

OVERVIEW

The International Atomic Energy Agency continued to play an important role in 2012. Consistent with its statutory mandate “to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world”, the Agency focused on: developing and transferring nuclear technologies for peaceful purposes to its Member States; contributing to the strengthening of the global nuclear safety framework and strengthening the security of nuclear material and facilities; and guarding against the proliferation of nuclear weapons. This overview surveys the state of the ‘nuclear world’ in 2012 from the perspective of the Agency.

NUCLEAR TECHNOLOGY

Nuclear Power

Status and trends

At the end of 2012, there were 437 nuclear power reactors in operation worldwide, with a total capacity of 372.1 gigawatts-electric (GW(e)), 1% more than at the beginning of the year. Only three reactors were permanently shut down. This compares with 13 permanent shutdowns in 2011 (12 of which were shut down in the aftermath of the accident at the Fukushima Daiichi nuclear power plant (the Fukushima Daiichi accident)).

Sixty-seven new reactors were under construction around the world at the end of the year. There were three new connections to the grid: Ningde-1 in China, and Shin-Wolsong-1 and Shin-Kori-2 in the Republic of Korea. In addition, two laid-up units, Bruce 1 and 2, were reconnected in Canada. Seven construction starts were recorded in 2012: Fuqing-4, Shidaowan-1, Tianwan-3 and Yangjiang-4 in China, Shin-Ulchin-1 in the Republic of Korea, Baltiisk-1 in the Russian Federation, and Barakah-1 in the United Arab Emirates (UAE).

The impact of the Fukushima Daiichi accident continued to be felt in 2012, slowing the expansion of nuclear power. However, Agency projections indicate significant growth in the use of nuclear energy worldwide — between 23 and 100% by 2030 — although its projections for 2030 are up to 9% lower than those made in 2011. Capacity is now expected to grow to 456 GW(e) in 2030 in the

Agency’s low projection and 740 GW(e) in the high projection. Growth is still centred in Asia, where 47 of the 67 reactors under construction are located, and in countries that already have operating nuclear power plants.

Rio+20 and the extension of the Kyoto Protocol

The United Nations Conference on Sustainable Development (also referred to as ‘Rio+20’), was held in June in Rio de Janeiro, Brazil, to review the progress made in sustainable development. The Rio+20 outcome document, *The Future We Want*, addresses several priority issues, including access to clean energy for everyone and ensuring that the energy produced does not contribute to climate change. The presentations on nuclear energy emphasized its low carbon source, which minimizes the greenhouse gases (GHGs) emitted in energy generation and mitigates the negative impact of climatic disruption on development.

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In November–December, the 18th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP-18) took place in Doha, Qatar, together with the 8th session of the Conference of the Parties to the Kyoto Protocol. The Parties to the Kyoto Protocol agreed to a second commitment period from 2013 to 2020. Without this commitment, the world would have had no international agreement limiting GHG emissions and nuclear power’s very low emissions would have less economic value.

Support to existing nuclear power programmes

There is continuing interest around the world in the long term operation of existing nuclear power plants. Thus, the trends of uprating the power

of these plants and of renewing or extending the licences of operating reactors continued in many countries. For example, the French Nuclear Safety Authority granted a ten year renewal of the operating licence for unit 2 of the Bugey nuclear power plant. In the United Kingdom, the Nuclear Decommissioning Authority was given permission to continue operating Wylfa-1 until September 2014 by transferring partially used fuel from unit 2. In the USA, six uprate applications were approved by the Nuclear Regulatory Commission (NRC).

The Agency organized the third International Conference on Nuclear Power Plant Life Management in Salt Lake City, Utah, USA, in May, with the sponsorship of the US Department of Energy and the NRC. The participants discussed ways to extend the life of operating nuclear power plants safely and cost effectively in a 'post-Fukushima world'.

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In September, at the second meeting of the Nuclear Operating Organizations Cooperation Forum, an initiative launched by the Agency in 2011, the participants shared operating experience and management strategies to help strengthen the effectiveness of nuclear operating organizations.

Launching nuclear power programmes

Countries with growing energy requirements continue to retain nuclear power as an important option to increase electricity production. Important steps taken by countries planning to introduce nuclear power included those of the UAE, which became the first country in 27 years to start construction of a first nuclear power plant. The Emirates Nuclear Energy Corporation poured the first concrete for the Barakah-1 unit after receiving a construction licence from the Federal Authority for Nuclear Regulation. