. The missions are part of a three year cooperation project with Fukushima Prefecture that was established in the margins of the Fukushima Ministerial Conference on Nuclear Safety, held in December 2012.

Incident and emergency preparedness and response

The Agency helps strengthen Member State capacity in emergency preparedness and response (EPR) through the development of safety standards and technical tools, delivery of training, and provision of expert support and appraisal services. In 2013, *Actions to Protect the Public in an Emergency due to Severe Conditions at a Light Water Reactor* (EPR-NPP Public Protective Actions) was published.

The Agency has 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. It regularly conducts Convention Exercises (ConvEx) in which the Agency, Member States and relevant international organizations practise different arrangements within the international EPR framework for nuclear or radiological emergencies. This year, the Agency conducted a total of seven ConvEx exercises, testing communication, response times and information exchange worldwide. In November, Morocco hosted the first ever large scale ConvEx-3 exercise to test Member State preparedness for, and response to, a severe radiological emergency triggered by a 'dirty bomb' attack. Fifty-nine Member States, including Morocco, and ten international organizations, including the Agency, participated in the exercise, which offered the opportunity to evaluate the response to a severe radiological emergency triggered by a nuclear security event and revealed areas of EPR systems that need further improvements, including response coordination among Member States.

Capacity building in nuclear safety

The Agency continued to provide assistance to regulatory bodies in Member States, focusing on areas such as capacity building and human resource development as well as the development of safety regulations and establishment of management systems. The Agency developed training materials that were used in many workshops at the national and regional levels, with a particular focus on strengthening core regulatory functions for new nuclear power reactor projects.

In March, the Secretariat informed the Board of Governors of the Agency's Strategic Approach to Education and Training in Nuclear Safety for the period 2013–2020. This approach identifies roles, responsibilities, processes and mechanisms to build effective capacity through education and training in Member States. In support of this approach and the integrated capacity building self-assessment, new guidelines for an Education and Training Review Service (ETRES) were developed and implemented in Indonesia and Pakistan.

"This year, the Agency conducted a total of seven ConvEx exercises, testing communication, response times and information exchange worldwide."

Conventions

In 2013, the Working Group on Effectiveness and Transparency, established by the Contracting Parties to the Convention on Nuclear Safety (CNS) at their Second Extraordinary Meeting in August 2012, held four meetings. At its final meeting, the Working Group adopted a report to be considered at the 6th Review Meeting of the Contracting Parties to the CNS, held in Vienna from 24 March to 4 April 2014. In December 2013, Switzerland submitted a proposal to amend the CNS, also to be considered at the 6th Review Meeting.

As agreed during the 4th Review 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 Contracting Parties to the Joint Convention held an Inter-sessional Meeting in April 2013, and a Topical Meeting on Comprehensive Approaches to the Back End of the Nuclear Fuel Cycle was organized at the Agency's Headquarters in Vienna in October 2013.

Civil liability for nuclear damage

The International Expert Group on Nuclear Liability (INLEX) developed *The 1988 Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention — Explanatory Text*, which was published in April as IAEA International Law Series No. 5.

At its 13th regular meeting, INLEX discussed, inter alia, liability issues in the case of the transport of nuclear material, transportable nuclear power plants, and the impact of the 2012 revision of the Agency's Transport Regulations to exclude small quantities of nuclear material from the scope of the nuclear liability conventions. A Workshop on Civil Liability for Nuclear Damage, attended

by 49 diplomats and experts from 34 Member States and one international organization, was held in Vienna in May.

A joint IAEA–INLEX mission visited Malaysia in August, met with policy makers and senior officials, and organized a Workshop on Civil Liability for Nuclear Damage for other interested stakeholders to raise awareness of the various international nuclear liability regimes. Outreach activities were conducted through a briefing for diplomats at the United Nations in New York in May, and a presentation on nuclear liability by the INLEX chairman at an IAEA Regional Workshop for the Pacific Islands in Nadji, Fiji, in April.

Nuclear Security

In the course of 2013, incidents reported to the Agency's Incident and Trafficking Database (ITDB) demonstrated the need for continued efforts to improve nuclear security worldwide. The importance of addressing nuclear security as a fundamental component of new nuclear power plants continued to be recognized. Nuclear and other radioactive material is being transported to meet demand, and there is increased interest in nuclear power. The Agency supports States, upon request, to fulfil their responsibility to ensure that material and associated facilities do not fall into the wrong hands.

As part of this effort, the Agency organized the International Conference on Nuclear Security: Enhancing Global Efforts, held in Vienna in July, aimed at promoting a global approach to nuclear security. This was the first Agency conference of its type, drawing more than 1300 participants from 125 Member States, including 34 representatives at the ministerial level and representatives from 21 organizations. The resulting Ministerial Declaration[5] on nuclear security affirmed the Agency's central role in strengthening the nuclear security framework globally and in leading the coordination of international activities in this field. As called for by the Conference, the Agency will organize periodic high level international conferences on nuclear security to provide continuity to international nuclear security processes.

During the year, the Agency continued to implement its *Nuclear Security Plan 2010–2013* and to increase Member State involvement in Agency nuclear security activities. These activities included work undertaken within the Nuclear Security Guidance Committee and other working groups on, for example, radioactive sources, and work as mission experts. Significant work was undertaken in the areas of capacity building, assessment tools such as the Integrated Nuclear Security Support Plans (INSSPs) and the Nuclear Security Information Management System (NUSIMS), and peer reviews and advisory services such as the International Physical Protection Advisory Service (IPPAS) and the International Nuclear Security Advisory Service (INSServ).

The new *Nuclear Security Plan 2014–2017*, which was drawn up in close consultation with Member States, was approved by the Board of Governors in September.

Capacity building in nuclear security

The Agency continues to facilitate collaboration and capacity building through the International Network for Nuclear Security Training and Support Centres, which currently has 98 members from 39 States and seven international organizations.

In 2013, the Agency conducted 88 training events covering all aspects of nuclear security, involving more than 2000 people.

NUCLEAR VERIFICATION

Implementation of Safeguards in 2013

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 mandate, and fulfilling its safeguards obligations for that year.

In 2013, safeguards were applied for 180 States[6,7] with safeguards agreements in force with the Agency[8]. Of the 117 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 63 States[9]; for the remaining 54 States, as all the necessary evaluations remained ongoing, the Agency was unable to draw the same conclusion. For these 54 States, and for the 55 States with a CSA but with no AP in force, the Agency concluded only that *declared* nuclear material remained in peaceful activities. For those States for which the broader conclusion 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. Integrated safeguards were implemented during 2013 for 53 States.

Safeguards were also implemented with regard to declared nuclear material in selected facilities in the five

[5] After the adoption of the Ministerial Declaration, one Member State made a statement to express reservations but did not object to reaching consensus on the document. See: *http://www-pub.iaea.org/iaeameetings/cn203p/RussianFederation-PDF.pdf.*

[6] 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.

[7] And Taiwan, China.

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

[9] And Taiwan, China.

nuclear-weapon States under their respective voluntary offer agreements and APs. For these five States, the Agency concluded that nuclear material to which safeguards were applied in selected facilities remained in peaceful activities or had been withdrawn from safeguards as provided for in the agreements.

For the three States in which the Agency implemented safeguards pursuant to safeguards agreements based on INFCIRC/66/Rev.2, the Agency concluded that the nuclear material, facilities or other items to which safeguards were applied remained in peaceful activities.

As of 31 December 2013, 12 non-nuclear-weapon States party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) had yet to bring into force CSAs as required by Article III of the Treaty. For these States, the Agency could not draw any safeguards conclusions.

Conclusion of Safeguards Agreements and Additional Protocols

In 2013, two CSAs and four APs entered into force. In addition, four operational small quantities protocols (SQPs) were amended. By the end of the year, safeguards agreements were in force with 180 States, and APs were in force with 122 States. Moreover, SQPs were in force and operational with 95 States.

Islamic Republic of Iran

During 2013, 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/2013/6, GOV/2013/27, GOV/2013/40 and GOV/2013/56).

In 2013, contrary to the relevant binding resolutions of the Board of Governors and the United Nations Security Council, the Islamic Republic of Iran (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 serious concerns about possible military dimensions to Iran's nuclear programme that is necessary to establish international confidence in the exclusively peaceful nature of that programme.

In October 2013, following further rounds of talks aimed at reaching agreement on a structured approach document for resolving outstanding issues related to Iran's nuclear programme, the Agency and Iran concluded that the negotiations had become deadlocked. As there was no prospect for agreement on the document, the Agency and Iran agreed that a new approach aimed at ensuring the exclusively peaceful nature of Iran's nuclear programme should be developed.

On 11 November 2013, the Director General, on behalf of the Agency, and the Vice President of Iran and President of the Atomic Energy Organization of Iran, on behalf of Iran, signed a 'Joint Statement on a Framework for Cooperation'. In the Framework for Cooperation, the Agency and Iran agreed to cooperate further with respect to verification activities to be undertaken by the Agency to resolve all present and past issues, and to proceed with such activities in a step by step manner. Iran agreed to take six initial practical measures within three months.

On 24 November 2013, a Joint Plan of Action[10] was agreed between Iran and China, France, Germany, the Russian Federation, the United Kingdom and the United States of America, 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". Under this Joint Plan of Action, the Agency was to be "responsible for verification of nuclear-related measures" contained therein.

"By the end of the year, safeguards agreements were in force with 180 States, and APs were in force with 122 States. Moreover, SQPs were in force and operational with 95 States."

The Director General welcomed the Joint Plan of Action, noting that it was an important step forward but that much more needs to be done. The Director General also indicated that, with the agreement of the Board of Governors, the Agency would be ready to fulfil its role in verifying the implementation of nuclear related measures [11].

While the Agency continued throughout 2013 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[12].

Syrian Arab Republic

In August 2013, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic*. No new information came to the knowledge of the Agency that would have an impact on the Agency's assessment

[10] INFCIRC/856.

[11] On 24 January 2014, the Board endorsed the Agency undertaking monitoring and verification in relation to the nuclear related measures set out in the Joint Plan of Action.

[12] 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.

that it was very likely that a building destroyed at the Dair Alzour site was a nuclear reactor which should have been declared to the Agency by the Syrian Arab Republic (Syria).[13] In 2013, 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.

While Syria invited the Agency to conduct an inspection at the Miniature Neutron Source Reactor in Damascus in 2013, the Agency decided not to conduct any in-field verification activities in Syria. In this regard, in June 2013, the Agency informed Syria that, after considering the United Nations Department of Safety and Security's assessment of the prevailing security conditions in Syria and the small amount of nuclear material declared by Syria at the reactor, the 2013 physical inventory verification at the reactor would be postponed until the security conditions had sufficiently improved. By the end of 2013 the assessment of the security situation 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 2013, the Agency concluded for Syria that declared nuclear material remained in peaceful activities.

Democratic People's Republic of Korea

In August 2013, 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/2013/39–GC(57)/22), which provided an update of developments since the Director General's report of August 2012.

Since 1994, the Agency has not been able to conduct all necessary safeguards activities provided for in the NPT Safeguards Agreement for the Democratic People's Republic of Korea (DPRK). 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 about it having conducted a third nuclear test 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.

Although not implementing any verification activities in the field, the Agency continued to monitor the DPRK's nuclear activities in 2013 by using open source information (including satellite imagery) and trade information. The Agency has continued to observe building renovation and new construction activities at various locations within the Yongbyon site, although, without access to the site, the Agency cannot confirm the purpose of these 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.

Enhancing Safeguards Implementation

In 2013, progress continued in strengthening the effectiveness and improving the efficiency of Agency safeguards through strategic planning, evolving safeguards implementation, introducing integrated safeguards in additional States, developing safeguards approaches, strengthening the Agency's technical and analytical capabilities, and increasing cooperation with State and regional authorities.

To continue ensuring consistency and non-discrimination in the implementation of safeguards, the Agency has improved internal work practices, including through: better integration of the results of safeguards activities conducted in the field with those carried out at Headquarters, in order to determine where to focus such activities for maximum effectiveness and efficiency; advances in the handling of safeguards relevant information to facilitate evaluation, and their documentation; and adjustments to the safeguards training programme. Of particular importance is the improvement of the key processes supporting safeguards implementation and the departmental oversight mechanisms relevant to the implementation of these processes.

In August, the Director General submitted a report to the Board of Governors entitled *The Conceptualization and Development of Safeguards Implementation at the State Level*, which was, inter alia, taken note of by the Board of Governors. The Board of Governors was informed that the Secretariat would prepare a supplementary document to the report to provide the Board with more information before the 2014 General Conference, and would consult with Member States to ensure that the Secretariat had captured all of the points that Member States asked to be addressed in that document. The General Conference resolution on Strengthening the Effectiveness and Improving the Efficiency of Agency Safeguards (GC(57)/RES/13)

[13] 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.

noted, inter alia, that the Director General will produce, after consulting with Member States, a supplementary document for consideration and action by the Board of Governors before the fifty-eighth (2014) session of the General Conference.

Information Analysis

Throughout 2013, the Agency enhanced and diversified its capabilities to acquire and process data, analyse and evaluate information, and securely distribute information internally to relevant parties, as an essential contribution to the State evaluation process and the drawing of safeguards conclusions. It also continued to investigate new tools and methodologies to streamline and prioritize workflows and processes.

Cooperation with State and Regional Authorities

To assist SQP States in building capacity for complying with their safeguards obligations, in April 2013, the Agency published the *Safeguards Implementation Guide for States with Small Quantities Protocols*. In addition, the Agency, with the assistance of experts from Member States, prepared drafts of two Safeguards Implementation Practices Guides.

The IAEA State System of Accounting for and Control of Nuclear Material Advisory Service (ISSAS) provides States, at their request, with advice and recommendations on the establishment and strengthening of such State systems. In 2013, ISSAS missions were conducted in the Republic of Moldova and Tajikistan to facilitate the improvements of their State systems of accounting for and control of nuclear material. In addition, preparatory meetings for ISSAS missions to be conducted in 2014 were carried out in Kyrgyzstan and the United Arab Emirates.

ECAS

Construction of the Nuclear Material Laboratory (NML) building at Seibersdorf, near Vienna, was completed in July 2013 on schedule and within the approved budget. The building was inaugurated on 23 September 2013. The phased transition of scientific functions from the leased Safeguards Analytical Laboratory building to the new NML building commenced in September 2013. The building is expected to be operational in 2014. Overall, activities within the Enhancing Capabilities of the Safeguards Analytical Services (ECAS) project were 70% complete by the end of 2013.

Information Technology

In 2013, the Agency continued to improve its safeguards information system in order to better support the implementation of safeguards. By the end the year, nearly half the re-engineering work necessary to replace outdated mainframe computer based software applications had been completed. In support of information analysis, further enhancements were made to the analytical tools released in 2012. To help secure sensitive information, improvements were made to security monitoring, digital forensics and the highly secure internal network. To address the Agency's continued safeguards IT modernization needs and to bring these efforts under a comprehensive management approach, the Modernization of Safeguards Information Technology project was established.

"Construction of the Nuclear Material Laboratory (NML) building at Seibersdorf, near Vienna, was completed in July 2013 on schedule and within the approved budget."

Preparing for the Future

Research and development are essential to meet the safeguards needs of the future. To address near term development objectives and to support the implementation of its verification activities, the Agency continued to rely on Member State Support Programmes (MSSPs) in implementing its Development and Implementation Support Programme for Nuclear Verification 2012–2013. Member State Support Programmes continued to make substantial contributions (in cash and in kind) to Agency safeguards. As of 31 December 2013, 20 States[14] and the European Commission had formal support programmes.

MANAGEMENT OF TECHNICAL COOPERATION FOR DEVELOPMENT

The technical cooperation programme is the primary vehicle for the delivery of Agency capacity building services to Member States, and it is through this programme that the Agency carries out its mandate "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

Technical Cooperation and the Global Development Context

The Agency is a member of the UN System Task Team on the Post-2015 UN Development Agenda and is providing input to the process of preparing new sustainable development goals (SDGs) for the post-2015 period. The Agency's input in 2013 focused on the importance

[14] 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.

of strong and robust national science, technology and innovation (STI) institutions in the new SDG framework. This framework and national targets and plans will provide a strategic programming framework for after 2015, and will open doors for new partnerships and resources.

In late 2013, the Agency participated in the Sixth Session of the Open Working Group on Sustainable Development Goals, contributing to the discussion on STI goals and indicators. The UN Secretary General's proposal for technology facilitation mechanisms that promote the development, transfer and dissemination of clean and environmentally sound technologies has important implications for Agency activities and Member State country programmes. The Agency's technical cooperation programme can contribute to both the global technology transfer mechanism and the science foundation network that enables R&D cooperation.

A Practical Arrangement (PA) was completed with the United Nations Convention to Combat Desertification (UNCCD) in 2013, and preparations were made for a further PA with UNEP, which will focus on climate change adaptation. A PA was also initiated with UNICEF as a framework for nutrition activities.

The Technical Cooperation Programme in 2013

In 2013, health and nutrition accounted for the highest proportion of actuals — i.e. disbursements — through the technical cooperation programme, at 28.6%. This was followed by nuclear safety and security at 22.8%, and by food and agriculture at 16.3% (Fig. 1). By the end of the year, financial implementation of the Technical Cooperation Fund (TCF) stood at 83.7%. Regarding non-financial implementation, the technical cooperation programme supported, inter alia, 3509 expert and lecture assignments, 209 regional and interregional training courses, and 2005 fellowships and scientific visits.

Throughout 2013, the Agency continued to assist Member States in strengthening human capacity for sustainable development. Attention was given to attaining optimum results in meeting basic human needs and achieving tangible socioeconomic impacts. In particular, efforts were made to improve quality, build partnerships, strengthen regional cooperation, and enhance radiation safety and security for the peaceful application of nuclear techniques. The programme was guided by the priorities expressed in individual Country Programme Frameworks, and in alignment with national development plans.

In Africa, the Agency provided assistance to more than 40 Member States, helping them to use nuclear and isotopic techniques to produce more food, to improve water management, and to develop capabilities for the diagnosis and treatment of diseases. The programme also focused on building safety infrastructure in the region. Nuclear techniques were applied in pest control, especially tsetse suppression and eradication, in combating desertification, and in supporting crop improvement and animal productivity in the region. In the area of human health, the Agency contributed to Member State efforts to strengthen existing cancer control facilities and to establish new ones. This included supporting feasibility studies for developing bankable project documents, providing expert services and equipment, and training radiotherapists, radiation oncologists, nuclear medicine specialists and other related personnel.

In 2013, the Agency participated in the fifth Tokyo International Conference on African Development (TICAD), which was organized jointly by the Government of Japan, UNDP, the World Bank and the African Union. A brochure entitled *IAEA Technical Cooperation in Africa* was distributed during the conference, and the Agency made an intervention during the thematic session on strengthening sectoral bases for growth.

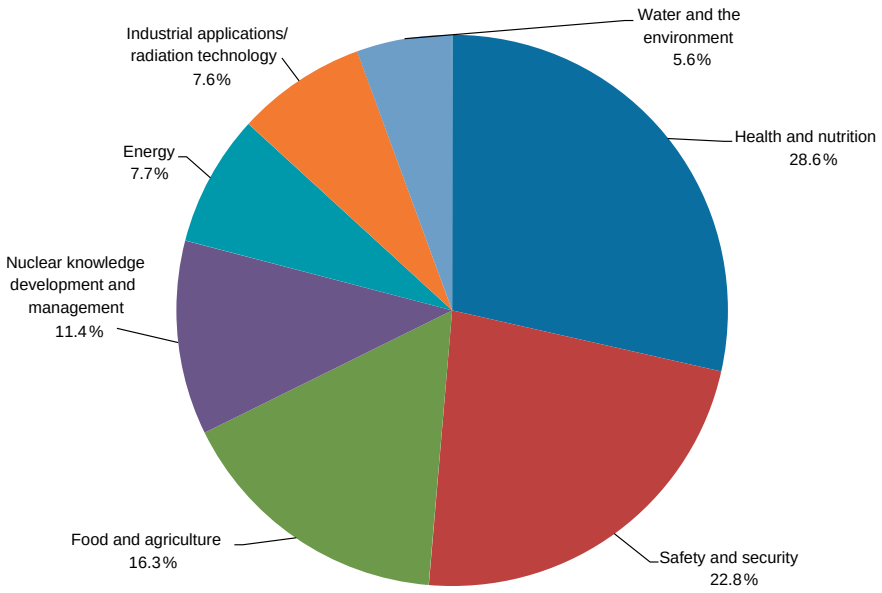


FIG. 1. Actuals by technical field for 2013. (Percentages may not add up to 100% due to rounding.)

Agency support in Africa has resulted in measurable progress in nuclear and radiation safety in the region, building national radiation safety and regulatory infrastructure. With the support of the Agency, African Member States made efforts to address gaps and to further strengthen their radiation safety infrastructure.

In the Asia and the Pacific region, the technical cooperation programme focused on the area of nuclear power. Of the countries planning the introduction of nuclear power, several are currently taking steps towards building their nuclear power infrastructure in preparation for launching a nuclear power programme in the future. A priority for the region in 2012–2013 was enabling the assessment of energy options in interested Member States (including those countries embarking on nuclear power).

Other areas of focus during 2013 included improving agricultural productivity and food safety, as well as strengthening national legal frameworks and regulatory infrastructure for radiation, transport and waste safety. Continued Agency scientific and technological expertise was required to access potable water, as well as to develop and manage natural resources and the environment in a sustainable manner.

Member States in the Asia and the Pacific region re-emphasized the importance of human health related applications, in particular those related to the diagnosis and treatment of diseases, as well as activities to ensure the safe use of ionizing sources and the adoption of quality assurance practices. Accordingly, the technical cooperation programme promoted strong regional cooperation and sought to further strengthen existing national and regional centres of excellence.

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 — as well as on cross-cutting areas for regional or subregional cooperation. A major emphasis was on maintaining appropriate levels of safety and security in all aspects of the peaceful use of nuclear technology. The highest number of technical cooperation projects for 2012–2013 was in the safety field, including knowledge management and nuclear applications in various areas.

The regional priority thematic areas of the technical cooperation programme for Latin America are established in the 2007–2013 Regional Strategic Profile for Latin America and the Caribbean (RSP). These are food security, human health, environment, energy and industry, and radiation safety. In addition to the traditional support to capacity building in the various fields of activity, particular attention was paid to supporting developments in food irradiation technology, and to enhancing understanding of the processes that affect the region's marine environment.

In 2013, the programming of the 2014–2015 technical cooperation cycle for the region was concluded, building on meeting the goals of the *Medium Term Strategy 2012–2017*. Emphasis was placed on covering needs that were not sufficiently addressed in preceding technical cooperation cycles, particularly in the areas of human health, environment, food security and radiation safety. In parallel, a comprehensive consultative process was carried out during 2012 and 2013, which culminated in the delivery of the final draft of the new RSP in November 2013. The draft was sent to Member States of the region for comments, and the final version will be forwarded to ARCAL policy bodies for endorsement.

"The Agency continued to focus on improving programme quality and transparency throughout 2013."

Dominica, a new Member State, designated a National Liaison Officer (NLO) and a National Liaison Assistant (NLA), who attended an Agency training course in March 2014. A decision to designate an NLO in Trinidad and Tobago, another new Member State, is expected in the first half of 2014.

Technical Cooperation Programme Management

The Agency continued to focus on improving programme quality and transparency throughout 2013. Training in the logical framework approach and results based management, for programme management officers, NLOs, technical officers and counterparts, ensured that all project proposals submitted for consideration in the 2014–2015 technical cooperation programme would be clearly linked to the Medium Term Strategy and be of high quality, with measurable, attainable and timely objectives. Special efforts were made to ensure that Member States received systematic feedback and information in a timely manner. Further efforts to improve the monitoring of technical cooperation projects were put into practice through the analysis of Project Progress Assessment Reports and the initiation of field monitoring missions.

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 €78.2 million in 2013, with approximately €66.3 million for the TCF (including assessed programme costs (APCs), National Participation Costs[15] (NPCs) and

[15] *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.

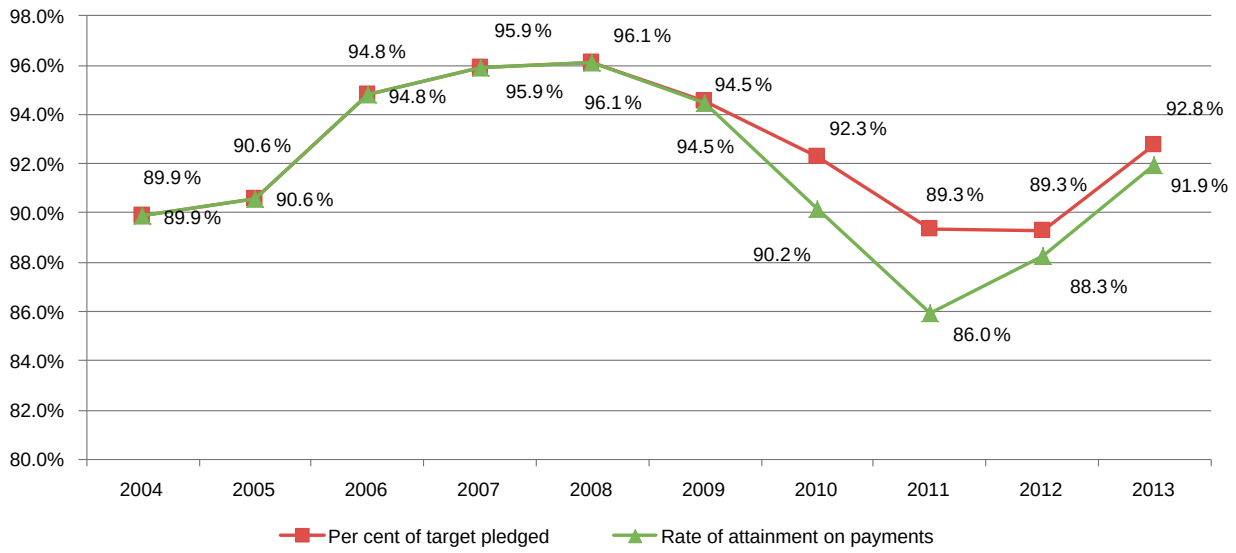


FIG. 2. Trends in the rate of attainment, 2004–2013.

miscellaneous income), €10.7 million in extrabudgetary resources, and about €1.2 million representing in kind contributions.

The rate of attainment[16] for the TCF stood at 92.8% on pledges and at 91.9% on payments at the end of 2013 (Fig. 2), while payment of NPCs totalled €440 300.

Actuals

In 2013, approximately €78.3 million was disbursed to 124 countries or territories, of which 31 were least developed countries, reflecting the Agency's ongoing effort to address the development needs of those States.

MANAGEMENT ISSUES

The Agency's Programme and Budget 2014–2015

The formulation of the *Programme and Budget 2014–2015* was guided by the goals of maximizing efficiency, reflecting changing priorities and striking an appropriate balance among the Agency's activities. At the same time, the current financial challenges faced by most Member States and the constantly increasing demands for the Agency's services were taken into account. A two stage budget preparation process using a new methodology was initiated that also considered the guidance given to the Secretariat by Member States and the priorities identified in the *Medium Term Strategy 2012–2017*.

[16] The rate of attainment is the percentage that results from dividing the total voluntary contributions pledged and paid to the TCF for a particular year by the TCF target for the same year. As payments can be made after the year in question, the rate of attainment can increase over time.

AIPS

Work continued on the implementation of the Agency-wide Information System for Programme Support (AIPS), an enterprise resource planning system that is enabling many of the Agency's business processes to be re-engineered for improved availability of information and enhanced programme management. With the completion of two of the project's four phases, AIPS is now being used for the planning, execution and assessment of the Agency's programmes and projects, fully incorporating the results based management approach. In 2013, a further component was added, allowing the central management of information relating to contacts such as suppliers, customers and meeting participants. Work also began on the project's third phase, covering human resources (HR) and the Agency's payroll. This phase will bring fully electronic HR processing, an enhanced performance review system, improved contracting procedures and automated payroll processes.

Partnership for Continuous Improvement

The Partnership for Continuous Improvement (PCI) initiative was launched in 2013 to improve the efficiency and effectiveness of Agency activities by eliminating unnecessary bureaucracy throughout the Secretariat. Working with managers throughout the Agency, over a hundred potential changes have so far been identified, and almost a third of these have been implemented. Examples include streamlining of administrative processes such as those for travel and meetings, and using desktop video conferencing to help staff implement programmes in a more cost effective manner.

Nuclear Technology

Nuclear Power

Objective

To enhance the capability of interested Member States considering launching nuclear power programmes to plan and build the necessary infrastructure. To enhance the capability of interested Member States with existing nuclear power programmes to improve nuclear power plant operating performance, life cycle management including decommissioning, human performance, quality assurance and technical infrastructure, through good practices and innovative approaches consistent with global objectives on non-proliferation, nuclear safety and security. To enhance the capacity of Member States to develop evolutionary and innovative nuclear technology for electricity generation, for actinide utilization and transmutation and for non-electric applications, consistent with sustainability goals.

Launching Nuclear Power Programmes

In 2013, several countries made significant progress on their first nuclear power plants. In May, the United Arab Emirates (UAE) poured the first concrete for the second unit at the Barakah site. In November, Belarus began construction of the first unit at the Ostrovets site (Fig. 1), becoming the second country in the past three decades to begin construction of its first nuclear power plant. A number of other countries that have decided to introduce nuclear power into their energy mix are in the advanced stages of infrastructure preparation: Bangladesh began site preparation work for its two-unit Rooppur nuclear power plant. Jordan selected Atomstroyexport as a preferred vendor for its first plant. Turkey signed two cooperation agreements with Japan for the Sinop plant. And Viet Nam prepared feasibility studies of two sites for nuclear power plants in Ninh Thuan Province. Table 1 shows the number of Member States at different stages of decision making and planning for nuclear power in 2011–2013.

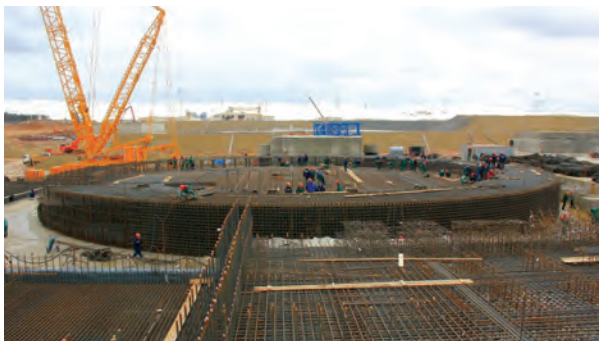


FIG. 1. Belarus began construction of its first nuclear power plant, at the Ostrovets site, on 6 November 2013. (Photograph courtesy of the Directorate for Nuclear Power Plant Construction, Belarus.)

TABLE 1. Number of Member States at different stages of decision making and planning for nuclear power in 2011, 2012 and 2013, according to their official statements.

	2011	2012	2013
First nuclear power plant started construction	0	1	2
First nuclear power plant ordered	3	2	1
Decided and started preparing infrastructure	6	6	6
Active preparation with no final decision	6	6	5
Considering a nuclear power programme	14	13	19

In 2013, the Agency continued to assist Member States that have decided to establish a nuclear power programme. In September, it launched a catalogue of services to help these 'newcomer' countries to identify and request appropriate Agency assistance for national organizations at different stages of the development or expansion of a nuclear power programme.

"In June, the International Ministerial Conference on Nuclear Power in the 21st Century attracted over 500 delegates from 87 countries and 7 international organizations, including over 50 ministerial level participants."

National and regional technical cooperation projects provided extensive support to assist interested countries 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, Indonesia, Jordan, Malaysia, the UAE and Viet Nam received significant Agency assistance for the review of nuclear laws, the development and review of regulations, the assessment of sites, and the development of regulatory guidance for on-site evaluation.

In June, the International Ministerial Conference on Nuclear Power in the 21st Century attracted over 500 delegates from 87 countries and 7 international organizations, including over 50 ministerial level participants. The conference was held in cooperation with

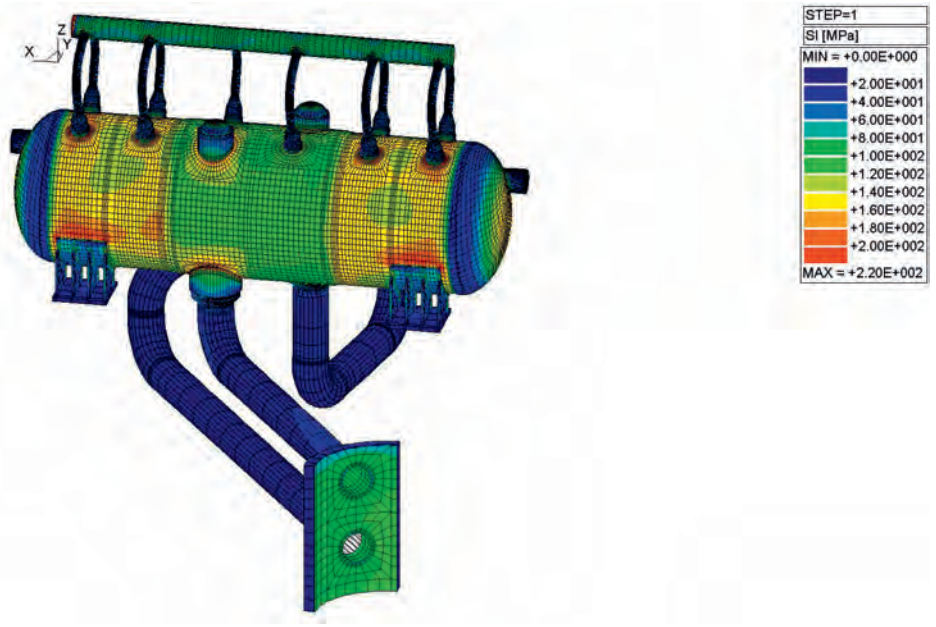


FIG. 2. Illustration of a preliminary strength analysis demonstrating the high stress areas of a steam generator. (Figure courtesy of the Centre for Material Science and Lifetime Management.)

the OECD/NEA and hosted by the Russian Federation in Saint Petersburg. As was noted in the Conference President's concluding statement, the conference "recognized that nuclear power remains an important option for many countries to improve energy security, reduce the impact of volatile fossil fuel prices and mitigate the effects of climate change", and "concluded that for many countries nuclear power is a proven, clean, safe, and economical technology that will play an increasingly important role in achieving energy security and sustainable development goals in the 21st century".

"Many countries have given high priority to licensing their nuclear power plants to operate for terms beyond the 30–40 years originally anticipated."

The Agency is committed to assisting countries that are interested in developing existing or establishing new nuclear power programmes to do so in a safe, secure and responsible manner. One of the services available to Member States provides assistance in building national capacities in energy analysis and planning, enabling them to consider the potential contribution of nuclear power to their national energy mix. Another service, Integrated Nuclear Infrastructure Review (INIR) missions, helps countries to assess the status of their national nuclear infrastructure development and to benefit from recommendations by international experts on how best to move forward. The Agency also assists countries in carrying out national Nuclear Energy System Assessments (NESAs) for developing long term strategies for nuclear energy deployment using the methodology developed through the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO). These three services — energy planning, INIR and NESA — are used in an integrated way to support Member States at different stages of the development of a nuclear power programme.

In 2013, INIR missions were conducted to Poland, South Africa and Turkey. The mission to South Africa was the first in Africa; it was also the first INIR mission to a country that already generates nuclear power and is preparing new build projects. An Agency mission to Nigeria was aimed at assisting the country in preparing a nuclear infrastructure self-evaluation report.

Engineering Support for Operation, Maintenance and Plant Life Management

At the end of 2013, more than 80% of the currently operating nuclear power plants worldwide had been in service for 20 years or longer. Many countries have given high priority to licensing their nuclear power plants to operate for terms beyond the 30–40 years originally anticipated. The demanding environment in which a nuclear reactor operates may affect the ability of a broad range of materials to perform their intended function over extended service periods. Therefore, identifying materials and components that are degrading is an important aspect of the safe and secure operation of nuclear power plants (Fig. 2). Current issues and future challenges of material degradation were discussed at a Technical Meeting held in Vienna in November. The meeting, organized jointly with the European Commission's Joint Research Centre (JRC), was attended by over 80 participants from 29 countries. The meeting concluded that the relationships between operating conditions and fracture toughness of material should be defined to improve structural integrity assurance, and that

FIG. 3. Installation of the containment cap for a unit at the Sanmen nuclear power plant, one of the many nuclear power plants under construction in China, a country with an expanding nuclear power programme. (Photograph courtesy of CNNC.)

the existing surveillance specimen programme of a reactor pressure vessel should be modified for long term operation and the neutron flux effect should be taken into consideration to find new positions of surveillance specimens.

Bringing together 125 participants from 32 countries, the 12th IAEA–FORATOM Management Systems Workshop — Journey to Excellence in a Changing Environment, held in Vienna, focused on three key issues: practical solutions for integrating elements into a management system and evaluating its performance, ways to improve a management system to adapt to a changing environment, and lessons learned from an emergency situation. Participants discussed how to adapt their systems to ensure safe management of nuclear facilities in a changing environment. The objectives of the meeting were to raise awareness, increase understanding and promote the application of the IAEA safety standards for nuclear installations and activities (IAEA Safety Standards Series Nos GS-R-3, GS-G-3.1 and GS-G-3.5).

In September, the Agency published *Advanced Surveillance, Diagnostic and Prognostic Techniques in Monitoring Structures, Systems and Components in Nuclear Power Plants* (IAEA Nuclear Energy Series No. NP-T-3.14). The publication describes conventional surveillance, diagnostic and prognostic technologies as well as the latest tools, algorithms and techniques enabling earlier identification of problems and enhanced solutions.

The Agency continued to support countries with expanding nuclear power programmes (Fig. 3). A Technical Meeting on Strategic Supply Chains and National Industrial Involvement for Nuclear Power was held in November in Dijon, France. The 56 meeting participants from 30 countries also visited relevant French manufacturing and training facilities.

"The development of human resources and the impact of human behaviour on nuclear power programmes continue to be important areas of focus for the Agency."

Human Resource Development

The development of human resources and the impact of human behaviour on nuclear power programmes continue to be important areas of focus for the Agency. In May, an International Experts Meeting on Human and Organizational Factors in Nuclear Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant was held in Vienna and attended by 160 participants from 41 countries and 5 international organizations. The participants expressed their strong support for the promotion of further activities which would both support a systemic approach to nuclear safety and emphasize the relationship between individuals, technology and organization.

The first seven modules of a new e-learning project to support newcomers were launched in 2013. The modules introduce the Agency's 'Milestones' approach[1] to non-experts through free, on-line training[2].

[1] See: *Milestones in the Development of a National Infrastructure for Nuclear Power*, IAEA Nuclear Energy Series No. NG-G-3.1, IAEA, Vienna (2007).

[2] Available at: *http://www.iaea.org/NuclearPower/Infrastructure/elearning/index.html.*

Nuclear Reactor Technology Development

In July, *Nuclear Reactor Technology Assessment for Near Term Deployment* (IAEA Nuclear Energy Series No. NP-T-1.10) was published. The publication served as the basis for workshops held in Austria, Saudi Arabia, Uruguay and Viet Nam, where over 100 participants received related training. In addition, the Agency's publicly accessible Advanced Reactors Information System (ARIS) database was revised and updated.[3]

At the International Conference on Fast Reactors and Related Fuel Cycles: Safe Technologies and Sustainable Scenarios (FR13), held in March in Paris, some 700 experts from 27 countries and 4 international organizations submitted 370 technical and scientific contributions in various fields of fast reactor and fuel cycle technology. The conference reaffirmed the consensus that nuclear fission will continue to play an important role in meeting future energy needs, complying with the expectation for energy production with minimal impact on the climate, the environment and health. In this context, the development of innovative fast neutron systems and closed fuel cycles is regarded as a necessary step to ensure a long term sustainable energy supply.

"In 2013, INPRO welcomed Kenya as a new member, bringing the total number of members to 39..."

A new CRP on Sodium Properties and the Design and Safe Operation of Experimental Facilities in Support of the Development and Deployment of Sodium Cooled Fast Reactors was launched in November. In addition, various related publications, including *Design Features and Operating Experience of Experimental Fast Reactors* (IAEA Nuclear Energy Series No. NP-T-1.9), as well as a booklet entitled *Status of Innovative Fast Reactor Designs and Concepts*, were issued in 2013.

A publication on evaluation of performance and benchmarks for high temperature gas cooled reactors (HTGRs) was issued in April as IAEA-TECDOC-1694. A CRP on modular HTGR safety design was approved in December. The goal of this CRP is to make proposals on safety design criteria, taking the unique inherent safety characteristics of HTGRs into consideration. It will also take into account the effects of the accident at the Fukushima Daiichi nuclear power plant, clarifying the safety requirements and safety evaluation criteria for design extension conditions, especially those events that can affect multiple reactor modules or are dependent on the application for which the reactors are being used, such as process heat or hydrogen production.

[3] Available at: *https://aris.iaea.org/*.

Cogeneration can effectively double thermal efficiency if waste heat is recovered and utilized. Responding to a General Conference resolution requesting the development of a report defining technical and economic aspects for a feasibility study on cogeneration, consultants meetings were organized to help prepare two draft documents, expected to be published in 2014. The Agency also conducted capacity building workshops on energy and water planning in Tunisia and on non-electrical applications in Austria and Malaysia.

Technical Meetings, workshops and seminars continued to address common technologies and issues with regard to small and medium sized reactors (SMRs). *Approaches for Assessing the Economic Competitiveness of Small and Medium Sized Reactors* (IAEA Nuclear Energy Series No. NP-T-3.7) was published in December.

Enhancing Global Nuclear Energy Sustainability through Innovation

INPRO was established in 2000 to help ensure that nuclear energy is available to contribute to meeting the energy needs of the 21st century in a sustainable manner. In 2013, INPRO welcomed Kenya as a new member, bringing the total number of members to 39[4]. In September, the results of the NESA for Belarus, performed by Belarusian experts using the INPRO methodology, were published with the Agency's assistance as IAEA-TECDOC-1716. The publication provides a model for performing a NESA for other countries. NESAs in Indonesia, Romania and Ukraine were also under way, to support strategic, long range nuclear energy planning.

The final report on the Global Architecture of Innovative Nuclear Energy Systems Based on Thermal and Fast Reactors Including a Closed Fuel Cycle (GAINS) collaborative project, entitled *Framework for Assessing Dynamic Nuclear Energy Systems for Sustainability* (IAEA Nuclear Energy Series No. NP-T-1.14), was published in November, and its findings were presented at FR13.

A number of additional reports were also published in 2013, including a report by INPRO on *Performance Assessment of Passive Gaseous Provisions (PGAP)* (IAEA-TECDOC-1698), *Passive Safety Systems in Advanced Water Cooled Reactors (AWCRs): Case Studies* (IAEA-TECDOC-1705), *Challenges Related to the Use of Liquid Metal and Molten Salt Coolants in Advanced Reactors* (IAEA-TECDOC-1696) and *Legal and Institutional Issues of Transportable Nuclear*

[4] The members of INPRO at the end of 2013 were Algeria, Argentina, Armenia, Belarus, Belgium, Brazil, Bulgaria, Canada, Chile, China, Czech Republic, Egypt, France, Germany, India, Indonesia, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Republic of Korea, Malaysia, Morocco, Netherlands, Pakistan, Poland, Romania, Russian Federation, Slovakia, South Africa, Spain, Switzerland, Turkey, Ukraine, United States of America, Viet Nam and the European Commission.

Power Plants: A Preliminary Study (IAEA Nuclear Energy Series No. NG-T-3.5).

A training course on the evaluation of collaborative scenarios of transition to sustainable nuclear energy systems using the Agency's energy supply model MESSAGE, held in October in Yogyakarta, Indonesia, focused on modelling scenarios based on once through and closed nuclear fuel cycles viewed from the global perspective. Thirty-three participants from 12 Member States attended the course.

The sixth INPRO Dialogue Forum, held in Vienna from 29 July to 2 August and attended by 105 participants from 37 Member States, addressed licensing and safety issues for SMRs. The Forum identified key issues for SMR development and deployment, as well as additional safety requirements for consideration in the revision of Agency safety standards for SMR development and deployment. At the seventh INPRO Dialogue Forum, held in November and attended by 63 participants from 33 Member States, the results of an assessment of the sustainability of seven evolutionary reactor designs related to safety were discussed with designers from the vendor organizations performing the assessment.

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.

Nuclear Fuel Cycle Objectives

In September, the Agency published *Nuclear Fuel Cycle Objectives* (IAEA Nuclear Energy Series No. NF-O). This high level publication sets out the overarching objectives of all Agency activities related to the nuclear fuel cycle.

Uranium Production Cycle and the Environment

Accurate knowledge of uranium resources, production and demand worldwide is essential for planning the supply of uranium fuel for nuclear power plants. The next issue of the joint IAEA–OECD/NEA publication *Uranium 2014: Resources, Production and Demand*, also referred to as the 'Red Book', is expected in 2014. The Agency's public on-line databases offer current information on the topic[1].

"In September, the Agency published Nuclear Fuel Cycle Objectives…[which] sets out the overarching objectives of all Agency activities related to the nuclear fuel cycle."

Identifying and extracting uranium resources is a challenge, especially in areas that have not been previously investigated (Fig. 1). To assist Member States, the Agency organized a series of meetings and training courses throughout the year. For example, some 250 experts from 35 countries were trained in uranium geology, exploration, mining and processing in various interregional and regional courses and workshops held in Chile, the Democratic Republic of the Congo, India, Malawi, Tunisia and Zambia. A number of Technical Meetings held in Vienna attracted more than 120 participants. In August, participants in a meeting of the Uranium Mining and Remediation Exchange Group visited uranium mines, both operating and under remediation, in the Czech Republic.

FIG. 1. Excavating an evaluation trench at a uranium deposit in central Jordan.

The availability of unconventional uranium resources is a factor when estimating total uranium resources. These include uranium in seawater and uranium recoverable as a by-product of other extraction processes. Past estimates of potentially recoverable uranium associated with phosphates, non-ferrous ores, carbonatite, black schists or shales, and lignite are of the order of 10 million tonnes of uranium (Mt U). Responding to continued Member State interest in the recovery of uranium from phosphate and other mineral ores, 49 participants from 22 countries were trained at an interregional training course in Tunisia that focused on extraction of uranium from phosphoric acid in a sustainable and cost effective manner.

An Agency technical cooperation project helped Peru demonstrate that, apart from its known deposits of uranium, the country has additional geological terrains favourable to hosting deposits of uranium. The project also provided training to new staff in the geology of uranium.

Thorium has been used as a nuclear fuel on a demonstration basis, although its broader use depends on the commercial deployment of thorium fuelled reactors. Known world thorium resources are estimated to be about 6–7 Mt. At a Technical Meeting in Vienna, participants from 32 countries discussed recent advances in identifying thorium resources that could be obtained as a by-product of rare earth elements mining and processing.

[1] The on-line World Distribution of Uranium Deposits (UDEPO) and World Thorium Deposits and Resources (ThDEPO) databases can be found at: *http://infcis.iaea.org*.

UPSAT Review

Uranium Production Site Appraisal Team (UPSAT) missions are designed to assist Member States in enhancing the operational performance and safety of uranium mining across all phases of the uranium production cycle. In May, the United Republic of Tanzania, a potential 'newcomer' to uranium mining, hosted an UPSAT mission to review its exploration and mining projects. The review focused on the areas of regulatory systems, operations, safety and the environment, social licensing and capacity building. The Mkuju River mining project, one of the projects reviewed by the mission, is located in the Selous Game Reserve and is expected to be the first to start production (2014–2015) (Fig. 2). Feedback from the mission will help improve the code of practice being developed for the uranium industry and may also benefit other countries in Africa, where a number of similar projects are being planned, potentially making the region one of the leading producers of uranium in the near future. This UPSAT mission is one of the many activities implemented through the Agency's technical cooperation programme.

FIG. 2. A geologist from uranium producer Uranium One (second from the left) with UPSAT members on the Mkuju River site, United Republic of Tanzania.

Nuclear Power Reactor Fuel Engineering

The Agency assists Member States in sharing information and undertakes cooperative research on the development, design, manufacture, use and performance of nuclear fuel. Following the completion of a long-running series of CRPs on reactor fuel modelling, the Agency published *Improvement of Computer Codes Used for Fuel Behaviour Simulation (FUMEX-III)* (IAEA-TECDOC-1697), which extends the work of FUMEX-II (Fuel Modelling at Extended Burnup) to cover a wider and more ambitious range of fuel performance parameters.

Some reactor owners have expressed concern over the assurance of a long term supply of reactor fuel. One potential mitigating strategy is to use fuel from more than one supplier. However, due to differences in design and material, use of fuel from different suppliers in the same reactor core can present both technical and regulatory challenges. The Agency published *Operation and Licensing of Mixed Cores in Water Cooled Reactors* (IAEA-TECDOC-1720) to help countries address these issues.

In line with the heightened global focus on the performance of nuclear fuel under accident conditions, the Agency published *Fuel Behaviour and Modelling under Severe Transient and Loss of Coolant Accident (LOCA) Conditions* (IAEA-TECDOC-CD-1709). Capturing the current state of work on fuel behaviour under accident conditions, this publication provides the starting point for a new CRP on this subject.

Spent Fuel Management

Spent fuel storage is an interim step in the back end of the nuclear fuel cycle whose duration is dependent on national policy. For countries opting for reprocessing, the duration can be relatively short. However, countries opting for direct disposal of spent fuel need to store such fuel until geological disposal facilities become available. The first geological disposal facility is expected to be operational in 2022, and it will be several decades until such facilities are commonly available in countries with nuclear power programmes.

To ensure the safety of ongoing spent fuel storage, a good understanding of the processes that may cause deterioration of both the spent fuel and the storage system is needed. In 2013, work to increase understanding of these processes continued through the long standing CRP on Spent Fuel Performance Assessment and Research (SPAR), which held its third Technical Meeting in Busan, Republic of Korea, in November (Fig. 3).

FIG. 3. Participants in the SPAR CRP inspecting the DrySim6 dry storage simulation test equipment at the Korea Atomic Energy Research Institute. (Photograph courtesy of VUJE.)

In addition, a second CRP on Demonstrating Performance of Spent Fuel and Related Storage System Components during Very Long Term Storage (DEMO) was launched to set up a dry storage demonstration test and to address specific issues related to dry storage systems. The first Technical Meeting was held in April in Cordoba, Argentina.

In response to Member State requests, a Technical Meeting on Spent Fuel Storage Options was held in July in Vienna. Participants from 23 countries accounting for more than 90% of the world's spent fuel provided an update on the available technologies for storing spent fuel. Other activities related to spent fuel management focused on implementation of the IAEA Action Plan on Nuclear Safety. In July, the terms of reference for a Spent Fuel Management Network (SFM-Net) were developed. In addition, a new CRP on Management of Severely Damaged Spent Fuel and Corium, aimed at developing and sharing techniques for managing damaged fuel and debris such as that expected during the Fukushima remediation efforts, was approved.

Topical Advanced Fuel Cycles Issues

A major trend in nuclear energy research is the search for long term sustainability in the nuclear fuel cycle, involving the efficient utilization of resources, management of radioactive waste and proliferation resistance. One promising avenue towards such sustainability is the use of advanced nuclear fuel cycles that partition minor actinides from the spent fuel and subsequently transmute these problematic constituents into shorter lived elements. This not only enables the efficient use of resources but also reduces the volume and radiotoxicity of the final waste, mitigating the potential environmental burden. By avoiding separation of pure fissile material, these advanced processes also strengthen proliferation resistance. Many countries with large nuclear installations are exploring these processes for next generation fuel cycles. A Technical Meeting held in Vienna in November that reviewed recent developments in advanced fuel cycles, with an emphasis on recycling technologies, demonstrated the need to coordinate and integrate work being done in the various disciplines in this field.

Another key goal of advanced fuel cycles is to produce more energy from a given amount of natural uranium resources. While fast breeder reactor fuel cycles have the potential to provide a hundred times more energy from uranium resources than is obtained today, the resource utilization of fuel cycles based on thermal reactors can also be improved. Of the currently available thermal reactors, heavy water reactors provide the highest resource utilization. An Agency meeting held in April in Mumbai, India, focused on the efficient use of existing uranium fuel in pressurized heavy water reactors, structure modifications planned in fuel bundle designs and the use of advanced fuels such as thorium, slightly enriched uranium and mixed oxide fuel.

One underutilized resource is the uranium produced from reprocessing operations. An Agency meeting in November allowed participants to share their experience and to discuss interesting prospects for the near future, such as the use of reprocessed uranium in heavy water reactors after blending with depleted uranium to produce either a natural uranium equivalent or uranium with a small residual enrichment.

Capacity Building and Nuclear Knowledge Maintenance for Sustainable Energy Development

Objective

To enhance the capacity of Member States to perform their own analyses of electricity and energy system development, energy investment planning and energy–environment policy formulation and their economic implications. To sustain and effectively manage nuclear knowledge and information resources for the peaceful uses of nuclear science and technology. To support Member States interested in including nuclear energy in their national energy mixes by providing nuclear information.

Energy Modelling, Databanks and Capacity Building

The Agency's projections of global nuclear power capacity are published annually. In the 2013 projections, the low case and the high case show an increase of 17% and 94%, respectively, by 2030. The strongest projected growth is expected in regions that already have operating nuclear power plants, led by countries in Asia, including China and the Republic of Korea. Eastern Europe, including the Russian Federation, as well as the Middle East and South Asia, including India and Pakistan, also show strong growth potential. However, for the third consecutive time since the accident at the Fukushima Daiichi nuclear power plant in 2011, projected growth is lower than in the previous year. Reasons include the decision of some countries to postpone introducing, or to phase out, nuclear power, the low price of natural gas and the increasing capacities of subsidized renewable energy.

During 2013, about 600 energy analysts and planners from 72 countries were trained in the use of the Agency's analytical tools for conducting national and regional studies on future energy strategies and the role of nuclear power. Conventional face to face training was complemented by web based e-learning courses. New versions of the tools were developed and distributed to interested Member States and are currently being used in research and planning institutions in 128 countries. These tools have also been acquired by 20 international and regional organizations for use in energy projects in developing countries.

Energy–Economy–Environment (3E) Analysis

In preparation for the 19th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP19), held in November in Warsaw, the Agency published an updated and considerably extended edition of the report *Climate Change and Nuclear Power*. Summarizing the latest data and information, the report demonstrates the importance of nuclear energy in reducing emissions of carbon dioxide from the electricity sector. It looks at the impact of restricting the use of nuclear energy as part of an international or domestic climate change mitigation portfolio on the cost and the environmental effectiveness of climate protection measures. In addition, the Agency continued its contributions to the United Nations High-Level Committee on Programmes (HLCP) Working Group on Climate Change. This included a side event at COP19, at which the Agency reported on its work on climate change mitigation. At COP19, the Agency also maintained an information centre to explain the linkages between nuclear power and climate change mitigation, sustainable energy development and other related issues.

"During 2013, about 600 energy analysts and planners from 72 countries were trained in the use of the Agency's analytical tools for conducting national and regional studies on future energy strategies and the role of nuclear power."

In 2013, the Agency continued its collaboration with the Intergovernmental Panel on Climate Change (IPCC) by submitting its inputs to the final drafts of the Fifth Assessment Report (AR5), completing a four year contribution to the work of Working Groups II and III. The report is subject to government review and approval at the IPCC Plenary Sessions in 2014.

The Agency provided support to Member States in enhancing their understanding of the financing of nuclear power projects. A consultants meeting on financial risk management involved participants from ten countries, and the first Technical Meeting of a CRP on Financing Nuclear Investments attracted participants from 12 countries. Issues regarding optimal financial risk allocation in financing nuclear power plants were presented at various meetings, including the OECD Workshop on the Role of Electricity Price Stability and Long-Term Financing for Nuclear New Build held in Paris in September, and during an expert mission to Phan Rang Tháp Chàm City, Viet Nam, in September.

The Agency initiated work on developing a set of analytical tools for assessing the social and economic impacts of nuclear energy programmes, including key economic implications of building and operating nuclear power plants. In December, the Agency organized a major international workshop in Cyberjaya, Malaysia, on the macroeconomic impacts of a nuclear power programme in South East Asia. The 35 senior level participants identified lessons learned from recent national experience with quantitative tools and developed strategies to further improve quantitative analysis in South East Asia through assessment of regional impacts.

Nuclear Knowledge Management

Three knowledge management assist visits were conducted in 2013. A mission to the Malaysian Nuclear Agency ('Nuclear Malaysia', part of the Ministry of Science, Technology and Innovation (MOSTI)) to help develop its knowledge management programme and system, focusing on process oriented knowledge management, took place in Kuala Lumpur in January. In February, a mission to assess the new curricula of the nuclear engineering department of Chulalongkorn University in Bangkok, Thailand, was undertaken. A follow-up knowledge management assist visit to the Nuclear Power Production and Development Company (NPPD) of the Islamic Republic of Iran, conducted in December in Tehran, made a number of recommendations for a roadmap for the implementation of a nuclear knowledge management system.

"In 2013, an average of 46 500 INIS searches and 2600 downloads were performed each month."

In addition to the annual Joint ICTP–IAEA Nuclear Energy Management School (NEMS), held at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, NEMSs were conducted in Japan and the USA. In March, an NEMS was held at Texas A&M University (Fig. 1), the first such meeting held in the USA, and in May, an NEMS was held in Tokyo and Tokai, Japan, with the University of Tokyo. A total of 90 participants graduated from these courses. In addition, the annual ICTP–IAEA Nuclear Knowledge Management School (NKMS) took place in September in Trieste. The NEMS and NKMS provide young professionals from the nuclear sector with specific knowledge on nuclear energy matters and specialized training in implementing knowledge management programmes in nuclear organizations.

The Agency continued to support the activities of and collaboration among regional nuclear education networks, including the AFRA Network for Education in Nuclear Science and Technology (AFRA-NEST), the Asian Network for Education in Nuclear Technology (ANENT), the European Nuclear Education Network (ENEN) and the Latin American Network for Education in Nuclear Technology (LANENT). Fifty delegates from 24 African Member States gathered in Arusha, United Republic of Tanzania, in August for the first General Assembly of AFRA-NEST. Attendees included delegates of universities, research institutes and laboratories, and national atomic energy commissions, along with representatives of ANENT, ENEN, the United Kingdom's Nuclear Technology Education Consortium (NTEC) and the Agency.

FIG. 1. Participants in the Nuclear Energy Management School held at Texas A&M University.

Collecting and Disseminating Nuclear Information

Operated in collaboration with 128 Member States and 24 international organizations, the International Nuclear Information System (INIS) is the Agency's largest document database. It comprises over 3.6 million records and more than 481 000 full texts not readily available through commercial channels. The INIS Collection Search offers a single point of access to the Agency's INIS and NUCLEUS databases and the Library catalogue. In 2013, an average of 46 500 INIS searches and 2600 downloads were performed each month. Assistance and on the job training were provided to a number of national INIS centres, improving all aspects of their INIS operational capabilities. The joint *INIS/ETDE Thesaurus* was expanded and now also covers Japanese.[1]

The 'NE News' app for iPad, iPhone and Android was launched in 2013, allowing users to access newsletters, brochures and social media channels through a single portal (Fig. 2).

[1] The joint *INIS/ETDE Thesaurus*, prepared jointly with the IEA Energy Technology Data Exchange (ETDE), is available for free in Arabic, Chinese, English, French, German, Japanese, Russian and Spanish at *www.iaea.org/inis*.

The IAEA Library continued to ensure that information resources and services remain current, cost effective and easily accessible. The number of electronic journals available through the Library increased from 16 000 in 2012 to over 20 000 in 2013. More than 14 300 people visited the Library in 2013, and loans rose from 25 241 to more than 30 000. Responding to customer requests for tailored packaging of nuclear information products and services, personalized user profiles increased from 1018 to 1145; and 69 234 information packages were delivered in 2013, compared with 58 987 in 2012.

Fulfilling the Agency's mandate of fostering information exchange, membership in the International Nuclear Library Network, coordinated by the IAEA Library, grew from 42 partners in 2012 to 49 in 2013.

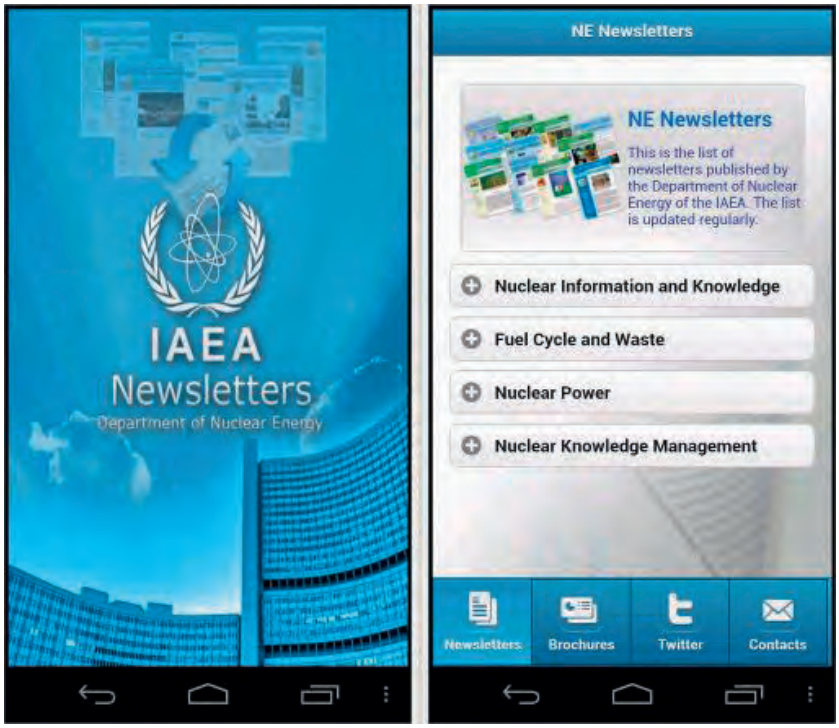


FIG. 2. The 'NE News' app, a single portal for information about the Agency's nuclear energy related activities, was launched in 2013.

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.

Atomic and Nuclear Data

Accurate and reliable nuclear, atomic and molecular data are vital for generating nuclear energy, whether by fission or fusion, as well as for other nuclear applications in essential fields such as medicine, non-destructive testing and environmental monitoring. These data are provided through on-line databases maintained by the Agency for use by its Member States. In 2013, the servers for the Nuclear Data Services web site[1] were moved to the 'cloud', ensuring increased security and cost savings.

"The number of visitors to the [Nuclear Data Services] web site averaged 22 700 per month, with about 1.2 terabytes of numerical data, reports and technical documents related to nuclear data downloaded during the year."

The number of visitors to the web site averaged 22 700 per month, with about 1.2 terabytes of numerical data, reports and technical documents related to nuclear data downloaded during the year. Parts of the data web site have been 'mirrored' in China and India to ensure greater accessibility to users in those regions.

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

LiveChart, which provides users with interactive information on nuclide properties, was developed further in 2013. For example, an enriched visual interface was added, displaying decay chains and gamma intensities. Users can access detailed graphical and tabular information by clicking on a nuclide in the chart (Fig. 1). Data on more than 4000 nuclides are taken from the Evaluated Nuclear Structure Data File (ENSDF) database maintained through the International Network of Nuclear Structure and Decay Data Evaluators (NSDD). An NSDD meeting was held in Kuwait in January to discuss technical issues concerning the compilation, evaluation and dissemination of nuclear structure and decay data. The Experimental Nuclear Reaction Data (EXFOR) database, developed by the International Network of Nuclear Reaction Data Centres (NRDC), reached a major milestone in 2013, having compiled 20 000 original experimental works.

In 2013, a free app was developed for Android tablets and smartphones. The app, called 'Isotope Browser', provides information on the nuclides in ENSDF. Since its launch in July, the app has already been downloaded more than 5000 times.

Four new CRPs were started during the year: One CRP, on material damage due to irradiation, will review the existing displacement per atom (dpa) standard and recommend a replacement. Another CRP focuses on validation of the International Reactor Dosimetry and Fusion File (IRDFF), a dosimetry library containing new reactions extending to 60 MeV. Delayed neutrons accompanying beta decay are of fundamental importance for fission applications and basic science; recent new experiments will be assessed and results incorporated into databases in a third CRP. As part of the series of CRPs studying plasma–wall interactions in fusion devices, a fourth CRP, on irradiated tungsten, will

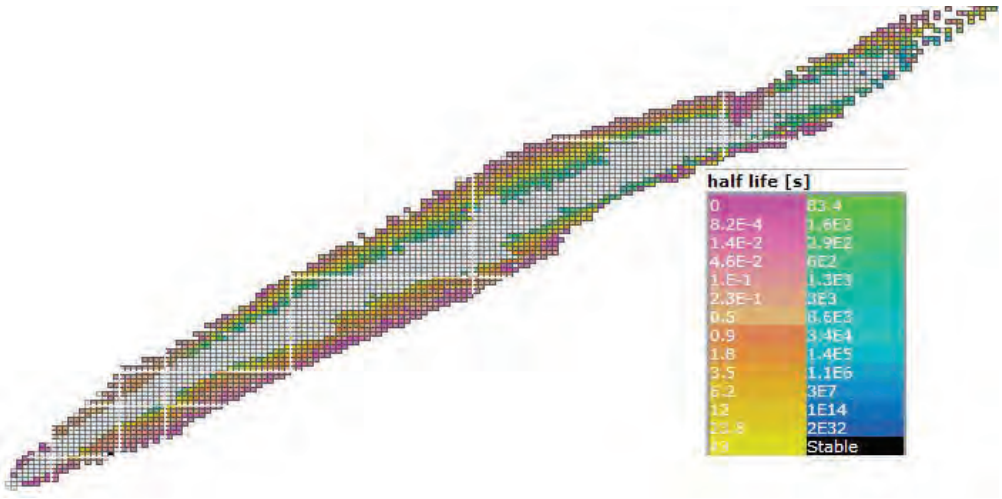


FIG. 1. A LiveChart display of nuclides: each square represents a nuclide; coloured squares represent nuclides discovered in the past 50 years; colours represent nuclide half-life values.

investigate tritium interactions with tungsten, a material important for planned fusion reactors.

The Agency held a number of meetings and workshops on nuclear data and on their application in a variety of fields, including medicine. Nuclei that decay by electron capture are a source of low energy (Auger) electrons that can be used for precisely targeted radiotherapy. An Agency meeting held in May in Vienna brought together experts to review the process and to make recommendations for further compilation of Auger data and high quality measurements. A September Workshop on Nuclear Data for Science and Technology: Medical Applications and another Workshop on Nuclear Data for Analytical Applications, held in October, both jointly organized with the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy, trained 46 participants. Biennial meetings of the International Atomic and Molecular Code Centre Network and the International Atomic and Molecular Data Centre Network held in Vienna in May and September addressed procedures for uncertainty estimates and recommended further emphasis on evaluations of collision cross-section data.

Research Reactors

Improving the utilization of research reactors

More than 30 research reactors worldwide participated in a series of proficiency tests in neutron activation analysis that began in 2010 and culminated in 2013. A majority reported improvement, with the most significant progress observed in Africa. A new series of tests will start in early 2015.

A July Workshop on Development and Implementation of Strategic Plans at Research Reactors, held in Vienna, provided feedback on strategic plan documents from more than 30 research reactor facilities worldwide. The event also provided the reactor facility managers a chance to share their experience related to strategic planning as well as the derived benefits.

Various publications on research reactor applications were issued in 2013, including *Commercial Products and Services of Research Reactors* (IAEA-TECDOC-1715) and *Applications of Research Reactors towards Research on Materials for Nuclear Fusion Technology* (IAEA-TECDOC-1724).

Research reactors in education and training

The Agency continued to support the Group Fellowship Training Programme on Research Reactors, held for the seventh time in 2013. The course, which began in September and took place in Austria and the Czech Republic, covered topics such as research reactor safety, utilization, operation and maintenance. Since it began in 2009, the programme has trained 53 students from Africa, Asia, Europe and Latin America.

A four week training workshop for the initial operating personnel of a newly constructed neutron source facility was completed in November at the Sevastopol National University of Nuclear Energy and Industry in Ukraine. The workshop served as a pilot for developing similar international training programmes.

The first demonstration of remote, Internet based reactor exercises was provided during a side event at the Agency's 57th General Conference. The audience witnessed two experiments broadcast live from a research reactor in France.

"More than 30 research reactors worldwide participated in a series of proficiency tests in neutron activation analysis that began in 2010 and culminated in 2013."

Research reactor infrastructure

The Agency's Research Reactor Database (RRDB) was linked to the Incident and Emergency Centre (IEC) information database, streamlining the IEC's capacity to more effectively communicate and provide timely assistance to research reactor centres in emergency situations. Data for 295 facilities were updated in the RRDB.

The publication *Non-HEU Production Technologies for Molybdenum-99 and Technetium-99m* (IAEA Nuclear Energy Series No. NF-T-5.4), issued in February, served as the basis for small scale medical isotope production support projects in developing countries. Fact finding missions assessing infrastructure and defining production requirements to supply national demand were conducted in Morocco, Peru, Poland and Romania.

Research reactor fuel

The Agency continued to support efforts to minimize civilian use of high enriched uranium (HEU). In 2013, the Czech Republic, Hungary and Viet Nam removed all HEU research reactor fuel from their territories through repatriation operations to the Russian Federation (Fig. 2).

A project and supply agreement (PSA) to facilitate the conversion of a research reactor in Jamaica from HEU to low enriched uranium (LEU) fuel came into force in December. The PSA secured the transfer and export of approximately 9 kg of LEU to Jamaica from the USA for the reactor's continued operation.

At the seventh meeting on lessons learned from the Russian Research Reactor Fuel Return programme, held in June in Sevastopol, Ukraine, over 70 participants from 17 countries shared their experience, contributing to future Agency activities in this area. As in the past, this experience, including identified good practices and

lessons learned, will be incorporated into future projects to optimize their implementation.

FIG. 2. Dual purpose casks (blue) procured by the Agency being loaded into TUK-145/C transport packages for the repatriation of spent HEU fuel at the KFKI Atomic Energy Research Institute research reactor site in Budapest.

"...the Agency began developing ultraportable gamma ray radiation sensors and spectrometers for use on [unmanned aerial vehicles]… . Such tools enable emergency responders and decontamination workers to rapidly survey and map medium sized areas…for radiological contamination."

Research reactor operation and maintenance

An Operation and Maintenance Assessments for Research Reactors (OMARR) mission to Pavia, Italy, was completed in March. In November, a follow-up OMARR mission was conducted to the National Institute of Standards and Technology (NIST) reactor in the USA, providing guidance on prioritizing improvements suggested by the experts participating in the mission.

A Workshop on the Implementation of Integrated Management Systems for Research Reactors was held in June in Vienna. Workshop participants shared information and lessons learned on establishing, implementing, assessing and improving management systems for operators.

Through the Agency's technical cooperation programme, and with the support of the US Department of Energy and the European Commission, the modernization of the instrumentation and control system for the WWR-SM research reactor in Uzbekistan was completed. The entire system was accepted for further routine use in July.

Accelerators for Materials Science and Analytical Applications

An International Topical Meeting on Nuclear Applications of Accelerators (AccApp'13), organized jointly by the Belgian Nuclear Research Centre (SCK•CEN), the American Nuclear Society and the Agency, was held in Bruges, Belgium, in August. At the meeting, 174 scientists from 40 countries discussed nuclear applications of particle accelerators, including the production or destruction of radionuclides.

Nuclear Instrumentation and Spectrometry

In 2013, an ultra high vacuum chamber (UHVC) facility integrating various X ray spectrometry techniques was developed at the laboratory of the Federal Institute of Physics and Technology (PTB) in Berlin, in collaboration with the Agency. The Agency installed the UHVC at a beam line at the Elettra Sincrotrone Trieste (EST) in Italy. Thanks to the Agency–EST collaboration agreement, the Agency and its Member States can utilize the new X ray fluorescence beam line 40% of the time to carry out experiments.

Unmanned aerial vehicles (UAVs) provide a low cost, remote platform that can be utilized for a range of different applications. In 2013, as part of the IAEA Action Plan on Nuclear Safety and supported by the Government of Japan, the Agency began developing ultraportable gamma ray radiation sensors and spectrometers for use on customized hexarotor and quadrotor UAVs. Such tools enable emergency responders and decontamination workers to rapidly survey and map medium sized areas (1 km × 1 km) for radiological contamination. UAVs also have other applications ranging from climate studies to crop surveys. The first UAVs were procured and initial flight tests were performed in Fukushima Prefecture, Japan, in December (Fig. 3).

Nuclear Fusion

The second workshop under the demonstration fusion power plant (DEMO) programme, held in December in Vienna, facilitated in-depth discussions among some 90 participants on areas in fusion technology key to the success of the DEMO experiment. Activities within established national roadmaps towards DEMO were presented by several Member States with strong fusion programmes.

A consultants meeting in June in Vienna enabled fusion scientists and engineers and non-proliferation

experts to share their experience with the Agency on non-proliferation aspects of magnetic confinement fusion energy. In particular, areas for enhanced R&D collaboration between the fusion community and the Agency in the area of safeguards activities were identified. In addition, the meeting concluded that it will be necessary to clarify the framework for non-proliferation verification of fusion power systems.

FIG. 3. An Aibotix X6 UAV hovering over a temporary storage site in Fukushima Prefecture in December.

Food and Agriculture

Objective

To promote and contribute to the improvement of food security and safety; and to enhance Member State capabilities in the application of nuclear techniques for sustainable agricultural development.

FAO/IAEA Agriculture and Biotechnology Laboratory

The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture (the Joint Division) has five separate laboratories. Through these facilities, the Agency — in partnership with FAO — continued to assist Member States in 2013 on cutting edge food and agricultural issues, as well as in the areas of insect pest control, plant breeding and genetics, soil and water management, and environmental protection.

"An FAO/IAEA Spreadsheet…was published…to assist managers in designing, costing, constructing, equipping and operating insect mass rearing factories of different sizes using different scenarios."

Sustainable Management of Major Insect Pests

The Neretva valley in Croatia is a major producer of citrus, but regular insecticide applications are required to control the Mediterranean fruit fly. With support from the Agency and the USA through the Peaceful Uses Initiative (PUI), the sterile insect technique (SIT) is being applied on an area-wide basis over an expanding range, effectively suppressing the pest. Compared with 2010, before SIT application, fruit infestation levels in 2013 were down by 97% and infested fruit in export shipments of mandarins was down by 93% to only 0.2%. In addition, insecticide use in the valley was reduced by 20 000 L per year, thereby protecting farmers, their families and wildlife in important wetland areas. The rejection of shipments by importing countries has declined drastically, with increased potential for selling fruit at a premium to organic markets. The project is also being used as a training location for 12 neighbouring countries.

A detailed understanding of the swarming, sexual behaviour and physiology of adult male mosquitoes is required to establish the biological and behavioural determinants of sterile male sexual competitiveness — defined as their ability to copulate with and inseminate wild females — relative to that of wild males. Implementation of methods for mosquito control, such as SIT or other genetic control approaches, requires not only colonization, mass rearing, shipping and release of male mosquitoes, but also assessment of their effective performance after release, which will affect the success of control. A CRP on the Biology of Male Mosquitoes in Relation to Genetic Control Programmes was completed, filling a critical knowledge gap in this area. The CRP created a network of researchers working on the biology and behaviour of male mosquitoes of the main mosquito vectors of malaria, dengue and chikungunya, and led to the acquisition of detailed knowledge of male pre-mating requirements, mating behaviour and mating success. A summary of the results of the CRP was published in a special issue of the journal *Acta Tropica*.

An FAO/IAEA Spreadsheet for Designing and Operation of Insect Mass Rearing Facilities was published, combining a procedures manual and an interactive spreadsheet to assist managers in designing, costing, constructing, equipping and operating insect mass rearing factories of different sizes using different scenarios. While the spreadsheet was designed using the vast experience gained from Mediterranean fruit fly mass rearing, its settings can be changed to suit any other fruit fly or insect pest.

The Joint Division developed a new DVD based tutorial in 2013 on using open source geographical information system (GIS) techniques in insect pest control programmes, which includes free GIS software. Area-wide insect pest control programmes require GIS for efficient design, implementation and analysis of entomological monitoring and pest control activities. However, many programmes can face difficulties in funding costly licences for commercial GIS software. Free open source software has made great strides in producing high quality software applications, and insect pest control programmes can now take advantage of this development.

Crop Improvement through Mutation Breeding

Member State demand for plant mutation breeding increased in 2013. The Agency was requested to irradiate a record number of plant materials for mutation induction, and this service has now been provided to over 75% of Member States. In addition, the Agency, through the Joint Division, supported the initiation of national plant mutation breeding programmes in Lesotho, Oman, Palestine, Qatar and Saudi Arabia through technical cooperation projects, irradiation services, training programmes and expert advice.

FIG. 1. Mutant wheat line resistant to Ug99 (left); wheat line susceptible to Ug99 (right).

In 2013, 18 new mutant cultivars of seven crops were officially released or pre-released to farmers in seven Member States. These include two mutant varieties of wheat in Kenya resistant to wheat black stem rust (race Ug99). The Kenyan success is part of a multinational effort coordinated through an interregional technical cooperation project on responding to the transboundary threat of wheat black stem rust (Ug99) involving 18 Member States. It is difficult to find varieties that are resistant to this devastating disease, which can cause complete crop failure if fungicides are not sprayed in time. The disease is a major concern for countries that depend on wheat for sustenance. During this project, the Agency, through the Joint Division, carried out seed irradiation to induce the desired resistance, provided individual and group training, and sought funding for additional group training on future objectives in selecting resistant mutant lines (Fig. 1).

"In 2013, 18 new mutant cultivars of seven crops were officially released or pre-released to farmers in seven Member States …. [including] two mutant varieties of wheat in Kenya resistant to wheat black stem rust (race Ug99)."

Soil and Water Management and Crop Nutrition

A new, cost effective technique for determining the stability and age of soil organic matter (SOM) pools is being evaluated at the Agency's laboratories in Seibersdorf. This evaluation is vital for assessing the impact of soil management and environmental factors on SOM dynamics, an important part of the global carbon cycle, and is key to improving climate-smart agriculture. The technique, based on measurements of the natural abundance of carbon-13, the nitrogen-15 stable isotope signature and the carbon to nitrogen ratio of the SOM fractions in agricultural soils, is less costly than the carbon-14 technique for assessing the age of SOM and its stability in different climatic and land use conditions. Soil samples with low and high SOM from long term field trials (over 15 years) from Austria, Belgium and Kenya are being analysed as part of this evaluation. The results show that the combined use of carbon-13 and nitrogen-15 is a promising approach to support decision making to enhance soil carbon sequestration in agricultural soils.

The increased focus on efficient use of water resources has led to a shift in the use of isotopic and nuclear techniques from a field approach to an area-wide approach. The Agency, through the Joint Division, and in collaboration with the Technical University of Vienna and the Austrian Federal Agency for Water Management, is evaluating the use of a cosmic ray soil moisture system for measuring area-wide soil water content to improve agricultural water management (Fig. 2). This new technology allows non-invasive, intermediate scale monitoring of soil water in an area of up to 40 hectares (ha). The evaluation is being carried out near Petzenkirchen, 80 km west of Vienna, where nearly 40 conventional soil water sensors covering an area of 60 ha of agricultural land were installed in 2013.

FIG. 2. Cosmic ray soil moisture system in Petzenkirchen, Austria.

Animal Production and Health

Animal diseases can pose significant public health threats, affecting people's lives and livelihoods. A new strain of avian influenza emerged in several provinces of China at the beginning of 2013, infecting 394 people, 123 of whom died. The outbreak was caused by a novel H7N9 strain that could not be detected using conventional influenza A tests. The Agency responded by developing, evaluating and validating diagnostic tests for the H7N9 strain, and providing technical support for their distribution to Member States. It also held two training courses in affected and at-risk areas of Asia and Europe.

"The Agency responded [to the outbreak of a new strain of avian influenza] by developing, evaluating and validating diagnostic tests for the H7N9 strain, and providing technical support for their distribution to Member States."

Another zoonotic disease, trypanosomosis, which is transmitted by tsetse flies, is one of the most devastating diseases in Africa. The Joint Division is working on a gamma irradiated vaccine. Experimental results have shown that these gamma ray attenuated trypanosomosis organisms induce protection against both homologous challenge and the development of parasitaemia. Trials for heterologous protection and the use of low virulent mutants of trypanosoma are in progress. As part of a pilot vaccine development project in Mongolia, an exceptionally strong X ray irradiator was installed in Ulaanbaatar. The instrument, capable of delivering doses of up to 7 kGy/h, will be used to develop procedures for the attenuation or inactivation of pathogens, which can be used as a vaccine to immunize animals.

Peste des petits ruminants (PPR), a virus similar to the recently eradicated rinderpest that is spreading rapidly worldwide, has been earmarked as the next virus to be eradicated. As part of this effort, the Joint Division performed molecular epidemiological studies to improve both diagnostic capabilities and the understanding of the geographical spread and disease dynamics of PPR.

Livestock biodiversity is essential for sustainable animal production in diverse agro-ecological environments and for enhancement of food security. The Agency supported Member States in implementing FAO's Global Plan of Action for Animal Genetic Resources by improving capacities in Burkina Faso, Iraq, Jordan, Myanmar, Oman, Pakistan, Yemen and Zambia through individual and group training in DNA marker based genetic characterization of indigenous livestock breeds. For example, 300 animals were evaluated in Myanmar (Fig. 3) and Zambia to characterize six indigenous cattle breeds. In addition, 194 DNA markers were developed at the Agency's laboratories to investigate parasite resistance in sheep. The parasite resistance markers are currently being tested using more than 3000 samples from animals in Argentina, Brazil, Burkina Faso, Ethiopia, Indonesia and the Islamic Republic of Iran.

Food and Environmental Protection

Technical expertise in measuring trace chemicals in food was refined and used in a new way to develop novel, cost effective food authenticity testing techniques to meet the needs of Member States. For example, isotopic measurements and metabolomics (the scientific study of the set of metabolites present within an organism, cell or tissue) can be used to combat fraud involving various food commodities important in terms of international trade, such as honey, fruit juices and dairy products. In this regard, reference materials were developed at the Agency's laboratories, in collaboration with other laboratories, and distributed to Member States.

Regional training courses on nuclear and related technologies, with an emphasis on integrated control of contaminants such as pesticides and veterinary drug residues, were held in Botswana, Colombia, Nigeria and Tunisia, and at the Agency's laboratories. The courses involved participants from Africa, Asia, Europe, and North and South America. Also in 2013, the Latin American and Caribbean Analytical Network (RALACA), a network of food control institutions, was established in the Latin America and the Caribbean region with support from the Agency. The network will be used as a model

FIG. 3. Native cattle breed sampled for DNA testing in Myanmar.

for other regions. These initiatives were both boosted by extrabudgetary funding obtained under the PUI. Activities in response to requests for direct support included a workshop on chemical residue monitoring in Faisalabad, Pakistan, as part of a national project on strengthening capabilities to monitor and control veterinary drug residues in food.

The growing use of irradiation as a phytosanitary treatment has helped producers reach markets that had been closed to them because of quarantine restrictions. The guidelines developed by the Joint Division in collaboration with Member States in the Asia and the Pacific region served as a basis for the new Regional Standard for Phytosanitary Measures (RSPM) *Approval of Irradiation Facilities*, approved by the Asia and Pacific Plant Protection Commission (APPPC) in September 2013. The same guidelines were later expanded into a manual on good food irradiation practices to be used by regulators, traders and irradiator operators in the participating countries.

Emergency Preparedness and Response

The Agency continued its efforts during the year to harmonize and optimize responses to a nuclear or radiological emergency by the food and agriculture sector. A new project focuses on the development of innovative information technology tools to link data collection, data management and geovisualization for improved decision making during nuclear or radiological emergencies to ensure food safety and the sector's rapid economic recovery. Twenty-two participants from eight countries and international organizations met at the first regional coordination meeting at the Agency's Headquarters to discuss the technology, needs and challenges, and to develop project and individual work plans.

"Regional training courses on nuclear and related technologies, with an emphasis on integrated control of contaminants such as pesticides and veterinary drug residues, were held in Botswana, Colombia, Nigeria and Tunisia, and at the Agency's laboratories."

In October 2013, the Follow-up IAEA International Mission on Remediation of Large Contaminated Areas Off-Site the Fukushima Daiichi Nuclear Power Plant, involving the Joint Division, reviewed the implementation of remediation activities and provided advice on addressing associated challenges. The team met with representatives of Japan's Ministry of the Environment and Ministry of Agriculture, Forestry and Fisheries, among others, and visited the remediation sites in Fukushima Prefecture. Good progress has been made in the remediation of affected farmland, and comprehensive implementation of food safety measures has protected

consumers and improved consumer confidence in farm produce. A comprehensive programme to monitor fresh water sources such as rivers, lakes and ponds is ongoing, including extensive monitoring of both wild and cultivated freshwater fish.

Following the events in Japan, there is renewed interest in the revision of international guideline levels for radionuclides in foods and commodities. Work undertaken in cooperation with international organizations included the dissemination and interpretation of international food safety standards, and the collation and analysis of monitoring data from Japan. Input was also provided to the Agency's ongoing review of the accident at the Fukushima Daiichi nuclear power plant, the assessment of the public and the environment by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and activities related to the IAEA Action Plan on Nuclear Safety.

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.

Quality Assurance and Metrology in Radiation Medicine

Nuclear applications in human health, predominantly in radiation medicine, constitute the single largest technical area in which Member States request support. Having in place a robust quality assurance (QA) system ensures that the technology is being used safely and effectively.

To support the implementation of QA programmes in radiation medicine in Member States, the Agency published *Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists* (IAEA Human Health Series No. 25). The book presents internationally harmonized guidelines on the roles and responsibilities of clinically qualified medical physicists as well as recommended minimum requirements for their academic education and clinical training. The publication has been endorsed by the International Organization for Medical Physics and is expected to serve as a basis for the preparation and updating of regional and national policy documents governing the medical radiation physics profession. The clinical training requirements in medical radiation physics proposed by the Agency were adopted in 2013 by the Abdus Salam International Centre for Theoretical Physics for its newly established graduate programme.

It is widely recognized that independent quality audits constitute an important part of QA programmes in radiotherapy. Although several national dosimetry audit networks exist, radiotherapy centres continue to have insufficient access to such audits. Increased availability of dosimetry audits is necessary to improve dosimetry practices in radiotherapy and to improve safety for patients undergoing radiation treatments. A Technical Meeting on Harmonizing Quality Audit in Radiotherapy and Promoting the Concept of Audit in Member States was held in December in Vienna, in conjunction with three regional technical cooperation projects. The meeting, which attracted about 100 participants from 63 Member States, focused on acquiring a better understanding of the operation of national networks for quality audits in radiotherapy and sought to strengthen interregional networking in this area. The meeting produced a list of 14 recommendations that may be used in defining best QA approaches for radiotherapy audits.

The Agency provides dosimetry services to Member States having no capabilities in this area. In 2013, the Agency calibrated 75 national dosimetry standards and carried out ten bilateral dosimetry comparisons with national reference laboratories to verify their traceability to the international measurement system. The IAEA–WHO postal dosimetry audit service checked 700 radiotherapy beams in Member States over the course of the year.

Accredited Training in Integrated Medical Imaging of Cardiovascular Diseases

To build capacity in the use of nuclear techniques for the management of cardiovascular diseases, the Agency organized an International Conference on Integrated Medical Imaging in Cardiovascular Diseases (IMIC 2013) in cooperation with 11 professional organizations. The conference, held from 30 September to 4 October in Vienna, was attended by 240 professionals from 70 countries. For the first time, IMIC participants were granted 26 European continuing medical education credits by the European Accreditation Council for Continuing Medical Education.

"In 2013, the Agency calibrated 75 national dosimetry standards and carried out ten bilateral dosimetry comparisons with national reference laboratories to verify their traceability to the international measurement system."

These credits are considered to be objective evidence of continuous professional development. The IMIC 2013 programme emphasized the importance of understanding a patient's pathology through imaging and the strategic advantages of patient tailored diagnostic, therapeutic and prognostic decision making. Appropriate interpretation of imaging and its application in cardiovascular diseases — particularly imaging of coronary artery disease and heart failure — were addressed. Special attention was given to the appropriate use and clinical applications of hybrid imaging. Other topics reviewed included anatomy, physics and radiochemistry, as well as quality, safety and reporting considerations. The conference confirmed the continuing need for capacity building efforts in cardiology and highlighted the importance of using multidisciplinary methods and accredited training to ensure quality and safe practice in this field.

FIG. 1. St John's Research Institute in Benguluru, India, an IAEA Collaborating Centre in nutrition. (Photograph courtesy of St John's Research Institute.)

Development of Standards for Paediatric Radiation Oncology for Low Income Countries

Whereas mortality among children is decreasing worldwide, deaths from cancer are on the rise. While the incidence of paediatric cancer is slightly lower in low and middle income countries (LMICs) than in high income countries (HICs), paediatric cancers make up a much higher proportion of all cancers in LMICs (3–6%) than in HICs (<1%). With proper treatment, it is possible to cure over 70% of all paediatric cancer patients. However, cure rates in LMICs are only 20–50%, creating a survival gap between HICs and LMICs. The Agency recognizes paediatric cancer as a critical issue and is working to enhance Member State capacity in paediatric radiation oncology (PRO), particularly in LMICs.

"The Agency recognizes paediatric cancer as a critical issue and is working to enhance Member State capacity in paediatric radiation oncology…"

A Technical Meeting on Paediatric Radiation Oncology: Closing the Gap, aimed at the development of PRO standards for LMICs, assessed the PRO situation worldwide and strategies to close the outcome gap between HICs and LMICs. Forty-one participants from 26 Member States prioritized problems and challenges faced by radiotherapy centres in LMICs in this area, studied treatment outcomes and adverse effects, and developed a set of recommendations on desirable standards for the practice of radiation therapy in children. For example, some of the recommendations emphasized the need to include paediatric cancers on health agendas, to enhance Member State capacity in PRO and to form partnerships between PRO centres in HICs and centres in LMICs.

Stable Isotopes for Assessing Vitamin A Interventions

Vitamin A deficiency can have tragic consequences, including blindness, illness and premature death. For this reason, WHO recommends that children between six months and five years of age living in vitamin A deficient regions of the world receive high potency vitamin A supplements every four to six months. In October, a Technical Meeting with the IAEA Collaborating Centre in nutrition at St. John's Research Institute, in Benguluru (Bangalore), India (Fig. 1), brought together international experts to discuss progress on the vitamin A labelled isotope dilution (VALID) technique. This technique provides a sensitive means of estimating the total amount of vitamin A in the body, and can be used to safely evaluate vitamin A supplementation or fortification efforts (Fig. 2). VALID can also be used to determine the amounts of vitamin A that humans require, as well as how well pro-vitamin A compounds from plant foods are converted into beneficial vitamin A in the body.

Programme of Action for Cancer Therapy (PACT)

In response to Member State demand for support in cancer control, the Agency, through its Programme of Action for Cancer Therapy (PACT), continued to assist

FIG. 2. Children participating in a study of the effectiveness of vitamin A fortified rice in northern Thailand. (Photograph courtesy of T. Pongcharoen, Mahidol University, Thailand.)

LMICs in strengthening cancer control capacity through partnerships with WHO, the International Agency for Research on Cancer, the Union for International Cancer Control and the National Cancer Institute (USA), among others, while integrating radiation medicine in a comprehensive national cancer control strategy.

In 2013, the Agency carried out comprehensive cancer control assessments, known as integrated missions of PACT (imPACT) Reviews, in 12 Member States. Conducted in collaboration with WHO, imPACT Reviews provide Member States with a situation analysis of cancer control capacity and recommend actions to establish or strengthen a national cancer control programme. To improve the quality of imPACT Review reporting, the Agency and its partners undertook an effort to review and revise guidelines utilized during imPACT Review missions. Since PACT's inception, a total of 59 Member States have received an imPACT Review.

The Virtual University for Cancer Control and Regional Training Network (VUCCnet) pilot project entered a new phase in 2013. During the year, the Agency facilitated discussions among founding Member States and agreement was reached on establishing VUCCnet as a pan-African intergovernmental organization.

The fourth meeting of the Advisory Group on Increasing Access to Radiotherapy Technology (AGaRT) in LMICs convened in Vienna in October. Group members recommended affordable, appropriate and suitable radiotherapy equipment packages for low and middle income settings, and began drafting guidelines to ensure long term functionality of equipment, including sales and servicing parameters. Once established, these equipment packages are expected to contribute to increased access to affordable and appropriate radiotherapy treatment in LMICs.

In collaboration with WHO, the Agency organized meetings in Europe and Latin America to assess regional progress and identify common challenges in cancer control among Member States. Both meetings provided participants with a platform to discuss and share practical experience in cancer control planning.

"In collaboration with WHO, the Agency organized meetings in Europe and Latin America to assess regional progress and identify common challenges in cancer control among Member States."

With the increased global focus on cancer and other non-communicable diseases (NCDs) brought about by the UN Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases, donors have continued to support actions to strengthen cancer control capacity. For example, in 2013, PACT received and accepted over €1.8 million in contributions and pledges from partner organizations and Agency Member States.

In November, the Agency participated in the World Cancer Leaders' Summit on the theme 'Closing the Cancer Divide by 2025', which highlighted the urgent

need to globally address glaring disparities in cancer control. Summit participants called for increased access to treatment and a 25% reduction of premature deaths from NCDs by 2025, a goal recently set in a World Health Assembly resolution.

Throughout 2013, the Agency continued to participate in the Global Initiative for Cancer Registry Development. This initiative seeks to increase the quality, coverage and usage of cancer registry data in LMICs and advocates the establishment of population based cancer registries in planning, monitoring and evaluation of cancer control activities. Cancer incidence information is a critical component of national planning related to radiotherapy and other radiation medicine related services.

Preparations were completed for PACT to be integrated into the Agency's technical cooperation programme as of January 2014. The move is intended to make optimum use of synergies between technical cooperation and PACT activities. PACT will continue to mobilize resources for cancer related activities and provide support to Member States for developing sustainable comprehensive cancer control systems.

Water Resources

Objective

To enable Member States to use isotope hydrology for the assessment, use and management of their water resources.

Water Resources in a Changing Climate

Seasonal snow cover is present on about a quarter of the world's land surface, at high latitudes and altitudes. Recent climate warming and changes in atmospheric circulation patterns have led to shorter snow cover seasons, reduced amounts of water stored in the snowpack and a widespread trend toward earlier spring melt and enhanced glacier melting. As part of a CRP on the Use of Environmental Isotopes in Assessing Water Resources in Snow, Glacier, and Permafrost Dominated Areas under Changing Climatic Conditions, the Agency used isotope techniques to assess the critical linkages between snow and ice systems and groundwater and surface water systems.

At the CRP's final Research Coordination Meeting held in Vienna in November, research groups from 12 Member States shared the results of their work using multiple isotope tracers to investigate the transit times of meltwater through snow and ice layers, and water to rivers and lakes. Several newly developed or more effective devices for field sampling were tested, such as a passive capillary sampler for collecting snow-meltwater at different locations within a snowpack. The results of this CRP provide insights into the causes of spatial and temporal variability of the isotopic composition of snowmelt. The sampling and data interpretation methods used in the CRP will be transferred to hydrological studies in snow dominated areas under various Agency technical cooperation projects. The CRP also resulted in a first — a dataset of isotopes in ice cores from Mount Elbrus in the Russian Federation.

'Old' groundwater — water stored in geological formations for a thousand to a million years — is an excellent archive of the nature and distribution of precipitation in past climate regimes. In early 2013, the Agency published a monograph entitled *Isotope Methods for Dating Old Groundwater*, which provides theoretical and practical information on using multiple isotope tracers for age dating groundwater. This information will contribute to greater confidence in groundwater assessments, to the development of management strategies in changing climate regimes, and to better assessments of the impact of climate change on aquifer systems.

Two new CRPs were initiated in 2013 aimed at improving isotopic methods for better understanding climate change impacts on tropical precipitation and large rivers (Fig. 1). The first CRP focuses on understanding the causes of present-day variations of isotopes in tropical

FIG. 1. Isotope measurements of river flow in the upper section of the Actopan River in Mexico. Such measurements are a key part of the data in the Agency's global networks of isotopes used for understanding climate impacts on the water cycle.

precipitation, so that isotope archives of precipitation in past climates, such as in groundwater and in carbonate deposits in caves, can be reliably interpreted. Research groups from 13 Member States will collect daily or event based precipitation samples and analyse them for stable isotopes; these data will then be compared with isotope data obtained from palaeoclimatic archives in the tropics. The isotope data will contribute to a better understanding of present-day atmospheric and climatic processes in tropical areas and will provide key basic data for isotope based palaeoclimatic reconstructions.

"In 2013, a new system to pre-concentrate low levels of natural tritium in water samples was tested for routine operation at the IAEA Isotope Hydrology Laboratory…"

The use of isotope tracers to study water and contaminant transport in low permeability rocks such as shale was reviewed at a consultants meeting held in Vienna in November. Knowledge of transport processes in such rocks is critical for characterizing the potential for groundwater pollution, as well as the potential for their use as host formations for radioactive and other hazardous waste. The meeting provided an overview of the use of isotopes to characterize solute transport through low permeability rocks, and outlined areas for future research.

The Agency also provided support, within the framework of a technical cooperation project, for the use of stable and radioactive environmental isotopes to improve management of the Valle de Leon aquifer, near the city of Leon, Mexico. The aquifer is the principal source of water supply for this large city and is crucial to the local economy. The results were shared with local water resource management authorities and are contributing to efforts to adopt sustainable water use policies.

Expanding Laboratory Access and Building Capacity for Isotope Hydrology

In 2013, a new system to pre-concentrate low levels of natural tritium in water samples was tested for routine operation at the IAEA Isotope Hydrology Laboratory (Fig. 2). Tritium is one of the fundamental isotopes used in hydrology, and this relatively inexpensive and compact system will greatly expand access to tritium analysis for Member States. The new system is being provided to interested laboratories and is expected to help increase the efficiency of Member State technical cooperation projects.

In 2013, 14 participants from nine Member States were trained in the installation and operation of laser absorption spectrographs, used for the analysis of the stable isotope composition of water samples. Sixteen trainees from five Member States participated in another training course on the use and interpretation of isotope data in hydrological investigations. In addition, an international intercomparison of tritium analysis of water samples was completed in 2013, with more than 60 laboratories taking part. The exercise helped tritium laboratories assess their overall performance and identify whether corrective actions are required to reach the expected analytical accuracy and precision. Together, these efforts have expanded the capacity of Member States to measure and interpret the isotopic composition of water samples for improved assessment and management of water resources.

FIG. 2. Development and testing of a high performance electrolytic tritium enrichment system (left, centre) for groundwater age dating were completed in 2013. A laser absorption spectrograph (right) being tested at the IAEA Isotope Hydrology Laboratory for the analysis of the carbon-13 content of dissolved carbon in water samples.

Environment

Objective

To enhance the capacity to understand marine, terrestrial and atmospheric environmental processes and identify problems caused by radioactive and non-radioactive pollutants and climate change using nuclear techniques and isotopes.

Pollutants in the Environment

Nuclear technologies are increasingly being used to monitor and to protect the environment. In 2013, the Agency, through the IAEA Environment Laboratories, finalized work on two analytical methods to assist laboratories in accurately measuring organic mercury and petroleum hydrocarbons in marine biota in the Mediterranean Sea, in the framework of the UNEP Mediterranean Action Plan's Programme for the Assessment and Control of Pollution in the Mediterranean Region (MED POL). Quality assured data on hazardous contaminants in marine samples are essential for accurately assessing pollution status and trends in the coastal marine environment to prepare action plans and measures to protect the Mediterranean Sea and ensure the sustainable delivery of ecosystem services.

Work continued on two projects supported by the Peaceful Uses Initiative, one on applications of isotopic measurements for determination of long lived radionuclides in the marine environment and the other on implementation of a comprehensive sampling and analytical methodology to determine and trace oil pollution in marine waters. The projects resulted in two publications in 2013: *Measurement and Calculation of Radon Releases from NORM Residues* (Technical Reports Series No. 474), on naturally occurring uranium and thorium; and a special issue of the *Journal of Environmental Radioactivity* on environmental remediation. The Agency also contributed to a report by the United Nations Secretary-General to the United Nations General Assembly (GA resolution A/RES/68/99) on remediation of areas affected by the Chernobyl accident.

"In 2013, the Agency…finalized work on two analytical methods to assist laboratories in accurately measuring organic mercury and petroleum hydrocarbons in marine biota in the Mediterranean Sea…"

The Agency is working with Japan to monitor the environmental impact of radioactive discharges from the affected reactors at the Fukushima Daiichi nuclear power plant. At Japan's request, and on the basis of an agreement between the Japanese Government and the Director General, the Agency sent experts to review the Japanese marine monitoring programme and procedures, and provided advice in relation to enhancing the quality of the measurements (Fig. 1). The experts' assessment confirmed the quality and credibility of the monitoring process. Fukushima University requested an Agency mission to provide advice on forest management in affected areas, and Agency staff lectured at the University

FIG. 1. Marine monitoring activities near the Fukushima Daiichi nuclear power plant.

of Tsukuba on monitoring programmes in contaminated forests and on the application of dynamic models for long term predictions of radionuclide behaviour.

"Six new reference materials were prepared in 2013: two for radionuclide analysis in seaweed and soil, two for trace element analysis in algae and marine sediment, and two for organic contaminants in marine sediment and biota."

Ecosystem Processes

The oceans play an essential role in regulating and buffering the Earth's climate through exchanges with the atmosphere. For example, about 25% of the carbon dioxide released by fossil fuels is absorbed by the oceans. A small fraction is transformed by marine phytoplankton into carbon rich particles that sink to depth and either feed deep ocean life or settle on the ocean floor. The Agency, through the IAEA Environment Laboratories in Monaco, is using natural radioisotopes to study these processes in sensitive environments such as upwelling regions and the Arctic Ocean. An international collaborative effort between the Agency and two German research institutes — the GEOMAR Helmholtz Centre for Ocean Research Kiel and the University of Kiel — that began in 2013 is aimed at better understanding tropical oceans and the carbon sedimentation and sequestration processes in low oxygen zones such as the Peruvian upwelling system. Initial results from field sampling and radioanalytical measurements were presented in October at the Latin American Congress of Marine Sciences. The results highlight the important carbon export in this highly productive region.

FIG. 2. An exhibit of the IAEA Environment Laboratories at the Scientific Forum 2013 at the 57th regular session of the General Conference.

Dissolved carbon dioxide also has the effect of increasing seawater acidity, a phenomenon known as ocean acidification (OA). OA has emerged as an issue of global concern, and a number of Agency activities are addressing the need for robust scientific information to support adaptive measures. These include: support for the Agency's Ocean Acidification International Coordination Centre (OA-ICC); a CRP on the socioeconomic impacts of OA; international workshops on the economic impacts of OA; laboratory experiments on the biological and ecological effects of OA; and specialist training in experimental radioisotope techniques.

In 2013, two Member States — Namibia and Peru — joined the CRP on Ocean Acidification and the Economic Impact on Fisheries and Coastal Society. Areas of research in the CRP include: investigation of shellfish and coral calcification using calcium-45; monitoring of pH and carbonate in coastal waters and aquaculture facilities; investigation of past ocean pH using palaeogeology; and bio-economic modelling of fisheries. The CRP aims at promoting awareness of food security, ecosystem services and livelihoods impacted by OA, and at fostering centres of knowledge in developing countries and in regions of anticipated sensitivity.

The OA-ICC is supporting biennial, multidisciplinary workshops to discuss the gap between OA impacts on ecosystem services and the associated economic costs. It has contributed to several publications, including a multilingual factsheet entitled *20 Facts about Ocean Acidification*[1]. The Agency highlighted its work on OA and the OA-ICC through outreach activities at the Scientific Forum during the 57th regular session of the Agency's General Conference in 2013 (Fig. 2), the 14th Meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (UNICPOLOS), and the 19th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP19).

Strengthening Laboratory Analyses in Member States

To assist Member States in enhancing the reliability of environmental data and to support their monitoring and research programmes, the Agency provides a range of reference materials for analysis of radionuclides, stable isotopes, trace elements and organic pollutants. Six new reference materials were prepared in 2013: two for radionuclide analysis in seaweed and soil, two for trace element analysis in algae and marine sediment, and two for organic contaminants in marine sediment and biota.

[1] Available at: *http://www.iaea.org/ocean-acidification/download/OA20Facts_Nov.pdf*.

The Agency also organizes annual proficiency tests that enable laboratories worldwide to evaluate their analytical performance. In 2013, the Agency collaborated with the UNEP Mediterranean Action Plan to test 32 laboratories in 11 Mediterranean countries on the determination of organic contaminants and trace elements in marine samples. Other activities included a proficiency test involving 31 laboratories in 24 countries that analysed seawater for strontium-90, caesium-134 and caesium-137. At the request of Japan, the analytical performance of 45 Japanese laboratories was also compared.

As part of the Agency's quality assurance strategy, the Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA), in cooperation with the Agency's Incident and Emergency Centre (IEC), formally registered ten member laboratories as national capabilities in the Agency's Response and Assistance Network (RANET) for radiological environmental emergencies. Several RANET laboratories registered for the current ALMERA proficiency test and received the samples for analysis in November 2013. In parallel, 60 ALMERA laboratories reported back analytical results from the 2013 proficiency test within 72 hours, as part of a training exercise for emergency preparedness.

Capacity Building in Member States

The Agency provides technical support to Member States through training courses and national, regional and interregional technical cooperation projects, and through preparation of methodologies and manuals. For example, scientists from Bosnia and Herzegovina, Cyprus, Egypt, Israel, Libya, Montenegro, Oman, Tunisia and Turkey were trained at the IAEA Environment Laboratories in analytical techniques for determining trace elements and organic contaminants in marine biota, and 34 participants from 30 European countries were trained in soil sampling methodologies (Fig. 3).

"…60 ALMERA laboratories reported back analytical results from the 2013 proficiency test within 72 hours, as part of a training exercise for emergency preparedness."

An Agency technical cooperation project to upgrade the National Nuclear Analytical Laboratory in Qatar provided training to local staff in environmental monitoring of the naturally occurring radionuclides industry. The training is aimed at enabling staff to assess the environmental impacts of the industry and the potential effects on human health in the region. Another technical cooperation project provided sampling equipment for the small island developing States in the Asia–Pacific region (Cook Islands, Fiji, Kiribati, Marshall Islands, Palau and the Solomon Islands) to assess the potential impact of discharges to the ocean from the Fukushima Daiichi nuclear power plant. The samples collected as part of the project were sent to the IAEA Environment Laboratories in Monaco for analysis.

FIG. 3. Training in soil sampling techniques for environmental radionuclide analysis.

Member States are continuing their efforts to mitigate and manage harmful algal blooms (HABs) to improve seafood safety. The radioligand receptor binding assay (RBA) methodology, developed by the US National Oceanic and Atmospheric Administration in collaboration with the Agency, is a cost effective and sensitive means of detecting HABs that is already in use in several Member States in the Africa, Asia–Pacific and Latin America regions. In response to continued increases in Member State interest in RBA, the Agency has expanded its activities to meet the challenges of this important environmental problem. In 2013, the RBA methodology was made operational at the IAEA Environment Laboratories and the Agency published *Detection of Harmful Algal Toxins Using the Radioligand Receptor Binding Assay: A Manual of Methods* (IAEA-TECDOC-1729). Both will improve training support to Member States in the field of HAB management and seafood safety.

Radioisotope Production and Radiation Technology

Objective

To strengthen national capabilities for producing radioisotope products and utilizing radiation technology, and contribute to improved health care and safe and clean industrial development in Member States.

Radioisotopes and Radiopharmaceuticals

The Agency works to ensure the worldwide availability of radioisotope products, such as those used for the management of cancer and other chronic diseases. In 2013, it strengthened efforts to promote alternative methods of producing important medical radionuclides, such as technetium-99m, as well as novel radionuclides such as copper-64 and alpha emitters, using cyclotron based technologies. New strategies for designing diagnostic and therapeutic radiopharmaceuticals to exploit the potential of nanostructures were also evaluated. In this context, a CRP devoted to reviewing methods for producing copper-64 was concluded in 2013. The CRP resulted in detailed procedures for the production of high specific activity copper-64 using a conventional medical cyclotron.

At a Technical Meeting on Alpha Emitting Radionuclides and Radiopharmaceuticals for Therapy, researchers discussed the current status of radiopharmaceuticals labelled with alpha emitting radionuclides. The meeting participants found that, although there were still many unresolved issues, including the chemical stability of the final radiocompound and microdosimetry calculations, current scientific and clinical studies on alpha emitting radiopharmaceuticals had the potential to open the way for new, more effective therapeutic agents against different cancers.

In vivo imaging of infection and inflammation sites remains an issue for diagnostic nuclear medicine. The ability to differentiate between sterile and bacterial inflammation is particularly important for countries in hot climates, where the rate of infectious diseases is high. To address this problem, a consultants meeting was held in Vienna in May to begin development of a CRP aimed at identifying ideal positron emission tomography (PET) and single photon emission computed tomography (SPECT) tracers for infection and inflammation imaging. The meeting included participants from Member States where the climate could add to the existing high burden of infectious disease, ensuring that the CRP's aims are in line with current needs.

Applying good manufacturing practice principles and maintaining appropriate levels of quality are important aspects of the production of radiopharmaceuticals. The Agency, WHO and the European Directorate for the Quality of Medicines and Health Care collaborated on a revision of *The International Pharmacopeia* (Ph. Int.), with a view to updating the general monograph and preparing monographs for individual radiopharmaceuticals. In 2013, the adopted texts were published by WHO in the fourth edition of the Ph. Int. The revised monograph provides Member States with a tool for ensuring appropriate handling of radiopharmaceuticals in conformity with widely accepted international standards (Fig. 1).

> *"In 2013, [the Agency] strengthened efforts to promote alternative methods of producing important medical radionuclides…using cyclotron based technologies."*

The Agency continued its support of on-line education in radiopharmacy. Participants in a consultants meeting held in April in Vienna developed a syllabus for training technologists and radiopharmacists. Development of a collaborative e-learning programme also began, with the involvement of universities in a number of Member States.

FIG. 1. Good manufacturing practice is a basic requirement in radiopharmaceutical work, both at the manufacturing level and in hospital radiopharmacy.

FIG. 2. Electron beam treatment of industrial wastewater to make it safer for disposal. (Photograph courtesy of EBTech.)

Participating universities will be able to issue appropriate (diploma or master's level) training completion certificates after theoretical and practical evaluation of the candidates.

Radiation Technology Applications

The Agency's activities have long focused on supporting Member States in adopting radiation based technologies for industrial development and environmental remediation. In 2013, a Technical Meeting on Radiation Treatment of Pollutants, Wastewater and Sludges was organized with the active participation of UNIDO, research and development institutions and industry. The meeting focused on assessing the current status of radiation technology applications for environmental remediation, particularly in the field of biosolids and wastewater management (Fig. 2). A scientific research gap analysis was conducted to formulate a strategy for the future implementation of this project. The meeting found that current shortfalls in the removal or destruction of chemicals of concern by conventional treatment processes could be addressed through radiation treatment in the future, as these chemicals have been shown to be easily degraded by radiation. It was also concluded that evidence on the reliable operation of radiation facilities for the treatment of wastewaters should help to overcome current misperceptions concerning the reliability of radiation technology based processing and lead to the further adoption of the technology.

In 2013, a consultants meeting on networking of users of electron beam facilities and the role of the IAEA Collaborating Centres was held at the Institute of Nuclear Chemistry and Technology in Warsaw. Participants identified areas where cooperation could be enhanced, as well as additional pathways for more effective and efficient implementation of radiation technologies in Member States. The meeting's discussions laid the groundwork for the creation of an Agency web module containing timely and qualified information on implementing quality management protocols at radiation facilities and communicating specific training requirements for radiation processing specialists.

Radiation processing technologies have enabled a number of 'green' production processes for advanced materials development. Considerable success has also been achieved in modifying non-toxic, renewable, readily available natural polymers by radiation processing. In 2013, a Technical Meeting was organized to review recent developments, and to revisit global, regional and national initiatives for preparing natural polymer based products for agricultural applications. The participants concluded that the Agency's support, through its regional courses organized under technical cooperation projects and CRPs, has provided tools for knowledge transfer and information exchange, and for developing general concepts and practical solutions. The Agency has also provided tools, guidance and protocols for the determination of basic physicochemical properties of bio-resourced polymers, and organized interlaboratory studies to test relevant analytical competence.

To assist Member States in the development of radiation technology for industrial processes and to ensure its sustainability, four consultants meetings were held in Vienna in 2013. The first meeting was to

establish the current status of, and to evaluate future trends in, nuclear techniques (radiotracers, sealed sources, nucleonic measurement and control systems) for industrial applications. The second meeting was on radiation protection, safety and regulatory aspects of radiotracer and nucleonic gauge applications. Participants began work on a guidebook on good practices, with the objective being to prepare an IAEA safety standard on the topic. During the third meeting, on neutron generators for radiotracer applications, experts evaluated the possibility of on-site production of radionuclides with short half-lives, to be used as radiotracers, as well as the replacement of neutron sources in nucleonic measurement systems. The fourth meeting dealt with the establishment of a training and certification system for radiotracers and nucleonic control system applications.

Nuclear Safety and Security

Incident and Emergency Preparedness and Response

Objective

To maintain and enhance effective and compatible Agency, national, regional and international emergency preparedness and response (EPR) capabilities and arrangements for early warning and timely response to nuclear or radiological incidents and emergencies independent of whether they arise from an accident, negligence or malicious act. To improve the provision and sharing of information on radiation incidents and emergencies among States, international organizations and the public/media.

Safety Standards and Guidelines

As part of its efforts to continue improving emergency preparedness and response (EPR) arrangements and capabilities in Member States, the Agency is developing comprehensive international standards, guidance and tools. In 2013, it published *Actions to Protect the Public in an Emergency due to Severe Conditions at a Light Water Reactor* (EPR-NPP Public Protective Actions 2013), part of the Agency's Emergency Preparedness and Response series. The publication outlines the actions necessary to protect the public in the event of an emergency at a light water reactor, including an emergency involving spent fuel. It provides a basis for developing, at the preparedness stage, the tools and criteria that would be needed to take protective and other actions in response to such an emergency.

The Agency also published the *IAEA Report on Preparedness and Response for a Nuclear or Radiological Emergency in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant*,[1] part of a series of International Experts Meeting reports. The publication highlights lessons learned and identifies the main actions needed for improved emergency preparedness and response at all levels, drawing on information from and the discussions and conclusions of various Agency meetings on emergency preparedness and response, and on Agency activities undertaken since the accident in 2011.

Communication with Member States

To improve reporting and information sharing, the Agency develops relevant guidance and makes it available in a number of the Agency's official languages. It also provides experts in Member States with information on the strategy, criteria and practical steps involved in reporting nuclear or radiological incidents and emergencies. To this end, the *Operations Manual for Incident and Emergency Communication* (EPR-IEComm 2012) was translated into Chinese, French and Russian, and made available to contact points for nuclear or radiological incidents and emergencies. The Agency also conducted exercises to test communication channels and parts or all of the international response procedures.

The Agency enhanced the usability of its secure Unified System for Information Exchange in Incidents and Emergencies (USIE) web site for reporting nuclear or radiological incidents and emergencies. It also improved features such as those for alerts and alert confirmations. Enhancements were also made to the International Radiological Information Exchange (IRIX) standard data set and data format for the exchange of information during nuclear or radiological incidents and emergencies. This standard provides web server to web server interfaces for importing and exporting information and data relevant in an emergency.

"In 2013, the Agency was directly informed of, or indirectly became aware of, 219 events involving or suspected to involve ionizing radiation…"

Response to Events

In 2013, the Agency was directly informed of, or indirectly became aware of, 219 events involving or suspected to involve ionizing radiation (Fig. 1). It took response actions in 51 of these events and offered good offices in 18 events — ten of which were in relation to events triggered by earthquakes and tsunamis — and delivered two assistance missions.

Response and Assistance Network

A Response and Assistance Network (RANET) Technical Meeting was held in Vienna to finalize *IAEA Response and Assistance Network* (EPR-RANET 2013), one of the EPR publications issued by the Agency in 2013. This publication contains changes reflecting recent developments in RANET, including: the addition of a new functional area to address on-site assistance and advice following an emergency at a nuclear installation; modifications to the concept of operations that build on and streamline the version

[1] Available at: *http://www.iaea.org/newscenter/focus/actionplan/reports/preparedness0913.pdf*.

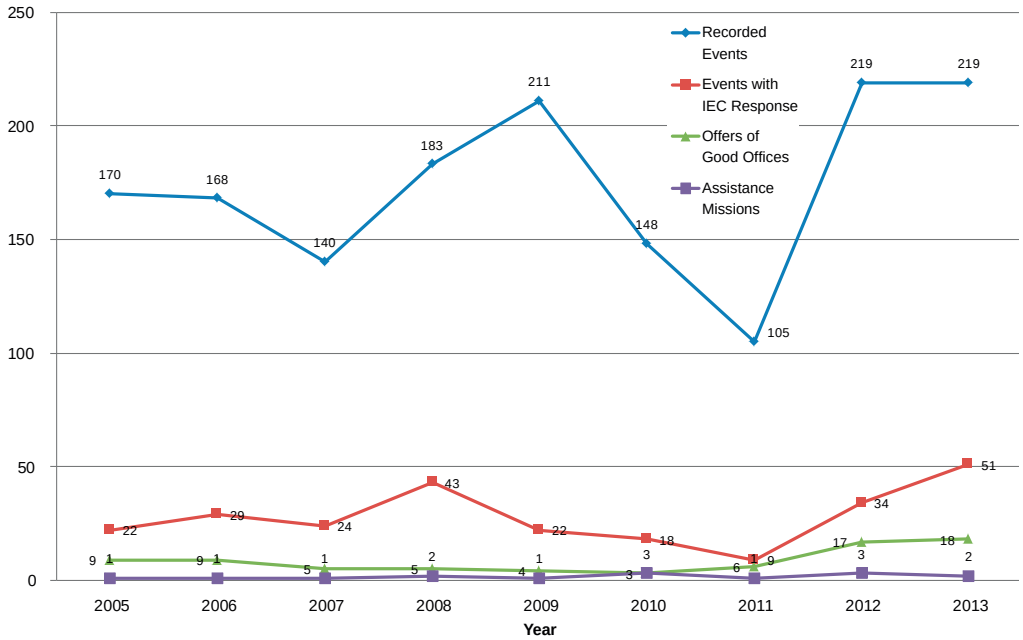


FIG. 1. Number of radiation events the Agency became aware of, and Agency responses, since 2005.

in EPR-RANET 2010; a description of the review of RANET national assistance capabilities, elaborating concepts introduced in EPR-RANET 2010; changes to the registration form to reflect recent developments in RANET; and inclusion of task lists to support assistance mission leaders. A RANET database containing information about the national assistance capabilities registered by Member States was also developed and made available on the USIE web site.

"In 2013, a process for assessment and prognosis in response to an emergency at a nuclear power plant was developed and reported to the Board of Governors."

In-house Preparedness and Response

The IAEA Action Plan on Nuclear Safety (the Action Plan) expanded the Secretariat's response role in an emergency at a nuclear power plant to cover the need "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, including analysis of available information and prognosis of possible scenarios based on evidence, scientific knowledge and the capabilities of Member States." In 2013, a process for assessment and prognosis in response to an emergency at a nuclear power plant was developed and reported to the Board of Governors. In developing this process, constraints and limitations were identified, tools for assessment and prognosis were set up, Agency staff were trained, and discussions were initiated with Member States on the minimum required set of data and parameters for assessment and prognosis.

Compliance with Current Standards

In accordance with the Action Plan, the Agency continued to assist Member States by appraising national EPR arrangements through Emergency Preparedness Review (EPREV) missions, and by reviewing the effectiveness of regulatory processes associated with EPR through Integrated Regulatory Review Service (IRRS) missions. In 2013, an EPREV mission was conducted to Jordan, and two EPREV preparatory missions were conducted, to Kuwait and South Africa. The effectiveness of the regulatory processes in relation to EPR was assessed in IRRS missions to Belgium, Bulgaria, the Czech Republic, Poland and the Russian Federation. In addition, the Agency conducted four expert missions — to Indonesia, Nicaragua, Thailand and Tunisia — to assist in assessing national EPR arrangements or testing EPR capabilities through exercises.

As part of its efforts to improve the quality of its appraisal services, the Agency initiated a review of the effectiveness of appraisals in the EPR area. In 2013, the Agency conducted a series of meetings and workshops to discuss improvements in the quality of EPREV missions. The EPREV Guidelines were enhanced and strengthened, leading to more focused and detailed recommendations. The EPR module of the IRRS was also modified to focus on the comprehensiveness of the EPR regulations and the effectiveness of the verification processes of regulatory bodies.

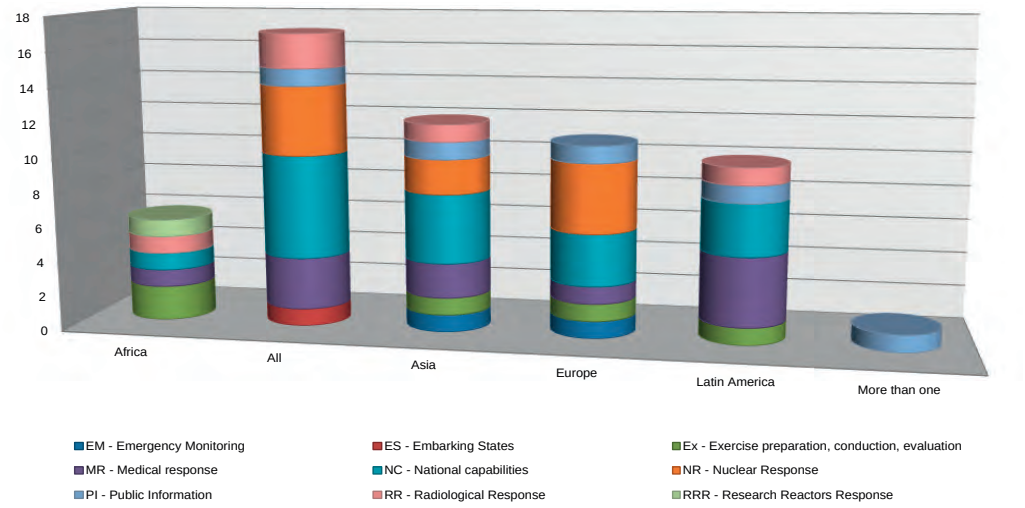


FIG. 2. EPR training events by region in 2013.

Capacity Building in Member States

To help Member States build EPR capacity, the Agency provides state of the art training at the interregional, regional and national levels, and is establishing regional EPR capacity building centres, with several centres per region, each focusing on a specific area (or areas) of specialization in EPR. In 2013, it conducted 58 EPR training events, covering all major areas, including medical aspects, public communications, preparedness for and response to nuclear or radiological emergencies, biodosimetry, first response and consequence assessment (Fig. 2). Several train the trainers sessions were also held, reflecting the growing focus on the long term sustainability of training programmes.

Inter-Agency Coordination

The Regular Meeting of the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE) in May 2013 endorsed the *Joint Radiation Emergency Management Plan of the International Organizations* (JPLAN), which was published by the Agency as EPR-JPLAN 2013.

The ConvEx-3 (2013) exercise, held in November and hosted by Morocco, was designed to allow Member States and international organizations to evaluate their response to a severe radiological emergency triggered by a nuclear security event and to identify EPR areas requiring improvement. Fifty-nine Member States, including Morocco, and ten international organizations, including the Agency, participated in the exercise, which lasted approximately 25 hours (Fig. 3). Twenty-four Member States and six international organizations tested their EPR arrangements and capability to respond to this type of event. The participation of relevant international organizations (including INTERPOL and Europol) contributed to the harmonized international response and the provision of consistent public information. Effective cooperation with the Moroccan Government in preparing, conducting and evaluating the exercise contributed to the improvement of emergency preparedness to respond to radiological emergencies worldwide.

FIG. 3. The Director General (centre, wearing orange vest) and members of his senior management team at the ConvEx3 (2013) exercise.

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 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.

Nuclear Safety Infrastructure

The Agency continued to assist Member States in their efforts to strengthen the governmental, legal and regulatory framework for safety through Integrated Regulatory Review Service (IRRS) missions. In 2013, the Agency conducted four IRRS missions — to Belgium, Bulgaria, the Czech Republic and Poland — and two IRRS follow-up missions — to the Russian Federation and the United Kingdom. To enhance the effectiveness and efficiency of the IRRS programme and missions, a number of improvements were made in 2013. For example, the revised *Integrated Regulatory Review Service (IRRS) Guidelines for the Preparation and Conduct of IRRS Missions*, a manual to assist IRRS reviewers, was published and a training course was held for potential IRRS reviewers, to ensure review consistency and quality.

"The Agency conducted over 40 workshops and training courses on regulatory topics for countries with nuclear power programmes and countries at different stages of programme development…"

The Agency organized the International Conference on Effective Nuclear Regulatory Systems: Transforming Experience into Regulatory Improvements, held in April in Ottawa, Canada. The purpose of the conference was to assess regulatory improvement efforts since the previous conference, held in Cape Town in 2009, and since the accident at the Fukushima Daiichi nuclear power plant in 2011. Senior regulators identified several areas for improvement — including ways that regulatory experience is collected, analysed and shared — and called for increased use of IRRS and IRRS follow-up missions by Member States.

The Agency's *Strategic Approach to Education and Training in Nuclear Safety for the Period 2013–2020* was developed in consultation with the Steering Committee on Competence of Human Resources for Regulatory Bodies. The approach supports capacity building and provides a framework for integrating education and training efforts, effectively strengthening the implementation of national and regional training strategies for nuclear safety.

The Agency continued to support Member States in assessing their capacity needs through the deployment of self-assessment tools such as the Guidelines for Systematic Assessment of Regulatory Competence Needs (SARCoN) and the Integrated Review of Infrastructure for Safety (IRIS), which was finalized and made available on-line in 2013.[1] The Agency conducted over 40 workshops and training courses on regulatory topics for countries with nuclear power programmes and countries at different stages of programme development — including Armenia, Bulgaria, Indonesia, the Islamic Republic of Iran, Jordan, Lithuania, Malaysia, the Netherlands, Nigeria, the Philippines, Poland, Thailand, Turkey and Viet Nam — as well as for Africa, the Asia–Pacific region and Europe.

Using the Agency's safety standards as a basis, the Regulatory Cooperation Forum (RCF) helps Member States to develop effectively independent and robust regulators of nuclear power, and promotes international cooperation and collaboration. The forum is open to all Agency Member States and to certain organizations such as the European Commission and the OECD/NEA. In 2013, the RCF expanded its membership to include Bangladesh and Kenya. During the year, it continued to support activities for building regulatory infrastructure and capacity building to develop competent regulatory bodies in Jordan and Viet Nam.

Convention on Nuclear Safety

The Convention on Nuclear Safety (CNS) is a legally binding international instrument whose objective is to achieve and maintain a high level of nuclear safety worldwide through the sharing of information related to nuclear installations. Its Contracting Parties commit to submitting national reports on the measures they have taken to implement each of the obligations of the CNS for peer review at periodic meetings during country group sessions. Oman became a Contracting Party to the CNS in 2013, increasing the membership to 76 Contracting Parties.

The Contracting Parties to the CNS, during their 2nd Extraordinary Meeting in August 2012, established a Working Group on Effectiveness and Transparency with the task of reporting to the 6th Review Meeting of the Contracting Parties to the CNS, to be held in Vienna from 24 March to 4 April 2014, on a list of actions to strengthen the CNS and on proposals to amend, where

[1] Available at: *http://www-ns.iaea.org/tech-areas/regulatory-infrastructure/iris-tool.asp.*

necessary, the Convention. Four meetings of the Working Group were held in 2013. Fourteen areas to improve the effectiveness and transparency of the CNS were identified and corresponding working papers were developed for each area. During the last meeting of the Working Group, in November, a final report was adopted, which included, inter alia, a list of actions to strengthen the convention.

Safety Assessment of Nuclear Installations

The Design and Safety Assessment Review Service (DSARS) is a modular service based on the Agency's safety standards whose objective is to review plant design safety. In 2013, the Agency reviewed improvements made by the Netherlands to their national nuclear power reactor safety requirements in the light of the Fukushima Daiichi accident in 2011. During the year, the IPSART (International Probabilistic Safety Assessment Review Team) module of DSARS was conducted in Bulgaria and the Netherlands, and the RAMP (Review of Accident Management Programmes) module was conducted in Mexico.

In addition, the IPSART module was expanded to include accidents caused by extreme natural events. The fault sequence analysis method, including the Fault Sequence Tool for Extreme Events (FAST-EE), was added to help Member States evaluate the robustness of their plants in the face of such an event. The Agency also completed two DSARS Generic Reactor Safety Review (GRSR) modules, one for the Russian Federation's AES 2006 design and one for China's ACPR1000+ conceptual design. The GRSR provides design reviews of new nuclear power reactors based on the Agency's safety standards.

The International Conference on Topical Issues in Nuclear Installation Safety: Defence in Depth — Advances and Challenges for Nuclear Installation Safety, held in Vienna in October, focused on how lessons learned from operating experience and recent events have been used to enhance safety. The implementation of the defence in depth approach covers a number of elements related to the different states and life cycle phases of a nuclear installation. The meeting emphasized that improvement in its implementation at all life cycle phases is still needed.

As part of its support of countries embarking on a nuclear programme, the Agency updated its training materials on nuclear safety assessment. Additionally, more than 50 training sessions and workshops were conducted to build safety assessment competencies.

Site Safety and Design against Internal and External Hazards

In establishing a nuclear safety infrastructure, countries initiating a nuclear programme often face difficulties developing the necessary regulations for site safety. In this regard, the Agency conducted a workshop for the staff of Bangladesh's regulatory authority.

Support in assessing site and design safety capacity building needs was provided to countries with nuclear power programmes — Romania and South Africa — and to countries at different stages of programme development — Jordan, Poland, Sri Lanka and Turkey — as well as for the Asia–Pacific region and Latin America.

Different modules of the Site and External Events Design (SEED) service are tailored to address capacity building needs but may also be used to carry out an integrated review of compliance with the Agency's safety standards and guidance. In 2013, two Preparatory-SEED missions were conducted, to Indonesia and Viet Nam, defining the scope of a future review. SEED missions were conducted to the Czech Republic in March and to Jordan in July, and for the proposed LEU bank in Kazakhstan in April.

Operational Safety and Experience Feedback

The Agency conducted its first Operational Safety Review Team (OSART) peer review mission in 1983 at the Kori nuclear power plant in the Republic of Korea. Since then, it has conducted more than 170 OSART missions in over 30 countries at more than 100 sites. In 2013, OSART returned to the Republic of Korea to hold a Technical Meeting to discuss improvements for preparing and conducting OSART missions, and to discuss safety culture tools for use by regulators and licensees.

In 2013, the Agency conducted an OSART mission to the Chooz nuclear power plant in France, where a number of good safety practices were identified. Additionally, seven OSART follow-up missions were conducted — to Armenia, China, the Czech Republic, France, the Russian Federation, South Africa and the United States of America (Fig. 1). Follow-up missions provide an independent assessment of progress made in the resolution of issues identified in initial OSART missions.

The first ever 'corporate' safety review was conducted at the ČEZ national electricity company in the Czech

FIG. 1. An Agency reviewer in an OSART follow-up mission assessing the functionality of an essential service water pump at the Gravelines nuclear power plant in France.

Republic. Corporate OSART missions cover aspects related to corporate management, independent oversight, human resources, communication, maintenance, technical support and procurement. At ČEZ, the OSART team identified good corporate practices and discussed improvements to the corporate processes and performance important to operational safety.

"Corporate OSART missions cover aspects related to corporate management, independent oversight, human resources, communication, maintenance, technical support and procurement."

The International Experts Meeting on Human and Organizational Factors in Nuclear Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant, held in May in Vienna, discussed a systemic approach to safety. Experts addressed safety culture and its relation to broader factors, and discussed regulatory oversight and the need to assess the safety culture of regulatory bodies themselves. These topics, among others, were discussed at a safety culture workshop for senior management of the Tokyo Electric Power Company, conducted by the Agency in Tokyo in October. Also in 2013, the Latin American Safety Culture Network (LASCN), a web based platform facilitating knowledge sharing among operators in the Latin American region and in Spain, was finalized.

The Agency conducted Safety Aspects of Long Term Operation of Water Moderated Reactors Peer Review Service (SALTO) missions to Armenia and Brazil, and one follow-up mission to Hungary. Additionally, the first phase of the International Generic Ageing Lessons Learned (IGALL) project was concluded. The efforts of Member States to collect knowledge and data on ageing management programmes for nuclear power plants continued during 2013 and will be reflected in two forthcoming publications.

Safety of Research Reactor and Fuel Cycle Facilities

Agency efforts to enhance research reactor safety included a regional meeting in Indonesia on the application of the Code of Conduct on the Safety of Research Reactors and three Technical Meetings on ageing management, safety performance indicators of research reactors under project and supply agreements, and operating experience feedback. Following feedback from lessons learned from the Fukushima Daiichi accident, the Agency conducted six workshops on safety reassessment, the management system, operational safety, radiation protection programmes, the interface between safety and security, and new research reactor projects. In total, more than 500 participants from 52 Member States currently operating or planning to build research reactors participated in these activities.

To improve knowledge and enhance networking, the Agency supported the establishment of a Regional Advisory Safety Committee for Research Reactors in Asia and the Pacific and held annual meetings of similar committees in Africa and Europe. Publications

FIG. 2. IRR-1 reactor operating staff in Israel briefing the INSARR team.

provided guidance on safety enhancements in the application of management systems for research reactor operating organizations, safety reassessments following feedback from the lessons learned from the Fukushima Daiichi accident and the bidding process for new research reactors.

In 2013, a Pre-INSARR (Integrated Safety Assessment of Research Reactors) mission was conducted to Poland; INSARR missions were conducted to Israel, Italy and South Africa (Fig. 2); and an INSARR follow-up mission was conducted to Romania. Safety missions for research reactors were also conducted to Bangladesh, Congo, Egypt, Ghana, Indonesia, the Islamic Republic of Iran, Jordan, Morocco, Thailand and Uzbekistan. These missions provided guidance and recommendations for safety improvements concerning regulatory supervision, safety analysis, operating procedures, ageing, radiological safety and decommissioning planning.

Radiation and Transport Safety

Objective

To achieve global harmonization of the development and application of the Agency's radiation and transport safety standards. To increase the safety and security of radiation sources and thereby raise the levels of protection of people, including Agency staff, against the harmful effects of radiation exposure.

Radiation Protection Issues in the Control of Foodstuffs and Drinking Water

The application of harmonized standards for the control of foodstuffs and drinking water contaminated as a result of a nuclear or radiological emergency was an issue of concern after the accident at the Fukushima Daiichi nuclear power plant in 2011. The Agency established a working group of international organizations to review the current international standards in order to identify any gaps or inconsistencies in these standards and to make recommendations on how they might be addressed. Participants in the working group, which met in Vienna in May and October, include the European Commission, FAO, the OECD/NEA and WHO, with the International Commission on Radiological Protection (ICRP) participating as an observer. In 2013, the working group focused on documenting the various existing standards for foodstuffs, issued by international organizations, as well as the basis on which they were derived and the circumstances in which they are intended to be used, with a view to facilitating the harmonization of these standards.

"The Agency also established the Smart Card/SmartRadTrack project to develop methods to track the radiation exposure of patients."

Radiation Protection of Patients

Cumulative radiation exposure is an important concern for patients and health care professionals. In recent years, individual patient exposure from radiological procedures using ionizing radiation (including procedures for children) has been increasing. In part, this increase is due to multiple procedures resulting in substantial cumulative effective doses. In this regard, the Agency held a Technical Meeting on Justification of Medical Exposure and the Use of Appropriateness Criteria, in Vienna in March. The Agency also established the Smart Card/SmartRadTrack project to develop methods to track the radiation exposure of patients. At a Technical Meeting on Patient Radiation Exposure Tracking: Progress Assessment and Development of Further Actions, held in Vienna in September, ten steps for advancing individual exposure tracking (i.e. a history of the radiological examinations a patient has undergone) and patient dose tracking in Member States were identified. A number of the steps involve developing consensus — for example, on the naming of radiological examinations, and on dose metrics and methods for determining cumulative risk. Others involve using the data as a basis for improvements in radiation protection, and developing training materials on patient exposure and dose tracking as well as strategies to educate patients and other stakeholders[1].

Occupational Radiation Protection

The Agency and OECD/NEA jointly operate the Information System on Occupational Exposure (ISOE) to enhance the radiation protection of workers at nuclear power plants worldwide. In 2013, the Agency helped to strengthen the work of the ISOE Technical Centre by participating in meetings of the ISOE Bureau and providing support to participating Member States. In August, the Agency supported the ISOE International ALARA symposium, held in Tokyo. More than 100 experts from over 30 Member States exchanged occupational radiation protection experience at the symposium. Occupational radiation protection achievements and regulatory experience from utilities and regulatory and governmental bodies were presented. The radiation protection situation in Fukushima was reported on, as were a number of potential developments in radiation protection. For example, colloid filters used in a nuclear power plant in the USA were found to reduce the source term in the plant, and a newly developed gamma imaging system with spectrum function was introduced which promises to be useful for radiation protection in the areas of nuclear security and safeguards.

The Agency assisted the China Institute of Atomic Energy and Nuclear and Radiation Safety Centre in organizing the Seventh International Symposium on Naturally Occurring Radioactive Material — NORM VII, held in Beijing in April. The symposium attracted nearly 150 participants from 32 countries and international organizations. It highlighted several challenges in managing exposure to NORM, including those related to implementing the graded approach to regulation, assessment of occupational and public exposures, residue management, remediation of legacy sites, communication and involvement of interested parties.

The Information System on Uranium Mining Exposure (UMEX) was initiated in 2013. As a first step, a survey of occupational exposures in the uranium mining and

[1] See: *https://rpop.iaea.org/*.

processing industry was carried out, covering nearly 90% of the uranium mining industry worldwide.

The Agency's Occupational Radiation Protection Appraisal Service (ORPAS) focuses on end users and service providers, and operates upon the request of Member States. Three ORPAS pre-mission visits, to Peru, the United Republic of Tanzania and Venezuela, were carried out in 2013. The missions identified areas of focus for the full scope missions, practices where occupational radiation protection is to be implemented, and the scope for improvement of occupational radiation protection in accordance with the Agency's safety standards.

Regulatory Infrastructure

The Agency organized several regional training courses for regulators on the authorization and inspection of radiation sources and national self-assessment seminars. Development began on new training materials and guidance on authorization and inspection of uranium mining and milling activities, authorization of proton therapy facilities, and the organization, management and competence of regulatory bodies. To provide assistance to Member States in drafting radiation safety regulations, the Agency holds schools for nuclear experts from both the technical and the legal areas. In 2013, schools were held in Asia in January, with participants from 11 Member States, and in Africa in December, with participants from nine Member States.

More than 300 participants from nearly 90 Member States and six international organizations attended the International Conference on the Safety and Security of Radioactive Sources: Maintaining the Continuous Global Control of Sources throughout their Life Cycle, held in Abu Dhabi in October. Participants reviewed current successes and challenges in ensuring the safety and security of radioactive sources, and identified means of maintaining the highest possible levels of safety and security from manufacture to disposal. Among the topics discussed were ways of better controlling the movement of radioactive sources throughout the world, including import and export controls, and the return and repatriation of disused sources, as well as global industry practices and trends with regard to the design, use, recycling and disposal of radioactive sources.

The third open-ended meeting of technical and legal experts on the development of a Metal Recycling Code of Conduct was held in February. Representatives of 55 Member States, one non-Member State and the European Union, and seven observers from the metal recycling industry, attended the meeting. The General Conference, in resolution GC(57)/RES/9, did not address the future development of such a code of conduct, but instead encouraged the Secretariat to make the results of the discussions conducted on this issue available to Member States in a Technical Document.

Transport Safety

Under the framework of a regional project for Africa on Strengthening Effective Compliance Assurance for the Transport of Radioactive Material, 20 countries completed the Self-Assessment of Regulatory Infrastructure for Safety (SARIS) questionnaire on transport in 2013. Corresponding peer review meetings are being held to validate national responses regarding the application of transport regulations. SARIS is an electronic tool provided to Member States as part of the Agency's self-assessment methodologies. It incorporates questions designed to address aspects of regulatory infrastructure related to both compliance and performance, and references the associated Agency Safety Requirements and Safety Guides. Carrying out a SARIS is both preparation for, and a prerequisite to, an IRRS mission.

"The Agency organized several regional training courses for regulators on the authorization and inspection of radiation sources and national self-assessment seminars."

As part of a technical cooperation project, the Agency held a course in Beijing on Compliance Assurance for Safe Transport of Radioactive Material. Participants from ten Member States in the Asia–Pacific region attended the one week course and received guidance on applying the *Regulations for the Safe Transport of Radioactive Material: 2012 Edition* (the Transport Regulations) (IAEA Safety Standards Series No. SSR-6) in their respective countries.

A second workshop, on Licensing and Safety Assessment of Dual Purpose Casks and Safety Assessment of Type B(U) Packages, was held at the request of Pakistan (Fig. 1). This was the second such workshop held for Pakistan at their request.

The Working Group on Best Practice Guidelines 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, chaired by Norway, provided their report to the delegates of the 57th General Conference.

FIG. 1. Transport packages for radiation sources under preparation.

Education and Training in Radiation Safety

The Agency continued to offer its postgraduate educational course (PGEC) in Radiation Protection and the Safety of Radiation Sources. In 2013, this half-year course was offered in Algeria, Argentina, Belarus, Ghana, Malaysia and Morocco.

The Agency provided Member States with support and guidance aimed at building sustainable competence through the establishment of national strategies for education and training in radiation, transport and waste safety. Regional workshops were organized in Africa (in Ghana and Morocco); Europe (in Belarus and Greece); Asia (in Malaysia); and Latin America (in Cuba).

"A total of 90 Member States accessed RASIMS [the Safety Information Management System] in 2013 to update their radiation safety infrastructure profiles."

Guidance on the Education and Training Appraisal (EduTA) service was updated, taking into account Member State needs for more direct support in the establishment of a national strategy. Initiatives were undertaken to support Member States in strengthening their human resources in the field of radiation, transport and waste safety. For example, a syllabus was drafted for a master's level PGEC on radiation protection. In addition, a pre-training course on radiation protection was adapted for an e-learning format; a pilot version was made available to participants in Ghana's PGEC on radiation protection, which began in November.

Radiation Safety Infrastructure Information Management

The Agency's 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 on radiation safety. The Agency also uses RASIMS as a decision aiding tool when evaluating requests for procurement of radiation sources for use in Member States, as well as prior to submitting technical cooperation projects to the Agency's Policy-making Organs for approval.

Further improvements to RASIMS's functionality were made throughout 2013. For example, an e-learning module was developed to improve user interaction with the RASIMS system[2]. A total of 90 Member States accessed RASIMS in 2013 to update their radiation safety infrastructure profiles. In addition, 102 Member States have now appointed RASIMS coordinators to promote national ownership of RASIMS information and to provide a local focal point for all national stakeholders.

[2] Available at: *http://rasims.iaea.org*.

Management of Radioactive Waste

Objective

To achieve global harmonization in policies, criteria and standards governing waste safety and public and environmental protection, together with provisions for their application, including state-of-the-art technologies and methods for demonstrating their adequacy.

Waste and Environmental Safety

Radioactive waste and spent fuel management

The Agency assists Member States in planning strategies and conducting research activities for the safe management of spent fuel. In particular, the Agency facilitates the sharing of experience and good practices among Member States.

In 2013, the Agency began development of new projects on the management of intermediate level waste and the management of large amounts of waste. The aim is to create a forum for Member States to exchange experience and to assist and provide guidance on the application of the Agency's safety standards. The Agency also published a Safety Guide entitled *The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste* (IAEA Safety Standards Series No. GSG-3) and provided assistance to Member States through technical cooperation projects, peer reviews and Technical Meetings.

During the year, the Agency published a number of reports on designing and managing the construction or operation of disposal facilities, including *Options for Management of Spent Fuel and Radioactive Waste for Countries Developing New Nuclear Power Programmes* (IAEA Nuclear Energy Series No. NW-T-1.24). In addition, the Internet based platform CONNECT (Connecting the Network of Networks for Enhanced Communication and Training) was developed further.

Assessment and management of environmental releases

As part of the Agency's programme on Modelling and Data for Radiological Impact Assessments (MODARIA), the Agency organized a second Technical Meeting in Vienna in November to continue the work on assessment methodologies and their application for remediation of contaminated areas, modelling of radiation exposures and effects on biota, and the dispersion of radionuclides in the marine environment. The meeting was attended by 153 participants from 43 Member States, including regulators and operators as well as environmental modellers and radiation protection experts. In addition, nine MODARIA working groups held meetings, hosted by various Member States, focusing on data compilation and model validation. Among the key results of MODARIA are improved parameter values and environmental models for use in the Agency's safety guidance and safety reports. The associated knowledge transfer between Member States is also important and is contributing to capacity building for radiological impact assessment.

"During the year, the Agency published a number of reports on designing and managing the construction or operation of disposal facilities…"

Decommissioning and remediation safety

During the year, the Agency continued to provide guidance on implementing optimal measures for remediating contaminated land. In a project carried out in the framework of the IAEA Action Plan on Nuclear Safety, situation specific remediation strategies are to be developed for contaminated urban and rural areas for a wide range of environmental conditions. The strategies integrate the experience gained after accidents such as those at the Chernobyl and Fukushima Daiichi nuclear power plants, and focus both on the radiological aspects and on the impact of technological, economic and societal factors on decisions concerning remediation.

The Agency's Coordination Group for Uranium Legacy Sites (CGULS) provides technical coordination and support to address issues related to uranium legacy sites in affected Member States. In 2013, a strategic plan was developed to guide future CGULS activities. A number of missions were also carried out, including one to assess capabilities for chemical and radiochemical analysis in the Central Asia region. Three missions were carried out to Kyrgyzstan: to develop a national monitoring strategy and programme for uranium legacy sites in the country (Fig. 1);

FIG. 1. Environmental sampling at a remediation site in Kyrgyzstan.

to develop recommendations for a remedial action strategy for the Mailuu-Suu site; and to characterize the Min-Kush site. In addition, the CGULS technical exchange forum was held in Vienna in June, and a meeting was held in Moscow in November to optimize the group's activities.

"In 2013, the Agency set up working groups to analyse and prepare guidance on the important aspects of managing large amounts of waste following emergency situations…"

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

Management of radioactive waste and spent fuel

Remediation and decontamination activities in affected areas after a nuclear or radiological emergency may, in a short period of time, produce large amounts of waste having relatively low levels of activity concentration, as was the case after the accident at the Fukushima Daiichi nuclear power plant. For these activities to be conducted smoothly, it is necessary to set up situation specific waste management strategies for the actual waste streams, taking into consideration the long term safety of the managed waste.

In 2013, the Agency set up working groups to analyse and prepare guidance on the important aspects of managing large amounts of waste following emergency situations to address important issues such as establishing an appropriate framework to address the technology aspects of waste management, demonstrating safety, and facilitating the licensing process for waste treatment and storage facilities.

Decommissioning of nuclear facilities and environmental remediation of sites

The Agency's Data Analysis and Collection for Costing of Research Reactor Decommissioning (DACCORD) project is part of a wider effort to provide tools, guidance and assistance for preparing preliminary cost estimates to those Member States with small nuclear facilities. The second annual meeting of DACCORD was held in December, with participants from more than 20 Member States. The participants analysed the collected cost relevant data for different generic types of research reactor, using detailed source information provided by participants relating to their own reactors.

The International Project on Decommissioning Risk Management (DRiMa) examines the factors that influence the risks of decommissioning projects. DRiMa provides recommendations on risk management for the decommissioning of facilities using radioactive material, as well as practical examples of the practices and procedures used for risk management in the planning and execution of decommissioning. A meeting of the DRiMa working groups was held in Cologne, Germany, in May, with 19 participants from 12 countries. Additional examples of decommissioning risk management were added to the draft report for the project, and plans for future activities were elaborated. The second annual meeting of the DRiMa project was held in Vienna in October, with 32 participants from 23 countries. The meeting focused on the collection and analysis of risk management related approaches and experience in decommissioning, addressing aspects of strategic and operational risk management.

In 2013, the Agency, through its Network on Environmental Management and Remediation (ENVIRONET), organized a training event, in cooperation with Argonne National Laboratory in the USA, on the planning and management of environmental remediation works. The event demonstrated that a successful remediation project can only be achieved through proper elaboration and implementation of a well developed plan supported by good managerial practices. The training was of particular relevance, as several Member States have an urgent need for adequate support in planning and managing technically sound and cost effective environmental remediation projects.

The CIDER project — concerned with addressing constraints to implementing decommissioning and environmental remediation programmes — was launched in 2013 as a joint activity of the International Decommissioning Network (IDN) and ENVIRONET with the goal of improving current levels of performance. The first phase of the project, taking place from 2013 through to 2015, is aimed at raising awareness of the importance of this issue and promoting greater cooperation among Member States and international organizations concerned with the implementation of decommissioning and environmental remediation programmes.

Joint Convention Inter-sessional Meeting

As agreed during the 4th Review 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), the Contracting Parties held an Inter-sessional Meeting in April. The purpose was to facilitate further consideration of proposals to improve the implementation of the Joint Convention and its review mechanisms. Further to this meeting, one Contracting Party requested the Secretariat to hold an extraordinary meeting, in conjunction with the next Joint Convention Organizational Meeting in

May 2014, to consider revisions to the Rules of Procedure and Financial Rules and to the guidance documents[1].

In October, a Topical Meeting on Comprehensive Approaches to the Back End of the Nuclear Fuel Cycle was organized at Headquarters in Vienna. The objective of the meeting was to provide a forum for the exchange of information on approaches to managing the back end of the nuclear fuel cycle in a comprehensive manner.

[1] See INFCIRCs 602/603/604, available at: *http://iaea.org/Publications/Documents/Infcircs/index.html*.

Nuclear Security

Objective

To contribute to global efforts to achieve effective security of nuclear or other radioactive material, by supporting national and international efforts to establish and maintain effective nuclear security. To assist 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.

Nuclear Security Plan

The Agency's nuclear security programme assists States in improving their national nuclear security. In this regard, the Agency continued implementing the *Nuclear Security Plan 2010–2013*, the third such plan to be approved by the Board of Governors. A fourth plan, covering the period 2014–2017, was approved by the Board of Governors in September.

"...the International Conference on Nuclear Security: Enhancing Global Efforts…was attended by more than 1300 participants from 125 Member States, including 34 representatives at the ministerial level, and by representatives from 21 organizations."

International Cooperation and Coordination

In July, the Agency convened the International Conference on Nuclear Security: Enhancing Global Efforts. The conference, held in Vienna, was attended by more than 1300 participants from 125 Member States, including 34 representatives at the ministerial level, and by representatives from 21 organizations. In his opening address, the Director General highlighted the need to bring into force the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM), as well as the benefit that all States could gain by inviting peer reviews of their nuclear security arrangements by international experts and by making use of the Agency's nuclear security guidance.[1] The main conclusions of the conference reflected these priorities, and the conference itself informed the development of the Agency's *Nuclear Security Plan 2014–2017*. The Ministerial Declaration adopted by consensus at the conference[2] urged the Agency to continue developing and publishing nuclear security guidance, and encouraged all States to take the guidance into account, as appropriate, in their efforts to strengthen and continuously improve their nuclear security. It also affirmed the central role of the Agency in strengthening the nuclear security framework globally and in leading the coordination of international activities in the field of nuclear security, while avoiding duplication and overlap. A report on the conference was presented to the September 2013 Board of Governors and the 57th General Conference.[3]

General Conference resolutions on nuclear security have encouraged the Secretariat to continue to play a constructive and coordinated role, in coordination with Member States, in other nuclear security related initiatives. In this regard, the Agency organized two Information Exchange Meetings, in May and December, which were attended by more than 25 participants from 12 organizations. Cooperation and coordination were also promoted through the efforts of the Border Monitoring Working Group, which met twice in 2013 to discuss border monitoring training and implementation, as well as joint activities in border monitoring (Fig. 1). The Working Group on Radioactive Source Security met in 2013 to improve the provision of technical assistance related to the protection and control of radioactive sources.

FIG. 1. A radiation portal monitor at the border between Thailand and Malaysia. This device detects radiation in real time, without interrupting normal import–export operations.

[1] See: *http://www.iaea.org/newscenter/statements/2013/amsp2013n15.html*.

[2] After the adoption of the Ministerial Declaration, one Member State made a statement to express reservations but did not object to reaching consensus on the document. See: *http://www-pub.iaea.org/iaeameetings/cn203p/RussianFederation-PDF.pdf*.

[3] GOV/INF/2013/9-GC(57)INF/6.

Incident and Trafficking Database

Membership in the Agency's Incident and Trafficking Database (ITDB) increased, with another six States joining in 2013. During 2013, 146 incidents were reported, including four incidents that involved Category 1–3 radioactive sources in unauthorized activities[4]. Three of these four incidents were reported as thefts.

Peer Reviews and Advisory Services

The modularization of the peer review and advisory services undertaken by the Agency at the request of Member States continued during the year. The goal is to streamline the assistance provided and allow States to select modules depending on their specific needs. The modules currently available in the International Nuclear Security Advisory Service (INSServ) address institutional infrastructure, detection and response systems and measures, and nuclear security at major public events.

In 2013, the Agency completed: three INSServ Detection and Response Systems and Measures missions, to Albania, Chile and Tunisia; one INSServ Institutional Infrastructure mission, to Chile; and six INSServ Nuclear Security at Major Public Events missions, to Belarus, Cambodia, Malaysia, Sri Lanka, Zambia and Zimbabwe. In addition, the Agency undertook four International Physical Protection Advisory Service (IPPAS) missions, to Australia, Hungary and the USA, and to the Agency's Laboratories in Seibersdorf, the first ever to an Agency facility. To share experience as well as lessons learned, and to discuss improvement of the service, the Agency organized an international seminar on IPPAS, held in December in Paris.

Integrated Nuclear Security Support Plans

The Ministerial Declaration issued at the International Conference on Nuclear Security held in July noted the important role that Integrated Nuclear Security Support Plans (INSSPs) play in assisting efforts by States to establish effective and sustainable national nuclear security regimes. The INSSP programme grew significantly in 2013: seven Member States formally approved their INSSPs, an additional 13 Member States finalized new INSSPs with the Agency and are in the process of approving them, and ten Member States with existing INSSPs held joint review meetings with the Agency. Together, these efforts have allowed the Agency to gather information on needs for nuclear security improvements in Member States, and to ensure that the Agency is prepared to meet State requests for nuclear security assistance in a timely manner.

In 2013, the Agency released a web based platform designed to assist Member States in reviewing the status of their nuclear security infrastructure, and in tracking their progress towards establishing, maintaining and sustaining an effective nuclear security regime. The system, known as the Nuclear Security Information Management System (NUSIMS), is intended to facilitate the identification and prioritization by States, on a voluntary basis, of their nuclear security needs and to allow the Agency, upon request, to provide a more tailored approach to address those needs.

"During 2013, 146 incidents were reported [to the Incident and Trafficking Database], including four incidents that involved Category 1–3 radioactive sources in unauthorized activities…"

Promotion of the Nuclear Security Framework

Despite being adopted in 2005, the Amendment to the CPPNM still has not entered into force. During 2013, ten States ratified, accepted or approved the Amendment to the CPPNM. The Agency organized two workshops to promote adherence to and implementation of the CPPNM Amendment: one in Beijing in April, and one for French-speaking African States, held in November in Brussels.

To assist States in meeting their obligations under the nuclear security framework, the Agency publishes guidance in the IAEA Nuclear Security Series. Three publications were issued during the year, including *Objective and Essential Elements of a State's Nuclear Security Regime* (the Nuclear Security Fundamentals), the top level publication in the series.

The guidance was drawn up with input from Member States through the Nuclear Security Guidance Committee (NSGC). The committee met twice in 2013 to review and approve publication drafts and proposals. The NSGC also reviewed and advised the Secretariat on a plan for publications in the IAEA Nuclear Security Series.

Building Capacity

The important role of education and training in helping States, upon request, to establish effective and sustainable national nuclear security regimes continues to be widely recognized. The Agency conducted 88 training events during the year, covering all aspects of nuclear security and involving more than 2000 people. Among the topics covered were cybersecurity, physical protection of nuclear

[4] The ITDB categorizes sealed radioactive sources on a scale of 1 to 5, in accordance with IAEA Safety Standards Series No. RS-G-1.9. Exposure of only a few minutes to a Category 1 source can be fatal. Category 5 sources are potentially the least dangerous; however, even these sources could give rise to doses in excess of the safe limits if not properly controlled.

FIG. 2. Secure storage at a facility in Ghana incorporating various types of physical barrier to prevent theft of and unauthorized access to radioactive material.

and other radiological material (Fig. 2), and nuclear security infrastructure for newcomers.

In 2013, six national Nuclear Security Support Centres (NSSCs) were established by Member States. The International Network for Nuclear Security Training and Support Centres, established by the Agency to facilitate collaboration between such centres, continued to develop. The network currently has 98 members from 39 Member States and seven international organizations.

"The Agency conducted 88 training events during the year, covering all aspects of nuclear security and involving more than 2000 people."

Five European universities launched a pilot European Master of Science degree programme, using the curriculum and peer reviewed teaching materials and textbooks prepared by the International Nuclear Security Education Network (INSEN) with Agency assistance. In addition, Chulalongkorn University in Thailand launched a Master of Science programme on nuclear safeguards and security, based largely on the INSEN materials and curriculum.

INSEN has over 95 member institutions from almost 40 Member States. Member institutions are implementing various modules of the INSEN nuclear security education curriculum using the peer reviewed materials. To enhance the capacities of these member institutions to deliver high quality nuclear security education programmes, the Agency initiated a coordinated research activity on Enhancing Nuclear Security Education Infrastructure through the Development of a Mentor/Protégé Programme.

The Agency also conducted the third annual two-week intensive school for young professionals in nuclear security at the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy, in April. A total of 47 participants from 39 Member States attended.

Major Public Events

The Agency supported six major public events in 2013, in Brazil, Cambodia, Malaysia, Sri Lanka, Zambia and Zimbabwe. Assistance provided at the request of the Member States concerned included the provision of reports from the ITDB, and the loan of equipment and associated training.

Radiological Crime Scene Management

A training curriculum on radiological crime scene management was finalized in 2013 aimed at strengthening the ability of Member States to ensure safe, effective and efficient operations at a crime scene where nuclear or other radioactive materials are known or are suspected to be present. To identify areas for further improvement of the training curriculum, a pilot workshop on the subject was conducted in the Czech Republic in November.

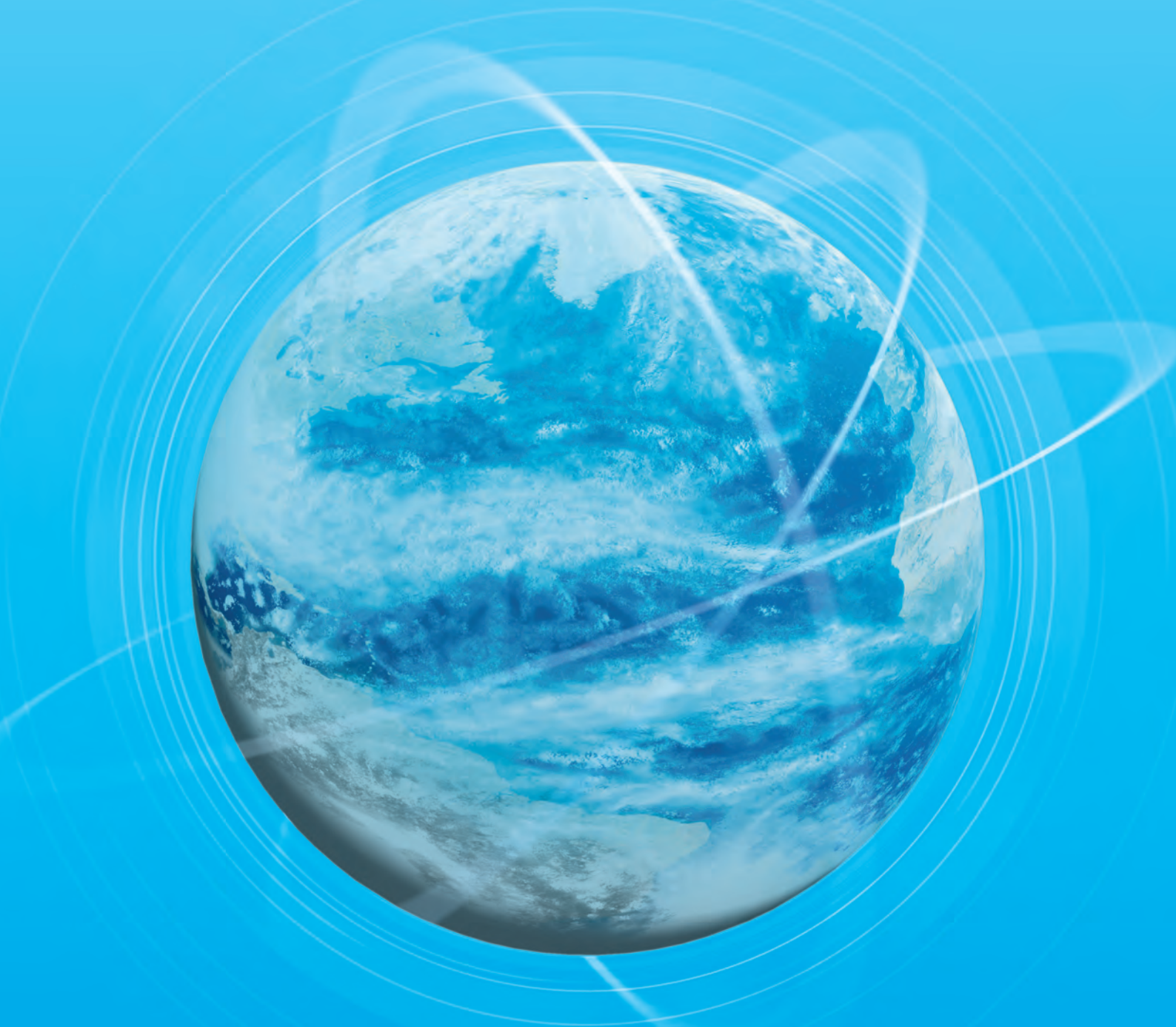
Provision of Equipment to Member States

The Agency provided expert advice and equipment to States for detecting and responding to the unauthorized movement of nuclear and other radioactive material, and for physical protection upgrades. For example, acceptance tests of 658 portable radiation detection instruments were performed and ten radiation portal monitors were installed. In addition, there were 39 shipments to Member States for the donation and loan of instruments.

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 €25.7 million. The €25.7 million comprised financial contributions from Australia, Belgium, Canada, China, Estonia, Finland, France, Italy, Japan, the Republic of Korea, the Netherlands, New Zealand, Romania, the Russian Federation, Spain, the United Kingdom, the United States of America, the European Commission, one private company and several minor contributors. In kind contributions of over €269 000 were also received.

Nuclear Verification



Nuclear Verification

Objectives

To deter the proliferation of nuclear weapons by detecting, as early as possible, 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 2013

At the end of each 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.

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, the Agency assesses the results of its verification and evaluation activities under CSAs and additional protocols (APs). Thus, for the Agency to draw such a broader conclusion, both a CSA and an AP must be in force in the State, 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 States that have 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 a 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. Integrated safeguards were implemented during 2013 for 53 States[1,2].

In 2013, safeguards were applied for 180 States[2,3] with safeguards agreements in force with the Agency[4]. Of the 117 States that had both a CSA and an AP in force, the Agency concluded that *all* nuclear material remained in peaceful activities in 63 States[5]; for the remaining 54 States, as all the necessary evaluations remained ongoing, the Agency was unable to draw the same conclusion. For these 54 States, and for the 55 States with a CSA but with no AP in force, the Agency concluded only that *declared* nuclear material remained in peaceful activities.

> *"In 2013, safeguards were applied for 180 States…with safeguards agreements in force with the Agency…"*

Safeguards were also implemented with regard to declared nuclear material in selected facilities in the five nuclear-weapon States under their respective voluntary offer agreements. For these five States, the Agency concluded that nuclear material to which safeguards were applied in selected facilities remained in peaceful activities or had been withdrawn from safeguards as provided for in the agreements.

For the three States in which the Agency implemented safeguards pursuant to safeguards agreements based on INFCIRC/66/Rev.2, the Agency concluded that the nuclear material, facilities or other items to which safeguards were applied remained in peaceful activities.

As of 31 December 2013, 12 non-nuclear-weapon States party to the Treaty on the Non-Proliferation of

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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 The status of safeguards agreements is given in the Annex to this report.

5 And Taiwan, China.

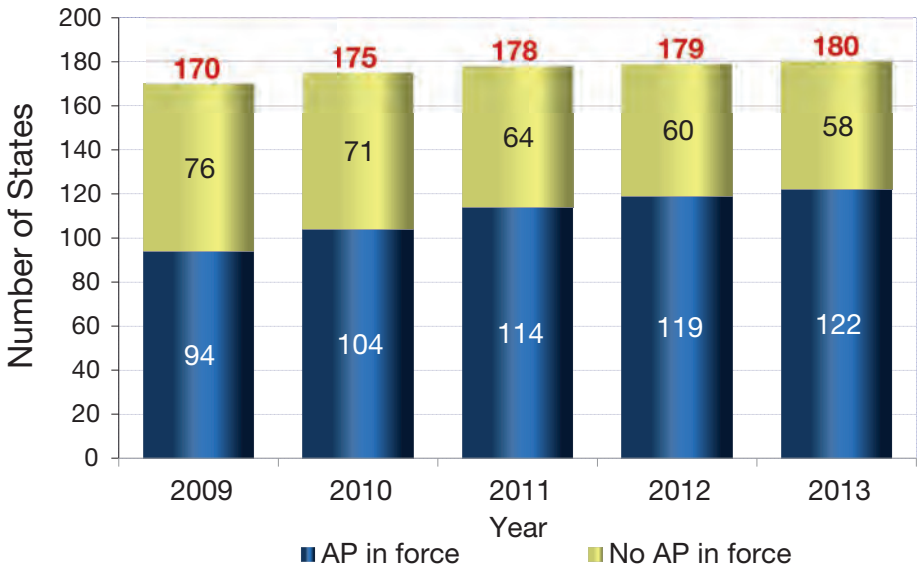

FIG.1. Number of APs for States with safeguards agreements in force, 2009–2013.

Nuclear Weapons (NPT) had yet to bring into force CSAs as required by 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)[6]. During 2013, a CSA and AP entered into force for two States[7,8], and APs entered into force for two other States[9,10]. The status of safeguards agreements and APs as of 31 December 2013 is shown in Table A6 in the Annex to this report. During the year, one State[11] signed a CSA and an AP, another State[12] signed an AP, and an AP was approved by the Board for another State[13].

The Agency continued to implement the *Plan of Action to Promote the Conclusion of Safeguards Agreements and Additional Protocols*[14], which was updated in September. During the year, the Agency organized an outreach event for Pacific Island States in Nadi, Fiji, held in April and May, at which the Agency encouraged the participating States to conclude CSAs and APs and to amend their SQPs. At the request of Myanmar, the Agency organized consultations and training for State officials in connection with the conclusion of an AP and amendment of its SQP. National workshops on safeguards were conducted for Myanmar and the Lao People's Democratic Republic in August. In addition, consultations on the amendment or rescission of SQPs and the conclusion of safeguards agreements and APs were held throughout the year with representatives from States in Bangkok, Geneva, Nadi, New York and Vienna, and also 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 small quantities protocols, with a view to amending or rescinding such protocols to reflect the revised standard text. During the year, operative SQPs were amended to reflect the revised standard text for four States.[15] This means that 51 States have operative SQPs in force based on the revised standardized text and four States have rescinded their SQPs.

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[6] 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.

[7] Bosnia and Herzegovina, and Vanuatu.

[8] The NPT Safeguards Agreement concluded with Bosnia and Herzegovina (INFCIRC/851) superseded with respect to Bosnia and Herzegovina the NPT Safeguards Agreement concluded with Yugoslavia (INFCIRC/204).

[9] Antigua and Barbuda, and Denmark.

[10] The Additional Protocol for Denmark is applicable to that part of Denmark which is covered by INFCIRC/176, i.e. Greenland (INFCIRC/176/Add.1).

[11] Guinea Bissau.

[12] Myanmar.

[13] Saint Kitts and Nevis.

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

[15] Andorra, Gabon, Kuwait and Mauritania.

Islamic Republic of Iran (Iran)

During 2013, 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/2013/6, GOV/2013/27, GOV/2013/40 and GOV/2013/56).

In 2013, 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 serious concerns about possible military dimensions to Iran's nuclear programme that is necessary to establish international confidence in the exclusively peaceful nature of that programme.

In October 2013, following further rounds of talks aimed at reaching agreement on a structured approach document for resolving outstanding issues related to Iran's nuclear programme, the Agency and Iran concluded that the negotiations had become deadlocked. As there was no prospect for agreement on the document, the Agency and Iran agreed that a new approach aimed at ensuring the exclusively peaceful nature of Iran's nuclear programme should be developed.

On 11 November 2013, the Director General, on behalf of the Agency, and the Vice President of Iran and President of the Atomic Energy Organization of Iran (AEOI), on behalf of Iran, signed a 'Joint Statement on a Framework for Cooperation' (the Framework for Cooperation). In the Framework for Cooperation, the Agency and Iran agreed to cooperate further with respect to verification activities to be undertaken by the Agency to resolve all present and past issues, and to proceed with such activities in a step by step manner. Iran agreed to take six initial practical measures within three months.

On 24 November 2013, a Joint Plan of Action[16] was agreed between Iran and China, France, Germany, the Russian Federation, the United Kingdom and the United States of America, the aim of which is to reach a "mutually-agreed long-term comprehensive solution" that would ensure that Iran's nuclear programme "will be exclusively peaceful". Under this Joint Plan of Action, the Agency was to be "responsible for verification of nuclear-related measures" contained therein.

The Director General welcomed the Joint Plan of Action, noting that it was an important step forward but that much more needs to be done. The Director General also indicated that, with the agreement of the Agency's Board of Governors, the Agency would be ready to fulfil its role in verifying the implementation of nuclear related measures[17].

While the Agency continued throughout 2013 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.[18]

"…51 States have operative SQPs in force based on the revised standardized text and four States have rescinded their SQPs."

Syrian Arab Republic (Syria)

In August 2013, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic*. No new information came to the knowledge of the Agency that would have an impact on the Agency's assessment that it was very likely that a building destroyed at the Dair Alzour site was a nuclear reactor which should have been declared to the Agency by Syria.[19] In 2013, 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.

While Syria invited the Agency to conduct an inspection at the Miniature Neutron Source Reactor in Damascus in 2013, the Agency decided not to conduct any in-field verification activities in Syria. In this regard, in June 2013, the Agency informed Syria that, after considering the United Nations Department of Safety and Security's assessment of the prevailing security conditions in Syria and the small amount of nuclear material declared by Syria at the reactor, the 2013 physical inventory verification at the reactor would be postponed until the security conditions had sufficiently improved. By the end

[16] INFCIRC/856.

[17] On 24 January 2014, the Board of Governors endorsed the Agency undertaking monitoring and verification in relation to the nuclear related measures set out in the Joint Plan of Action.

[18] 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.

[19] 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.

of 2013 the assessment of the security situation 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 2013, the Agency concluded for Syria that declared nuclear material remained in peaceful activities.

Democratic People's Republic of Korea (DPRK)

In August 2013, 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/2013/39–GC(57)/22), which provided an update of developments since the Director General's report of August 2012.

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 about it having conducted a third nuclear test 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 in the DPRK, are deeply regrettable.

"The analysis of safeguards relevant information is an essential part of evaluating a State's nuclear activities and drawing safeguards conclusions."

Although not implementing any verification activities in the field, the Agency continued in 2013 to monitor the DPRK's nuclear activities by using open source information (including satellite imagery) and trade information. The Agency has continued to observe building renovation and new construction activities at various locations within the Yongbyon site, although, without access to the site, the Agency cannot confirm the purpose of these 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.

Enhancing Safeguards

Evolving safeguards implementation

In 2013, progress continued in strengthening the effectiveness and improving the efficiency of Agency safeguards through strategic planning, evolving safeguards implementation, introducing integrated safeguards in additional States, developing safeguards approaches, strengthening the Agency's technical and analytical capabilities, and increasing cooperation with State and regional authorities responsible for safeguards implementation.

To continue ensuring consistency and non-discrimination in the implementation of safeguards, the Agency has improved internal work practices, including through: the better integration of the results of safeguards activities conducted in the field with those carried out at Headquarters, in order to determine where to focus such activities for maximum effectiveness and efficiency; advances in the handling of safeguards relevant information to facilitate evaluation, and their documentation; and adjustments to the safeguards training programme. Of particular importance is the improvement of the key processes supporting safeguards implementation and the departmental oversight mechanisms relevant to the implementation of these processes.

In August, the Director General submitted a report to the Board of Governors entitled *The Conceptualization and Development of Safeguards Implementation at the State Level*, which was, inter alia, taken note of by the Board of Governors. The Board of Governors was informed that the Secretariat would prepare a supplementary document to the report to provide the Board of Governors with more information before the 2014 General Conference, and would consult with Member States to ensure that the Secretariat had captured all of the points that Member States asked to be addressed in that document. The General Conference resolution on Strengthening the Effectiveness and Improving the Efficiency of Agency Safeguards, (GC(57)/RES/13), noted, inter alia, that the Director General will produce, after consulting with Member States, a supplementary document for consideration and action by the Board of Governors before the fifty-eighth (2014) session of the General Conference.

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 information from verification activities performed at Headquarters and in the field, including the results of non-destructive assay (NDA), destructive assay,

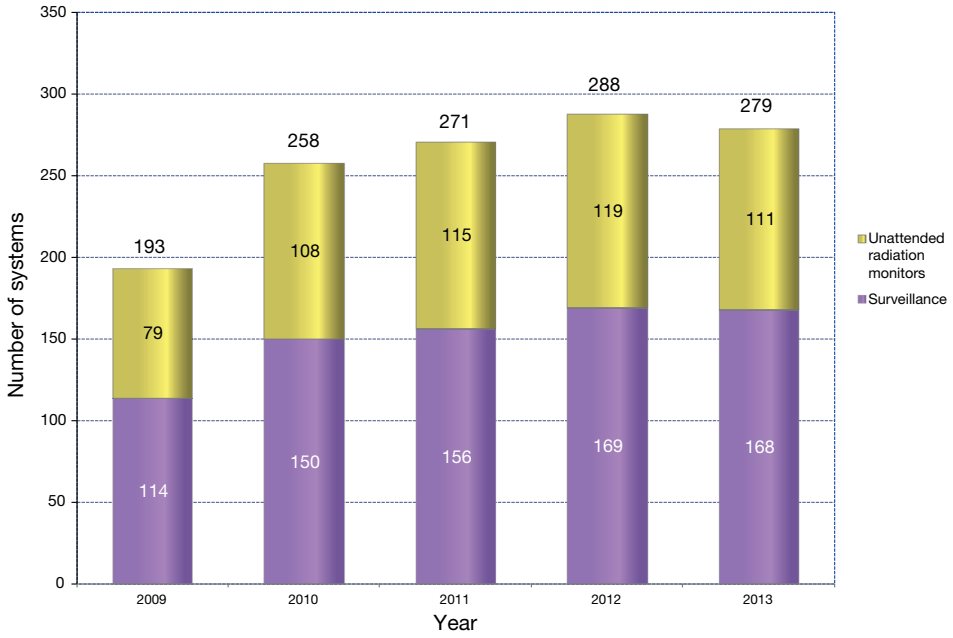


FIG. 2. Dynamics of remote monitoring deployments between 2009 and 2013.

environmental sample analyses and remotely monitored equipment, and from a diverse range of information sources, open sources (including commercial satellite imagery), trade data and other sources of safeguards relevant information. Throughout 2013, the Agency enhanced and diversified its capabilities to acquire and process data, analyse and evaluate information, and securely distribute information internally, as an essential contribution to the State evaluation process and the drawing of safeguards conclusions. It also 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 systems performance; organized international technical meetings; and provided to States training and workshops on nuclear material accounting, including measurement and material balance evaluation concepts.

Cooperation with State and regional authorities

The effectiveness and efficiency of Agency safeguards depend, to a large extent, on the effectiveness of State and regional systems of accounting for and control of nuclear material, and on the level of cooperation between State or regional authorities and the Agency.

To assist SQP States in building capacity for complying with their safeguards obligations, in April the Agency published the *Safeguards Implementation Guide for States with Small Quantities Protocols* (IAEA Services Series No. 22).

The Agency also conducted two IAEA SSAC Advisory Service (ISSAS) missions in 2013 — to the Republic of Moldova and Tajikistan — and preparatory visits for two more missions to be conducted in 2014 — to Kyrgyzstan and the United Arab Emirates.

Safeguards equipment and tools

Throughout 2013, the Agency ensured that, across the world, its instrumentation and monitoring equipment vital to the implementation of effective safeguards continued to function as required. During the year, 1974 separate pieces of equipment were prepared and assembled into 891 portable and resident NDA systems. By the end of 2013, a total of 155 unattended monitoring systems were in operation worldwide, and the Agency had 1322 cameras connected to 612 systems operating at 251 facilities in 34 States[20]. In addition, the Agency is responsible for maintaining approximately 200 cameras used jointly with regional and State authorities. The total number of electronic seals transmitting remote data to Headquarters was 206. By the end of 2013, there were 279 safeguards systems remotely connected to Headquarters and installed at 123 facilities in 23 States[21] (see Fig. 2).

Member State Support Programmes (MSSPs) continued to provide significant resources in support of safeguards equipment innovations.

The Agency's infrastructure to support its verification activities was further strengthened in 2013 by completing the refurbishment of the Unattended Monitoring Systems Laboratory and the Safeguards Equipment Receiving Area at Agency Headquarters. More than 7000 pieces of verification equipment were dispatched to support verification activities in the field.

The Agency's Network of Analytical Laboratories (NWAL) consists of the Agency's Safeguards Analytical Laboratory (SAL) and 20 other qualified laboratories in Australia, Brazil, France, Hungary, Japan, the Republic of Korea, the Russian Federation, the United Kingdom, the

[20] And Taiwan, China.

[21] And Taiwan, China.

United States of America and the European Commission. Additional laboratories in the areas of environmental and nuclear material sample analysis are in the process of qualification in Argentina, Belgium, Canada, China, the Czech Republic, France, Germany, Hungary, the Republic of Korea, the Netherlands and the United States of America. In 2013, SAL analysed all 455 nuclear material samples collected by inspectors in the field, and 791 sub-samples from environmental swipe sampling were analysed in the NWAL (including at SAL).

"In 2013, the Agency continued to improve its safeguards information system in order to better support the implementation of safeguards."

Support

Developing the safeguards workforce

In 2013, the Agency continued updating the 'Introductory Course on Agency Safeguards' to take into account the evolution of safeguards implementation. During the year, the Agency conducted 124 safeguards training courses to provide safeguards staff with the necessary competencies. Several of these courses were held at nuclear facilities.

Quality management

Quality audits were conducted on the industrial safety programme, internal safeguards training, quality control activities, and two analytical methods used at SAL. The report system in place to identify root causes of events and actions to prevent recurrence was expanded to include both radiation and industrial safety events, and quality control trends. Improvements and refinements were made to existing processes, tools and methods. In particular, these included the processes for retaining critical knowledge of staff members retiring or separating from the Agency, as well as processes for safeguards reporting and for design information verification; tools for managing and controlling internal documents and for tracking condition reports; and the method of estimating safeguards costs.

Significant Safeguards Projects

Enhancing the Capabilities of Analytical Services — ECAS

In the Environmental Sample Laboratory, the Agency's first multi-collector inductively coupled plasma mass spectrometer, introduced in 2012, further improved the precision of analysis of uranium and plutonium in environmental swipes. A laser ablation module was procured to complement this technology for the analysis of micrometre sized particles. In its second full year of operation, the Agency's large geometry secondary ion mass spectrometer (LG-SIMS) provided a significant increase in the precision of measurements of environmental samples collected during safeguards inspections, design information verifications and complementary access. Techniques pioneered by the Agency were adopted by NWAL members that acquired LG-SIMS instruments for particle analysis.

Construction of the Nuclear Material Laboratory (NML) building in Seibersdorf was completed in July 2013 on schedule and within the approved budget. The building was inaugurated on 23 September 2013. The phased transition of scientific functions from the leased SAL building to the NML commenced in September 2013. The building is expected to be operational in 2014.

Overall, ECAS project activities reached 70% completion as of 31 December 2013. The remaining principal tasks in the ECAS project include the transitions of laboratory functions, facilities management and security practices to meet nuclear security recommendations on physical protection of nuclear material and nuclear facilities (INFCIRC/225/Revision 5); construction of the pedestrian arrival and goods screening buildings, traffic control lanes, internal roads and parking; construction of wastewater and electrical power supply infrastructure; design and construction of the NML building's wing of office and training space; and procurement of certain analytical instruments and equipment for use in the NML.

Information technology

The *Medium Term Strategy 2012–2017* highlighted the safeguards information systems as a vital component of the Agency's verification infrastructure. The information technology (IT) on which the Agency currently relies for day to day safeguards implementation is outdated and increasingly difficult to maintain. The system is also vulnerable to cyber-attacks. Therefore, the Agency needs to modernize its safeguards information technology.

In 2013, the Agency continued to improve its safeguards information system in order to better support the implementation of safeguards. By the end of the year, nearly half the re-engineering work necessary to replace outdated mainframe computer based software applications that help record and process safeguards data had been completed. In support of information analysis, further enhancements were made to the analytical tools released in 2012 to make them more effective and usable. Efforts to improve the Agency's capability to protect sensitive information also continued. More specifically, improvements were made to security monitoring, digital forensics and the highly secure internal network, capable of hosting the next generation of safeguards applications.

To address the Agency's continued safeguards IT modernization needs and to bring these efforts under a comprehensive management approach, the Agency

established a Modernization of Safeguards Information Technology project.

Chernobyl

The objective of the Chernobyl safeguards project is to develop safeguards approaches and instrumentation for routine safeguards implementation at the new Chernobyl facilities. The Agency is involved in the early design stages in order to integrate appropriate safeguards measures in an effective and efficient manner. During 2013, discussions took place regarding revisions to design information. Construction of the 'Interim Storage Facility for Spent Nuclear Fuel, Number 2' is now expected to be completed in 2015. The 'New Safe Confinement' over the damaged Reactor Unit 4 is expected to be completed in 2016.

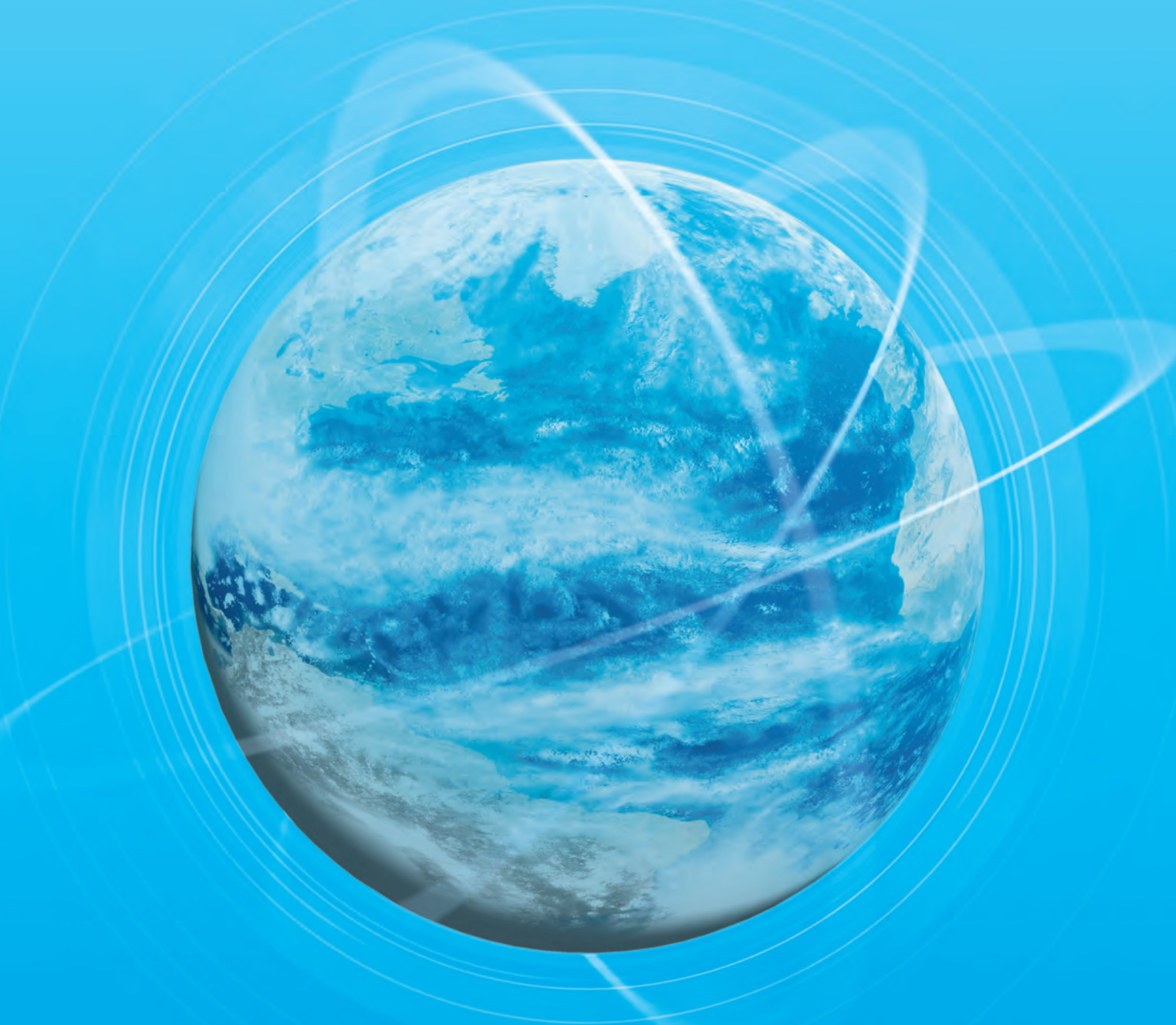
Research and Development

Research and development (R&D) are essential to meet the safeguards needs of the future. In 2013, the Agency provided to MSSPs the *IAEA Department of Safeguards Long-Term R&D Plan, 2012–2023*. The document outlines the capabilities necessary to achieve the strategic objectives, for which Member State R&D support is needed. In doing so, the plan covers a number of topics, including: concepts and approaches; detection of undeclared nuclear material and activities; safeguards equipment and communication; information technology; analytical services; and training.

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 2012–2013*. At the end of 2013, 20 States[22] and the European Commission had formal support programmes with the Agency, with contributions both in cash and in kind. During 2013, the Agency prepared the next edition of this programme report for 2014–2015, which is linked to the long term strategy through its alignment with the *Long-Term R&D Plan, 2012–2023*. It provides MSSPs, other Member States, the R&D community and stakeholders with a framework for resource planning and for the identification of potential solutions to existing and future safeguards challenges. It also provides a basis by which the Agency can monitor progress towards reaching its strategic objectives.

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

Technical Cooperation



Management of Technical Cooperation for Development

Objective

To enhance the use of nuclear technology for sustainable development and social and economic benefits in Member States.

The Technical Cooperation Programme

The Agency's technical cooperation programme builds capacities in Member States to support the peaceful application of nuclear technology to address development priorities in human health, food and agriculture, water and the environment, and industry, thereby helping to achieve, inter alia, the Millennium Development Goals. The programme also helps Member States to identify and meet future energy needs, and to improve nuclear safety and security worldwide, including providing legislative assistance.

Country Programme Frameworks and Revised Supplementary Agreements

Country Programme Frameworks (CPFs) define mutually agreed priority development needs and interests that can be supported through technical cooperation activities. At the end of 2013, 91 Member States — over 70% of all participating countries — had valid CPFs. While this represents an increase over past cycles, a constant effort is required by national authorities and the Secretariat to maintain the dynamic process of continuous initiation and conclusion of CPFs. In 2013, Angola, Bangladesh, Kuwait, Nigeria, Pakistan, Panama, Portugal, Romania, Sri Lanka, The former Yugoslav Republic of Macedonia, Turkey, Uganda and Ukraine signed CPFs.

Efforts were also made to strengthen the analytical content of CPFs and to generate an accountability framework for country programme management. The partnership matrix for integrating the country programme with national development policies and partners is showing itself to be highly useful for project planning and design. The response of potential partners to proposals based on country strategies and future priorities has been good, while the renewed emphasis on funding shortfalls is expected to contribute to resource mobilization efforts.

As of 16 January 2014, a total of 123 Member States had signed a Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA).

Managing the Agency's Technical Cooperation Programme

At the end of 2013, 791 projects were active. During the course of the year, 97 projects were closed, of which four were cancelled. An additional 169 were in the process of being closed. One Programme Reserve project was implemented, in Saudi Arabia. Member State priorities, as reflected in programme disbursements, were health and nutrition, safety and security, and food and agriculture, with some variations in emphasis across regions.

"Member State priorities, as reflected in programme disbursements, were health and nutrition, safety and security, and food and agriculture, with some variations in emphasis across regions."

Financial highlights

Pledges against the 2013 Technical Cooperation Fund (TCF) totalled €66.3 million (not including National Participation Costs (NPCs) and assessed programme cost (APC) arrears), against the target of €71.4 million, with the rate of attainment on payments at the end of 2013 standing at 91.9%. The use of these resources resulted in a TCF implementation rate of 83.7%.

Improving the quality of the technical cooperation programme

The Agency emphasizes continuous improvement in the quality of the technical cooperation programme. A systematic review process is in place to measure the quality of projects and their compliance with technical cooperation programme criteria. Quality reviews of project concepts and designs submitted for the 2014–2015 programme cycle were conducted, and lessons learned, as well as areas for improvement, were identified. Feedback on necessary improvements was provided to the project team members.

The Agency continues to apply a results based approach to the management of the technical cooperation programme. An e-learning course for technical cooperation stakeholders on the logical framework approach (LFA), developed in 2012 under a technical cooperation project

on Supporting Nuclear Education and Training through e-Learning and Other Means of Advanced Information Communication Technology (ICT), was launched in early 2013. The course provides training for all those involved in a technical cooperation project, from planning through to implementation and monitoring. It is available in English and Spanish on the IAEA Cyber Learning Platform for Nuclear Education and Training (CLP4NET)[1].

Monitoring and evaluating technical cooperation projects

As part of the Agency's strategy to improve the monitoring of projects, and to enhance project implementation, a monitoring and evaluation guidelines manual for technical cooperation stakeholders was published in 2013. As of 31 December 2013, 413 Project Progress Assessment Reports (PPARs) had been submitted to the Secretariat. The contents of these reports are being compiled as feedback for continual improvement. The field monitoring mission methodology developed and tested in 2012 was validated via several missions in 2013.

Collecting best practices in technical cooperation project design and management

The technical cooperation best practices mechanism was officially launched in March, using a methodology developed in 2012. Eight best practices were identified and disseminated in 2013:

- Encouraging local community involvement in technical cooperation rural water resource assessment projects.
- Ensuring that clear project tasks are assigned and that there is effective management of counterpart duties.
- Providing possibilities for the mutual benefit of research institutions and regulatory bodies.
- Setting up a school for drafting regulations: Dynamic approach for drafting regulations.
- Improving the equipment purchasing procedure.
- Enhancing the prosperity of RCA: RCA promotional and information programme engages in a wide range of stakeholders.
- Building the future on strong foundations: Evidence based regional priorities for the RCA.
- Building the future on effective and sustainable technology transfer: An active and monitored TCDC (technical cooperation among developing countries) and partnership programme for the RCA.

[1] The course is available in English at *http://nkm.iaea.org/clp4net/olms/m2/course/view.php?id=165* and in Spanish at *http://nkm.iaea.org/clp4net/olms/m2/course/view.php?id=168*.

Coordination with the United Nations and Other International Organizations

Efforts to increase coordination with the United Nations and other international organizations focused on field level coordination and partnership building in support of country programme results. Partnership requirements were assessed in terms of filling gaps and identifying supporting activities that the Agency would otherwise be unable to accomplish or where other international organizations could benefit from the Agency's advantages. Potential partners were identified using the standard project design methodology of the LFA, comprising problem, stakeholder and situation analysis.

A Practical Arrangement (PA) was completed with the United Nations Convention to Combat Desertification (UNCCD), while a further PA was initiated with UNEP. The latter will, inter alia, form the core of a thematic partnership framework for climate change adaptation that will include the United Nations Framework Convention on Climate Change (UNFCCC), CGIAR and the Global Environment Facility (GEF), and will be the focus of partnership building activities in 2014.

At the regional level, in Africa, efforts to establish operational partnerships through active participation in the United Nations Development Assistance Framework (UNDAF) were strengthened. By the end of 2013, the Agency was involved in the UNDAF process in 16 countries in the Africa region. Three new UNDAFs, for Egypt, Niger and Nigeria, were signed by the Agency in 2013. The Agency also participated in United Nations Day activities in two Member States — Ghana and the United Republic of Tanzania — to increase public awareness of the contribution of nuclear applications to sustainable development (Fig. 1).

Millions of people in developing countries lack access to basic radiotherapy and related cancer services. Increasingly, non-traditional partners such as the Organisation of Islamic Cooperation (OIC) and the Islamic

FIG. 1. At Ghana's United Nations Day celebrations, students visited an exhibition organized by the Ghana Atomic Energy Commission in cooperation with the Agency.

Development Bank (IDB) are working with the Agency to support developing Member States in the fight against cancer. As a follow-up of the 2012 high level seminar on OIC–IDB–IAEA cooperation in support of African countries' efforts to tackle cancer, held in Jeddah, Saudi Arabia, the Agency organized a consultative meeting in Vienna to review progress made and to agree with IDB and OIC on follow-up actions. With Agency support, Côte d'Ivoire, Niger and Tunisia submitted 'bankable' proposals on cancer control to the IDB in 2013, while other countries are at earlier stages of planning. The Agency and IDB will coordinate the review of the requests.

In the Asia and the Pacific region, efforts to build synergies with other United Nations organizations continued, focusing on areas such as health, agriculture and the environment, where nuclear technology provided through the technical cooperation programme provides an added advantage. Contacts and coordination with the United Nations Country Teams (UNCTs) were intensified in pursuit of a more comprehensive approach to capacity building in various sectors. Likewise, the incorporation of international cooperation in CPFs is creating greater awareness of the importance of leveraging the Agency's impact through support to existing national efforts.

Also in the Asia and the Pacific region, the Agency, FAO and the International Rice Research Institute (IRRI) joined forces in 2013 to enhance rice productivity, combining their expertise to develop sustainable rice production systems that will improve food security and farmers' livelihoods in the region. The initiative brought together nuclear techniques for crop mutation induction, supported by the Agency, and conventional methods that include molecular and biotechnologies, promoted by FAO and IRRI, in integrated packages supported by innovative management of soil, water and crop nutrients. The initiative also aimed at developing improved rice varieties that are better able to adapt to climate variability and change, and at transferring these varieties efficiently to rice farmers. The success of this inter-agency joint effort will serve as a benchmark for future collaboration in rice production.

In Europe, the Agency cooperates closely with UNDP Resident Coordinator Offices in relevant Member States and with UNCTs. In 2013, the Agency participated in the 'One United Nations' process through the United Nations Regional Coordination Mechanism for Europe and Central Asia. The Agency also provided inputs for UNDAF progress assessment and review processes in several Member States in the Europe region. Cooperation with other United Nations agencies within the framework of specific projects continued in areas such as health care, investigation and preservation of cultural heritage, animal diseases, food safety and security, uranium production legacy sites, and intellectual property.

The Agency continues to cooperate with numerous institutions in the Europe region. Two centres in the region support the implementation of post-graduate training programmes in radiation protection: the Greek Atomic Energy Commission, in Athens, and the International Sakharov Environmental University, in Minsk. The Agency also maintains 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. Most recently, 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. There are also some ten institutes and research centres in France, Italy, the Netherlands, Poland, the Russian Federation and the USA where PAs are in place to facilitate training activities under technical cooperation projects.

"…the Agency, FAO and the International Rice Research Institute (IRRI) joined forces in 2013 to enhance rice productivity, combining their expertise to develop sustainable rice production systems that will improve food security and farmers' livelihoods…"

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 2013, the Agency signed UNDAFs for Cuba (2014–2018), Mexico (2014–2019) and Nicaragua (2013–2017). Participation in UNCT retreats offers a particularly good opportunity to present the Agency's contributions to development, as during such events the UNDAF is either elaborated or reviewed for the purpose of better aligning the work of resident and non-resident United Nations agencies. For example, in January, Agency participation in the UNCT retreat in the Dominican Republic led to closer interaction with UNDP, the Pan American Health Organization (PAHO), FAO, the World Food Programme (WFP) and UNICEF. As a result, concrete opportunities for programmatic cooperation with UNDP and FAO were identified, and the UN Coordination Officer agreed to ensure a strategic consultative process with the high level involvement of national authorities during the preparation of the CPF.

Efforts to intensify engagement with European Union (EU) institutions continued. Cooperation between the EU and the Agency is well established in the fields of nuclear and radiation safety, nuclear security, and safeguards. A number of contribution agreements are in place between both organizations for collaboration on projects related to capacity building on nuclear safety, waste management, environmental remediation and strengthening regulatory authorities. In 2013, the Agency signed a new contribution agreement for a €9.26 million

contribution from the European Commission, to support normative activities as well as technical cooperation projects on the ground, benefiting all geographical regions. A mechanism of joint portfolio review was established in 2013 for discussion of all Agency projects receiving financial support from the EU's Nuclear Safety Cooperation Instrument. Similarly, cooperation was maintained with the United Nations Team in Brussels as a means to advance the Agency's message with the various EU institutions.

"Regional agreements and other Member State groups promote horizontal cooperation, self-reliance and sustainability."

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.

In 2013, the African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) continued to foster TCDC in Africa and to enhance regional cooperation among the 39 AFRA States Parties. Following the endorsement of the second Regional Strategic Cooperative Framework (RCF), covering the period 2014–2018, much work has been done to align proposed AFRA regional project designs for the 2014–2015 technical cooperation cycle with the major themes of the new RCF. The new framework prioritizes human resource development and partnership building with strategic partners. In 2013, human capacities were further enhanced through the provision of education and training in various fields, including through AFRA regional designated centres.

Implementation of the AFRA strategy for partnership building and resource mobilization continued in 2013 through a series of meetings held between the AFRA Chair, the Vienna based African Group and the Resident Representatives of donor countries in Vienna. This led to the sharing of information on achievements and success stories, and to the seeking out of further support for the implementation of the unfunded portion of the programme. Similarly, partnership with the African Commission on Nuclear Energy (AFCONE) was enhanced through the drafting of a Memorandum of Understanding with AFRA. In the same vein, a cooperation agreement among Regional Nuclear Educational Networks, including the AFRA Network for Education in Nuclear Science and Technology (AFRA-NEST), was signed in September.

In the Asia and the Pacific region, Palau became a Party to the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) for Asia and the Pacific in 2013, bringing the number of Contracting Parties to the RCA to 14 countries. The RCA States Parties continued their collective efforts to further improve the quality and effectiveness of the RCA programme. The 42nd RCA General Conference Meeting agreed on the formation of four working groups to evaluate new project concepts for the 2016–2017 cycle. It was also agreed to update the Guidelines and Operating Rules for the RCA Programme, to develop the RCA Medium Term Strategy and Strategic Priorities and to consider possible RCA engagement with the Pacific Island countries. The RCA Regional Office continued its efforts to enhance the visibility of the RCA and to promote partnerships to support the Agreement. The mechanisms under the RCA were recognized as examples of best practice in the Agency's first Technical Cooperation Best Practice Awards, in January.

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 in 2013 for a third term, to end in 2020. With the support of the Agency, ARASIA revised its Guidelines and Operating Rules, which will contribute to further strengthening the implementation of the Agreement and to ensuring quality in the development and delivery of the ARASIA programme.

Efforts continued aimed at strengthening cooperation among Member States 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. The strategy was used to design a focused regional programme for 2014–2015 that addresses Member State priorities as identified in the Europe Regional Profile (the medium term plan for 2014–2017), updated in November. Member States in the region worked with the Secretariat to reduce the number of regional and national technical cooperation projects for the 2014–2015 cycle, increasing Member State ownership and building a more focused programme that is expected to have a stronger impact.

During 2013, improving communication — both within the Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) and with external stakeholders — was a top priority owing to the limited visibility of the technical cooperation programme in the region. Under a technical cooperation project on Strengthening Communication and Partnerships in ARCAL Countries to Enhance Nuclear Applications and Sustainability, the Agency supported activities to increase the visibility of the ARCAL regional agreement and to advance and deepen regional partnerships. Two ARCAL strategies have been prepared: a partnership exercise was initiated in late 2013 to design a technical cooperation project for the 2016–2017

cycle in the field of the marine environment, and an action plan has been agreed to engage relevant United Nations agencies, institutional partners and other potential partners. The project proposal is expected to be complete by the end of 2014. Specific tools, including information management systems and communication guidelines to be followed in all ARCAL projects, were also developed.

The programme proposed by ARCAL for 2014–2015 was designed on the basis of the current Regional Strategic Profile for Latin America and the Caribbean (RSP), also taking into account the deliberations and priority setting for the new RSP currently under preparation. Strategic planning meetings were held with the aim of improving the regional technical cooperation programme in Latin America and the Caribbean, and of better delivering results in a timely and cost efficient manner. In November, relevant stakeholders of ARCAL met in Vienna to ensure that the commencement of the project would be well coordinated. Meeting participants were also briefed on ARCAL practices for communication and outreach.

The period of the rotating ARCAL presidency was extended to two years for better implementation of the newly adopted mechanisms for improving programme planning and monitoring.

Outreach and Communication

Agency outreach to the international development community was strengthened through participation in a number of international events, including the UN ECOSOC Innovation Fair in Geneva, the Eleventh Session of the Conference of the Parties (COP 11) of UNCCD in Namibia and the biennial International Waters Conference of IW:LEARN (UNDP–GEF) in Barbados. The Agency also participated in the European Development Days in Brussels. 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 and the Agency's General Conference, and the Agency 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 57th General Conference, highlighting technical cooperation activities (Fig. 2).

A fourth Seminar on Technical Cooperation, 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 89 web articles, nine photo essays and four videos during 2013, and now has some 1300 visitors a week. In 2013, the site received over 85 000 visits. More than 450 tweets were sent out from the @IAEATC Twitter account, which now has over 1500 followers. A number of new outreach products were issued, including an updated technical cooperation brochure.

FIG. 2. Exhibition by Ethiopia during the Agency's 57th General Conference.

Legislative Assistance

In 2013, the Agency continued to provide legislative assistance to its Member States through the technical cooperation programme. Country specific bilateral legislative assistance was provided to 16 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 (INIR) missions. Short term scientific visits to the Agency's Headquarters were organized for a number of individuals, allowing fellows to gain further practical experience in nuclear law.

" Exhibitions focusing on technical cooperation activities were organized for World Cancer Day and the Agency's General Conference, and the Agency took advantage of special 'UN Days' to implement targeted information campaigns, using social media and the web, to promote relevant technical cooperation activities."

The Agency organized the third session of the Nuclear Law Institute, in Baden, Austria, from 29 September to 11 October 2013. The two week course, which uses teaching methods based on interaction and practice, was established to meet the increasing demand by Member States for training in nuclear law 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-three 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.

A Workshop for Diplomats on Nuclear Law was organized in July, to provide diplomats and technical experts from Member States with a broad understanding of all aspects of nuclear law. The workshop was attended by 65 participants from 43 Member States. A similar workshop was held in Geneva in April.

A briefing for experts on nuclear law was held in Vienna in July, providing advanced training in nuclear law, particularly on special issues on international nuclear law governing the safe, secure and peaceful use of nuclear material and ionizing radiation, and on civil liability for nuclear damage. The briefing was attended by 17 legal experts from 15 Member States.

The third IAEA Treaty Event organized by the Secretariat took place during the 57th regular session of the Agency's General Conference. The event provided 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.

To raise the awareness of national policy makers about the importance of adhering to relevant international legal instruments adopted under the Agency's auspices, the Agency continued to organize 'awareness missions' to Member States, the latest of which took place in Thailand in August. Arrangements are being made with other Member States for the conduct of similar missions in 2014.

Annex

Note: Tables A24–A29 are available on the attached CD-ROM.

Table A1. Regular budget allocation and utilization of resources in 2013 by Programme and Major Programme (in euros)

Programme / Major Programme	Original budget $1/€1	Adjusted budget €1/ $1.3245	Obligations	Actuals	Expenditure	Unobligated balances
	a	b	c	d	e=c+d	f=b-e
1 Nuclear Power, Fuel Cycle and Nuclear Science						
Overall management, coordination and common activities	1 067 347	1 011 138	47 006	1 255 987	1 302 993	(291 855)
Nuclear Power	7 659 655	7 177 722	338 622	6 917 901	7 256 523	(78 801)
Nuclear Fuel Cycle and Materials Technologies	3 364 910	3 132 815	193 084	2 822 102	3 015 186	117 629
Capacity Building and Nuclear Knowledge Maintenance for Sustainable Energy Development	10 743 887	10 201 341	1 352 824	8 021 426	9 374 250	827 091
Nuclear Science	9 890 695	9 446 664	746 867	8 752 116	9 498 983	(52 319)
Corporate shared services	1 378 946	1 316 915	91 813	1 126 993	1 218 806	98 109
Total Major Programme 1	**34 105 440**	**32 286 595**	**2 770 216**	**28 896 525**	**31 666 741**	**619 854**
2 Nuclear Techniques for Development and Environmental Protection						
Overall management, coordination and common activities	4 838 966	4 639 994	763 370	3 827 823	4 591 193	48 801
Management of the coordinated research activities	715 336	685 335	49 581	670 400	719 981	(34 646)
Food and Agriculture	11 202 300	10 703 768	1 397 124	9 372 194	10 769 318	(65 550)
Human Health	9 583 937	9 117 334	1 231 568	7 844 737	9 076 305	41 029
Water Resources	3 440 738	3 279 750	363 313	2 835 925	3 199 238	80 512
Environment	6 026 933	5 742 658	118 228	5 594 563	5 712 791	29 867
Radioisotope Production and Radiation Technology	2 209 298	2 085 592	270 227	1 770 527	2 040 754	44 838
Corporate shared services	1 095 268	1 043 436	63 807	891 717	955 524	87 912
Total Major Programme 2	**39 112 776**	**37 297 867**	**4 257 218**	**32 807 886**	**37 065 104**	**232 763**
3 Nuclear Safety and Security						
Enhancing the global nuclear safety and security framework	714 986	678 692	42 742	655 343	698 085	(19 393)
Enhancing and strengthening capacity building, communications, knowledge networking, education and training	315 542	301 579	5 424	250 969	256 393	45 186
Nuclear Safety Action Plan	638 800	606 324	38 052	584 651	622 703	(16 379)
Incident and Emergency Preparedness and Response	3 445 988	3 222 202	180 754	3 040 694	3 221 448	754
Safety of Nuclear Installations	10 134 357	9 621 600	379 910	9 155 548	9 535 458	86 142
Radiation and Transport Safety	5 931 319	5 632 930	140 918	5 445 057	5 585 975	46 955
Management of Radioactive Waste	7 097 610	6 683 704	403 090	6 192 111	6 595 201	88 503
Nuclear Security	4 552 060	4 316 276	61 595	4 313 190	4 374 785	(58 509)
Corporate shared services	1 603 822	1 532 277	99 630	1 296 693	1 396 323	135 954
Total Major Programme 3	**34 434 484**	**32 595 584**	**1 352 115**	**30 934 256**	**32 286 371**	**309 213**
4 Nuclear Verification						
Overall management and coordination	2 976 983	2 824 785	335 764	3 015 704	3 351 468	(526 683)
Quality management	999 077	949 314	2 028	623 438	625 466	323 848
Resources management	1 364 170	1 304 668	4 717	1 111 052	1 115 769	188 899
Safeguards Implementation	108 888 763	103 428 202	11 577 315	88 253 811	99 831 126	3 597 076
Other Verification Activities	542 668	515 053	272	515 298	515 570	(517)
Development	10 344 225	9 798 995	2 255 111	9 449 600	11 704 711	(1 905 716)
Corporate shared services	5 513 133	5 276 844	445 576	4 933 313	5 378 889	(102 045)
Total Major Programme 4	**130 629 019**	**124 097 861**	**14 620 783**	**107 902 216**	**122 522 999**	**1 574 862**
5 Policy, Management and Administration Services						
Policy, Management and Administration Services	72 345 163	69 699 015	5 111 162	64 629 243	69 740 405	(41 390)
Corporate shared services	4 172 326	3 979 643	135 935	3 597 897	3 733 832	245 811
Total Major Programme 5	**76 517 489**	**73 678 658**	**5 247 097**	**68 227 140**	**73 474 237**	**204 421**
6 Management of Technical Cooperation for Development						
Management of Technical Cooperation for Development	19 903 653	19 020 572	723 943	18 187 525	18 911 468	109 104
Corporate shared services	813 417	772 498	36 635	705 800	742 435	30 063
Total Major Programme 6	**20 717 070**	**19 793 070**	**760 578**	**18 893 325**	**19 653 903**	**139 167**
Total Operational Regular Budget	**335 516 278**	**319 749 635**	**29 008 007**	**287 661 348**	**316 669 355**	**3 080 280**
Major Capital Investment Funding Requirements						
1. Nuclear Power, Fuel Cycle and Nuclear Science	—	—	—	—	—	—
2. Nuclear Techniques for Development and Environmental Protection	—	—	—	—	—	—
3. Nuclear Safety and Security	—	—	—	—	—	—
4. Nuclear Verification	1 682 710	1 682 710	258 089	1 056 261	1 314 350	368 360
5. Policy, Management and Administration Services	6 658 242	6 658 242	176 931	971 522	1 148 453	5 509 789
6. Management of Technical Cooperation for Development	—	—	—	—	—	—
Capital Regular Budget	**8 340 952**	**8 340 952**	**435 020**	**2 027 783**	**2 462 803**	**5 878 149**
Total Agency Programmes	**343 857 230**	**328 090 587**	**29 443 027**	**289 689 131**	**319 132 158**	**8 958 429**
Reimbursable work for others	2 417 027	2 259 071	—	3 200 038	3 200 038	(940 967)
Total Regular Budget	**346 274 257**	**330 349 658**	**29 443 027**	**292 889 169**	**322 332 196**	**8 017 462**

Column a: General Conference resolution GC(56)/RES/5 of September 2012 — adjusted to reflect the share of corporate shared services under each of the operational major programmes.

Column b: Original budget revalued at the United Nations average rate of exchange of US $1.3245 to €1 or €0.7550 to US $1.

Column c: Amounts related to purchase orders issued involving claims against resources for which expenditure authority has been given but not yet invoiced (paid).

Column f: The reimbursable work for others (RWfO) accounted for additional revenue of €940 967 which was fully expended in 2013. This amount represents expenditure in addition to that for which provisions were made in the Regular Budget. RWfO was entirely financed from other VIC based organizations and projects financed from the Technical Cooperation Fund and extrabudgetary resources.

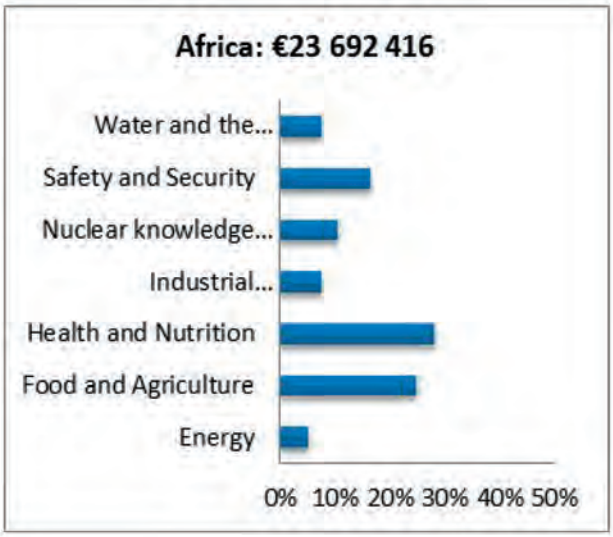
Table A2. Extrabudgetary regular programme fund resource utilization in 2013 by Programme and Major Programme (in euros)

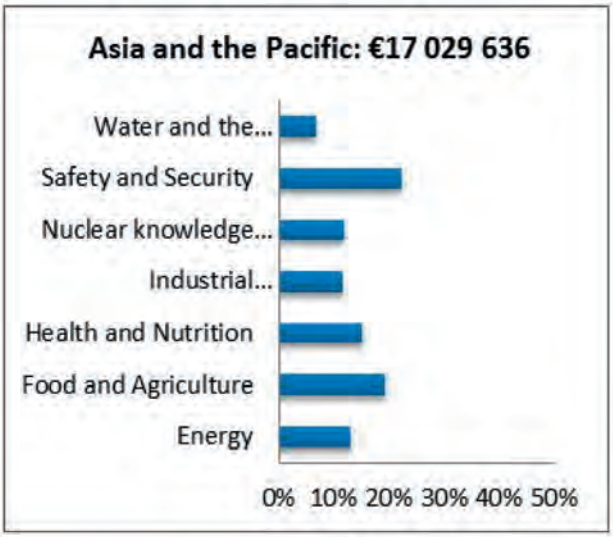
Summary of resource utilization by Programme and Major Programme	2013 expenditure
1 Nuclear Power, Fuel Cycle and Nuclear Science	
Overall management, coordination and common activities	84 328
Nuclear Power	3 554 208
Nuclear Fuel Cycle and Materials Technologies	1 826 000
Capacity Building and Nuclear Knowledge Maintenance for Sustainable Energy Development	637 140
Nuclear Science	928 443
Corporate shared services	—
Total Major Programme 1	**7 030 119**
2 Nuclear Techniques for Development and Environmental Protection	
Overall management, coordination and common activities	307 106
Management of the coordinated research activities	—
Food and Agriculture	2 543 026
Human Health	1 616 248
Water Resources	300 787
Environment	990 908
Radioisotope Production and Radiation Technology	—
Corporate shared services	—
Total Major Programme 2	**5 758 075**
3 Nuclear Safety and Security	
Enhancing the global nuclear safety and security framework	571 474
Enhancing and strengthening capacity building, communications, knowledge networking, education and training	2 791 616
Nuclear Safety Action Plan	3 200 373
Incident and Emergency Preparedness and Response	789 633
Safety of Nuclear Installations	5 942 172
Radiation and Transport Safety	1 664 543
Management of Radioactive Waste	2 254 077
Nuclear Security	16 982 147
Corporate shared services	—
Total Major Programme 3	**34 196 035**
4 Nuclear Verification	
Overall management and coordination	985 924
Quality management	—
Resources management	79 270
Safeguards Implementation	3 940 677
Other Verification Activities	10 094
Development	9 510 882
Corporate shared services	—
Total Major Programme 4	**14 526 847**
5 Policy, Management and Administration Services	
Policy, Management and Administration Services	1 157 949
Corporate shared services	—
Total Major Programme 5	**1 157 949**
6 Management of Technical Cooperation for Development	
Management of Technical Cooperation for Development	—
Corporate shared services	—
Total Major Programme 6	**—**
Total extrabudgetary programme funds	**62 669 025**

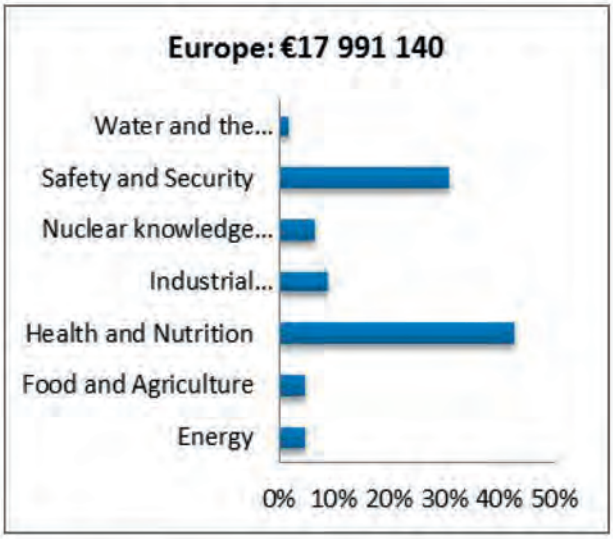
Table A3(a). Disbursements (actuals) by technical field and region in 2013

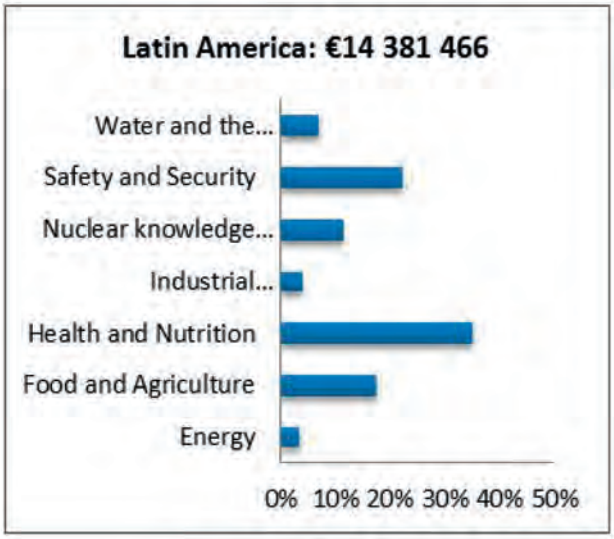
Summary of all regions (in euros)							
Technical field		**Africa**	**Asia and the Pacific**	**Europe**	**Latin America**	**Global/inter-regional**	**Total**
1	Energy	1 190 250	2 234 551	849 188	481 845	1 293 424	6 049 258
2	Food and Agriculture	5 857 708	3 306 717	829 117	2 480 811	309 963	12 784 316
3	Health and Nutrition	6 660 219	2 553 213	7 687 839	5 026 114	439 436	22 366 821
4	Industrial Applications/ Radiation Technology	1 793 596	1 958 004	1 603 257	548 748	49 842	5 953 447
5	Nuclear Knowledge Development and Management	2 520 934	1 991 200	1 152 723	1 663 859	1 596 212	8 924 928
6	Safety and Security	3 872 678	3 807 716	5 573 825	3 176 160	1 418 572	17 848 951
7	Water and the Environment	1 797 031	1 178 234	295 192	1 003 929	105 308	4 379 695
Total		**23 692 416**	**17 029 636**	**17 991 140**	**14 381 466**	**5 212 758**	**78 307 416**

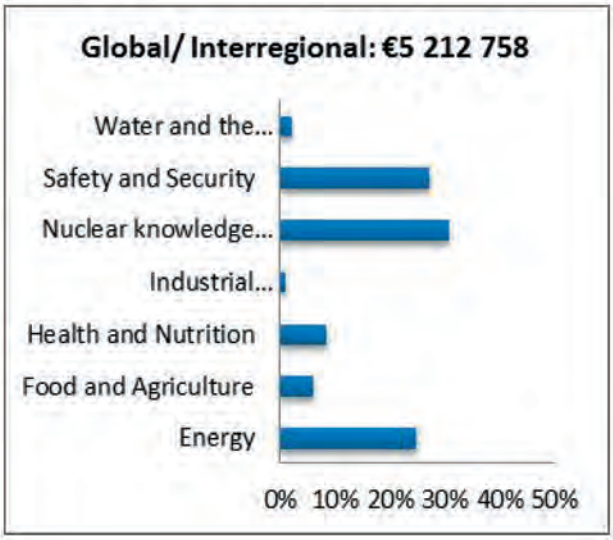
Table A3(b). Graphical representation of the information in Table A3(a)

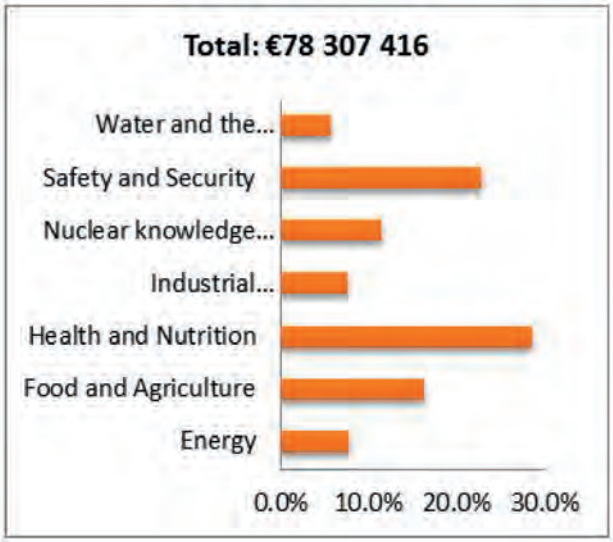












Note: See Table A3(a) for the full titles of the technical fields.

Table A4. Amount of nuclear material at the end of 2013 by type of agreement

Nuclear material	Comprehensive safeguards agreement[a]	INFCIRC/66-type agreement[b]	Voluntary offer agreement	Quantity in SQs
Plutonium[c] contained in irradiated fuel and in fuel elements in reactor cores	124 832	2 258	18 321	145 411
Separated plutonium outside reactor cores	1 912	5	10 399	12 316
HEU (equal to or greater than 20% U-235)	190	1	0.3	191
LEU (less than 20% U-235)	16 812	244	972	18 029
Source material[d] (natural and depleted uranium and thorium)	9 818	409	2 308	12 535
U-233	18	0.001	0	18
Total significant quantities (SQs)	**153 582**	**2 917**	**32 001**	**188 500**

Amount of heavy water at the end of 2013 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**	**0**	**431**

a Covering safeguards agreements pursuant to NPT and/or Treaty of Tlatelolco and other CSAs; including facilities in Taiwan, China.

b Covering facilities in India, Israel and Pakistan.

c The quantity includes an estimated amount (10 772 SQs) of plutonium (Pu) in fuel elements loaded into reactor cores and Pu in other irradiated fuel, which has not yet been reported to the Agency under agreed reporting procedures (the non-reported Pu is contained in irradiated fuel assemblies to which item accountancy and containment/surveillance measures are applied).

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 NPT and/or Treaty of Tlatelolco and other CSAs; including facilities in Taiwan, China.

g Covering facilities in India, Israel and Pakistan.

h In Taiwan, China.

Table A5. Number of facilities under safeguards during 2013

Facility type	Number of facilities			
	Comprehensive safeguards agreements (CSAs)[a]	INFCIRC/66-type agreements[b]	Voluntary offer agreements	Totals
Power reactors	240	11	1	252
Research reactors	147	3	1	151
Conversion plants	18	0	0	18
Fuel fabrication plants	43	2	1	46
Reprocessing plants	11	1	1	13
Enrichment plants	16	0	3	19
Separate storage facilities	121	1	4	126
Other facilities	74	0	0	74
Subtotals	**670**	**18**	**11**	**699**
Material balance areas containing locations outside facilities[c,d]	561	1	0	562
Totals	**1231**	**19**	**11**	**1261**

[a] Covering safeguards agreements pursuant to the NPT and/or the Treaty of Tlatelolco and other CSAs; includes facilities in Taiwan, China.

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

[c] Includes 52 material balance areas in States with the amended small quantities protocol.

[d] Excludes the material balance areas containing locations outside facilities of the Agency (2) and the European Commission in Luxembourg (1).

Table A6. Conclusion of safeguards agreements (CSAs), additional protocols (APs) and small quantities protocols (SQPs) (as of 31 December 2013)

State	SQP[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
The 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[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	X	In force: 17 Dec. 1999	586	

Table A6. Conclusion of safeguards agreements, additional protocols (APs) and small quantities protocols (SQPs) (as of 31 December 2013) (cont.)

State	SQP[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

Table A6. Conclusion of safeguards agreements, additional protocols (APs) and small quantities protocols (SQPs) (as of 31 December 2013) (cont.)

State	SQP[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Finland[13]		Accession: 1 Oct. 1995	193	In force: 30 April 2004
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	Signed: 15 May 2009
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	

Table A6. Conclusion of safeguards agreements, additional protocols (APs) and small quantities protocols (SQPs) (as of 31 December 2013) (cont.)

State	SQP[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Italy		In force: 21 Feb. 1977	193	In force: 30 April 2004
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	
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				

Table A6. Conclusion of safeguards agreements, additional protocols (APs) and small quantities protocols (SQPs) (as of 31 December 2013) (cont.)

State	SQP[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Monaco	Amended: 27 Nov. 2008	In force: 13 June 1996	524	In force: 30 Sept. 1999
Mongolia	X	In force: 5 Sept. 1972	188	In force: 12 May 2003
Montenegro	In force: 4 March 2011	In force: 4 March 2011	814	In force: 4 March 2011
Morocco	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]	X	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

Table A6. Conclusion of safeguards agreements, additional protocols (APs) and small quantities protocols (SQPs) (as of 31 December 2013) (cont.)

State	SQP[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
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
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 and Nevis[5]	X	In force: 7 May 1996	514	Approved: 10 Sept. 2013
Saint Lucia[5]	X	In force: 2 Feb. 1990	379	
St V. and the Grenadines[5]	X	In force: 8 Jan. 1992	400	
Samoa	X	In force: 22 Jan. 1979	268	
San Marino	Amended: 13 May 2011	In force: 21 Sept. 1998	575	
São Tomé and Príncipe				
Saudi Arabia	X	In force: 13 Jan. 2009	746	
Senegal	Amended: 6 Jan. 2010	In force: 14 Jan. 1980	276	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	

Table A6. Conclusion of safeguards agreements, additional protocols (APs) and small quantities protocols (SQPs) (as of 31 December 2013) (cont.)

State	SQP[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
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
Syrian Arab Republic		In force: 18 May 1992	407	
Tajikistan[30]	Amended: 6 March 2006	In force: 14 Dec. 2004	639	In force: 14 Dec. 2004
Thailand		In force: 16 May 1974	241	Signed: 22 Sept. 2005
The fYR 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[31] In force: 14 Aug. 1978 Signed: 6 Jan. 1993[14]	175 263* 	In force: 30 April 2004
United Rep. of Tanzania	Amended: 10 June 2009	In force: 7 Feb. 2005	643	In force: 7 Feb. 2005
United States of America	 X	In force: 9 Dec. 1980 In force: 6 April 1989[14]	288* 366	In force: 6 Jan. 2009
Uruguay[2]		In force: 17 Sept. 1976	157	In force: 30 April 2004
Uzbekistan		In force: 8 Oct. 1994	508	In force: 21 Dec. 1998
Vanuatu	In force: 21 May 2013	In force: 21 May 2013	852	In force: 21 May 2013
Venezuela[2]		In force: 11 March 1982	300	
Viet Nam		In force: 23 Feb. 1990	376	In force: 17 Sept. 2012
Yemen, Republic of	X	In force: 14 Aug. 2002	614	

Table A6. Conclusion of safeguards agreements, additional protocols (APs) and small quantities protocols (SQPs) (as of 31 December 2013) (cont.)

State	SQP[a]	Safeguards agreements[b]	INFCIRC	Additional protocols
Zambia	X	In force: 22 Sept. 1994	456	Signed: 13 May 2009
Zimbabwe	Amended: 31 Aug. 2011	In force: 26 June 1995	483	

Key

States: States not party to the NPT whose safeguards agreements are of INFCIRC/66-type.

States: Non-nuclear-weapon States that are party to the NPT but have not yet brought into force comprehensive safeguards agreements (CSAs) pursuant to Article III of that Treaty.

*: Voluntary offer safeguards agreement for NPT nuclear-weapon States.

Note: This table does not aim at listing all safeguards agreements that the Agency has concluded. Not included are agreements whose application has been suspended in light of the application of safeguards pursuant to a CSA. Unless otherwise indicated, the safeguards agreements referred to are CSAs concluded pursuant to the NPT.

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[a] Provided that they fulfil certain conditions (including that the quantities of nuclear material do not exceed the limits set out in paragraph 37 of INFCIRC/153), States with CSAs have the option to conclude a 'small quantities protocol' (SQP) that holds in abeyance the implementation of most of the detailed provisions set out in Part II of the CSA as long as these conditions continue to apply. This column contains countries whose SQP has been approved by the Board and for which, as far as the Secretariat is aware, these conditions 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 in Taiwan, China, under two agreements, INFCIRC/133 and INFCIRC/158, which entered into force on 13 October 1969 and 6 December 1971, respectively.

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

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

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

[7] The application of safeguards in Bulgaria under the NPT 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 in Cyprus under the NPT 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 in the Czech Republic under the NPT 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 in Denmark under the bilateral NPT 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, the agreement between the Agency and Denmark (INFCIRC/176) re-entered into force for Greenland. The Additional Protocol for Greenland entered into force on 22 March 2013 (INFCIRC/176/Add.1).

[12] The application of safeguards in Estonia under the NPT 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 in Finland under the bilateral NPT 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 (INFCIRC/193) between the non-nuclear-weapon States of Euratom, Euratom and the Agency, to which Finland had acceded, entered into force for Finland.

[14] The safeguards agreement referred to 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 in Greece under the NPT bilateral safeguards agreement INFCIRC/166, provisionally 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 in Hungary under the bilateral NPT 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 in Latvia under the bilateral NPT 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 in Lithuania under the bilateral NPT 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 in Malta under the bilateral NPT 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 referred to 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 SQP with New Zealand (INFCIRC/185) also apply to Cook Islands and Niue, the AP thereto (INFCIRC/185/Add.1) is not applicable to the Cook Islands and Niue.

[23] The application of safeguards in Poland under the NPT 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 in Portugal under the bilateral NPT 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 in Romania under the NPT 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 in Serbia (formerly Serbia and Montenegro) to the extent relevant to the territory of Serbia.

[27] The application of safeguards in Slovakia under the bilateral NPT 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 in Slovenia under the NPT 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 in Sweden under the NPT 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] The SQP ceased to be operational upon entry into force of the amendments to the SQP.

[31] 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 2013)

	State/Organization	P&I	VC	CPPNM	CPPNMAM	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 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									S		
	Bahamas			Pr											
*	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	Cs	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														
*	Bulgaria	Pr	P	P	Cs	P	P	P	P	P			P	X	X
*	Burkina Faso			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 2013) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNMAM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Burundi												P		
*	Cabo Verde			P											
*	Cambodia			P		P			P				P		
*	Cameroon	P	P	P		P	P	P					P		
	Canada	Pr		P	Cs	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		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
	DPRK					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											
*	Dominica			P											
*	Dominican Republic			P		P							P		
*	Ecuador	P		P									P		
*	Egypt	P	P			Pr	Pr	P	S				P		
*	El Salvador			Pr		Pr	Pr						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 2013) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNMAM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
	Equatorial Guinea			P											
*	Eritrea														
*	Estonia	P	P	P	Cs	P	P	P	P	P			P	X	X
*	Ethiopia												P	X	
*	Fiji			P	Cs										
*	Finland	P		Pr	Cs	P	Pr	P	P	P				X	X
*	France			Pr	Cs	Pr	Pr	S	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				Pr	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 2013) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNMAM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Ireland	P		Pr		P	Pr		P	P			P	X	X
*	Israel		Sr	Pr	Csr	Pr	Pr		S				P		
*	Italy	Pr		Pr		Pr	Pr	P	P	P	S	S		X	X
*	Jamaica	P		P									P		
*	Japan	P		P		P	Pr		P	Pr				X	X
*	Jordan	Pr		Pr	Cs	P	P		P				P		
*	Kazakhstan	P	P	P	Cs	P	P		P	P	P		P		
*	Kenya			P	Cs								P		X
	Kiribati														
*	Korea, Republic of	Pr		Pr		P	Pr		P	P			P	X	X
*	Kuwait	P		Pr		P	P		P				P		
*	Kyrgyzstan									P			P		
*	Lao People's Democratic Republic			Pr		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		
*	Malaysia					Pr	Pr						P		
	Maldives														
*	Mali			P	Cs	P	P		P				P		
*	Malta			P	Cs				P	P			P	X	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 2013) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNMAM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	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		
*	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	P		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		

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 2013) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNMAM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Peru		P	Pr		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		P	P						P		
*	Republic of Moldova	Pr	P	P	Cs	P	P		P	Pr			P		
*	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											
	St Kitts and Nevis			P											
	Saint Lucia			Pr	Cs										
	St Vincent and the Grenadines		P			P	P	P							
	Samoa														
	San Marino														
	São Tomé and 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				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

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 2013) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNMAM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	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		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											
	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		P		
*	United Kingdom	P	S	Pr	Cs	Pr	Pr	S	P	P				X	X
*	United Republic of Tanzania			P		P	P						P		
*	USA			P		Pr	Pr		P	P		Csr			
*	Uruguay		P	P		P	P	P	P	P			P	X	
*	Uzbekistan			P	Cs					P			P		
	Vanuatu														

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 2013) (cont.)

	State/Organization	P&I	VC	CPPNM	CPPNMAM	ENC	AC	JP	NS	RADW	PAVC	CSC	RSA	VI	XIV.A
*	Venezuela												P		
*	Viet Nam	P		Pr	Cs	Pr	Pr		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)
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 2013, 1 State adhered to the Agreement. By the end of the year, there were 84 Parties.

Vienna Convention on Civil Liability for Nuclear Damage (reproduced in INFCIRC/500). Entered into force on 12 November 1977. In 2013, 1 State adhered to the Convention. By the end of the year, there were 39 Parties.

Optional Protocol Concerning the Compulsory Settlement of Disputes (reproduced in INFCIRC/500/Add.3). Entered into force on 13 May 1999. In 2013, the status remained unchanged with 2 Parties.

Convention on the Physical Protection of Nuclear Material (reproduced in INFCIRC/274/Rev.1). Entered into force on 8 February 1987. In 2013, the number of Parties remained unchanged at 148 Parties.

Amendment to the Convention on the Physical Protection of Nuclear Material. Adopted on 8 July 2005. In 2013, 10 States adhered to the Amendment, bringing the total to 71 Contracting States.

Convention on Early Notification of a Nuclear Accident (reproduced in INFCIRC/335). Entered into force on 27 October 1986. In 2013, 3 States became Parties to the Convention. By the end of the year, there were 117 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 2013, 3 States became Parties to the Convention. By the end of the year, there were 111 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 2013, the status of the Protocol remained unchanged with 27 Parties.

Convention on Nuclear Safety (reproduced in INFCIRC/449). Entered into force on 24 October 1996. In 2013, 1 State became a Party to the Convention. By the end of the year, there were 76 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 2013, 4 States became Parties to the Convention. By the end of the year, there were 68 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 2013, 1 State became a Party to the Protocol. By the end of the year, there were 11 Parties.

Convention on Supplementary Compensation for Nuclear Damage (reproduced in INFCIRC/567). Opened for signature on 29 September 1997. In 2013, 2 States signed the Convention. By the end of the year, there were 4 Contracting States and 17 Signatories.

Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA). In 2013, 1 State concluded a RSA. By the end of the year, there were 121 States party to a 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 2013, 2 States became Parties to the Agreement. By the end of the year, there were 14 Parties.

African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) (Fourth Extension) (reproduced in INFCIRC/377). Entered into force on 4 April 2010. In 2013, 1 State became a Party to the Agreement. By the end of the year, there were 35 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 2013, 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) (First Extension) (reproduced in INFCIRC/613/Add.2). Entered into force on 29 July 2008. In 2013, the status remained unchanged with 9 Parties.

Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project (reproduced in INFCIRC/702). Entered into force on 24 October 2007. In 2013, 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 2013, the status remained unchanged with 6 Parties.

Table A9. Nuclear power reactors in operation and under construction in the world (as of 31 December 2013)[a]

Country	Reactors in operation		Reactors under construction		Nuclear electricity supplied in 2013		Total operating experience through 2013	
	No. of units	Total MW(e)	No. of units	Total MW(e)	TW·h	% of total	Years	Months
Argentina	2	935	1	692	5.7	4.4	70	7
Armenia	1	375			2.2	29.2	39	8
Belarus			1	1 109				
Belgium	7	5 927			40.6	52.1	261	7
Brazil	2	1 884	1	1 245	13.8	2.8	45	3
Bulgaria	2	1 906			13.3	30.7	155	3
Canada	19	13 500			94.3	16.0	655	7
China	20	15 977	29	28 774	104.8	2.1	160	0
Czech Republic	6	3 884			29.0	35.9	134	10
Finland	4	2 752	1	1 600	22.7	33.3	139	4
France	58	63 130	1	1 630	405.9	73.3	1 932	4
Germany	9	12 068			92.1	15.4	799	1
Hungary	4	1 889			14.5	50.7	114	2
India	21	5 308	6	3 907	30.0	3.5	397	6
Iran, Islamic Republic of	1	915			3.9	1.5	2	4
Japan	48	42 388	2	1 325	13.9	1.7	1 646	4
Korea, Republic of	23	20 721	5	6 370	132.5	27.6	427	1
Mexico	2	1 330			11.4	4.6	43	11
Netherlands	1	482			2.7	2.8	69	0
Pakistan	3	690	2	630	4.4	4.4	58	8
Romania	2	1 300			10.7	19.8	23	11
Russian Federation	33	23 643	10	8 382	161.7	17.5	1 124	2
Slovakia	4	1 815	2	880	14.6	51.7	148	7
Slovenia	1	688			5.0	33.6	32	3
South Africa	2	1 860			13.6	5.7	58	3
Spain	7	7 121			54.3	19.7	301	1
Sweden	10	9 474			63.7	42.7	412	6
Switzerland	5	3 308			25.0	36.4	194	11
Ukraine	15	13 107	2	1 900	78.2	43.6	428	6
United Arab Emirates			2	2 690				
United Kingdom	16	9 243			64.1	18.3	1 527	7
United States of America	100	99 081	4	5 633	790.2	19.4	3 912	4
Total[b, c]	**434**	**371 733**	**72**	**69 367**	**2 358.9**		**15 660**	**7**

[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;

39.8 TW·h of nuclear electricity generation, representing 19.1% of the total electricity generated.

[c] The total operating experience also includes shut down plants in Italy (80 years, 8 months), Kazakhstan (25 years, 10 months), Lithuania (43 years, 6 months) and Taiwan, China (194 years, 1 month).

Table A10. Emergency Preparedness Review (EPREV) missions in 2013

Type	Country
EPREV	Jordan

Table A11. Integrated Regulatory Review Service (IRRS) missions in 2013

Type	Country
IRRS	Belgium
IRRS	Bulgaria
IRRS	Czech Republic
IRRS	Poland
IRRS follow-up	Russian Federation
IRRS follow-up	United Kingdom

Table A12. Operational Safety Review Team (OSART) missions in 2013

Type	Location/nuclear power plant	Country
OSART follow-up	Yerevan	Armenia
OSART follow-up	Hongyanhe	China
OSART follow-up	Dukovany	Czech Republic
OSART corporate	Prague, ČEZ company	Czech Republic
OSART follow-up	Cattenom	France
OSART	Chooz	France
OSART follow-up	Smolensk	Russian Federation
OSART follow-up	Koeberg	South Africa
OSART follow-up	Seabrook	United States of America
OSART limited scope corporate	Slovenske Elektrarne	Slovakia

Table A13. Integrated Safety Assessment of Research Reactors (INSARR) missions in 2013

Type	Location/nuclear power plant	Country
INSARR	Tel Aviv, IRR-1 reactor	Israel
INSARR	Pavia, TRIGA reactor	Italy
INSAR follow-up	Piteşti	Romania
INSARR	Pretoria, SAFARI-1 reactors	South Africa

Table A14. Safety expert missions for research reactors based on the INSARR methodology in 2013

Type	Country
Expert mission	Bangladesh, Congo, Egypt, Ghana, Indonesia, Islamic Republic of Iran, Jordan, Morocco, Poland, Thailand, Uzbekistan

Table A15. Safety Aspects of Long Term Operation of Water Moderated Reactors Peer Review Service (SALTO) missions in 2013

Type	Location/nuclear power plant	Country
SALTO	Angra 1	Brazil
SALTO	Armenian Nuclear Power Plant	Armenia
SALTO follow-up	Paks	Hungary

Table A16. Design and Safety Assessment Review Service (DSARS) missions in 2013

Type	Location/nuclear power plant	Country
GRSR	AES 2006	Russian Federation
GRSR	ACPR1000+ conceptual design	China
IPSART	Kozloduy	Bulgaria
IPSART follow-up	Borssele	Netherlands
RAMP	Laguna Verde	Mexico
SAAP	Putra Jaya	Malaysia

Table A17. Education and Training Review Service (ETRES) missions in 2013

Type	Country
ETRES	Pakistan

Table A18. Site and External Events Design (SEED) missions in 2013

Type	Location/nuclear power plant	Country
SEED	Temelin	Czech Republic
SEED	Amman	Jordan
SEED	Ust-Kamenogorsk, LEU bank	Kazakhstan

Table A19. Site safety expert missions in 2013

Type	Country
Expert mission	Poland, Sri Lanka, Turkey

Table A20. Occupational Radiation Protection Appraisal Service (ORPAS) missions in 2013

Type	Country
Pre-ORPAS	Peru, United Republic of Tanzania, Venezuela

Table A21. Advisory missions in 2013

Type	Country
Regulatory infrastructure and control of sources	Benin, Bosnia and Herzegovina, Haiti, Kyrgyzstan, Montenegro, Nepal, Qatar, Sierra Leone, Tajikistan
Remediation	Kyrgyzstan

Table A22. International Nuclear Security Advisory Service (INSServ) missions in 2013

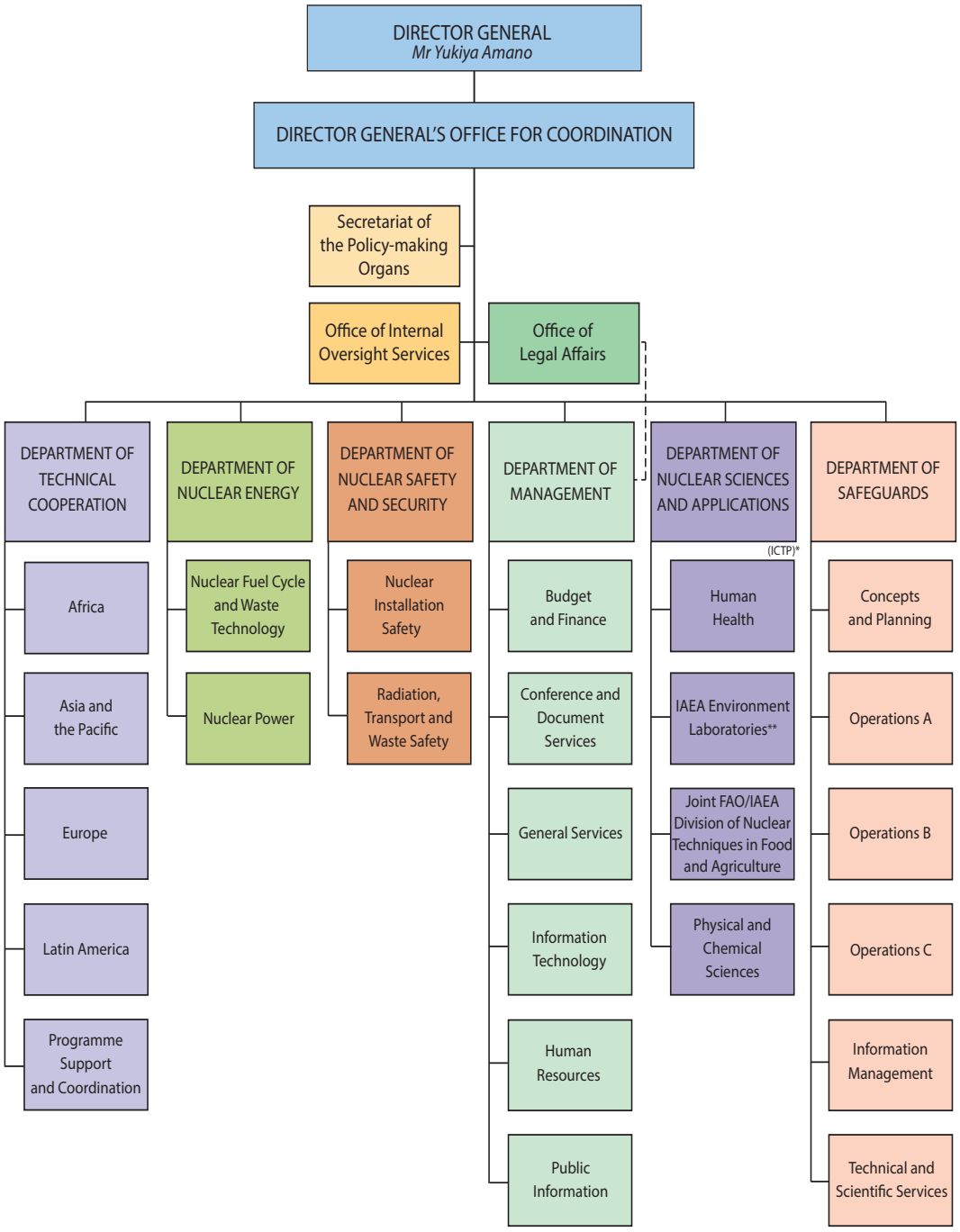
Type	Country
Detection and Response Systems and Measures	Albania, Chile, Tunisia
Institutional Infrastructure	Chile
Nuclear Security at Major Public Events	Belarus, Cambodia, Malaysia, Sri Lanka, Zambia, Zimbabwe

Table A23. International Physical Protection Advisory Service (IPPAS) missions in 2013

Type	Country
IPPAS	Australia, Hungary, United States of America, IAEA Laboratories (Seibersdorf)

ORGANIZATIONAL CHART

(as of 31 December 2013)



* 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

www.iaea.org

International Atomic Energy Agency
PO Box 100, Vienna International Centre
1400 Vienna, Austria
Telephone: (+43-1) 2600-0
Fax: (+43-1) 2600-7
Email: Official.Mail@iaea.org

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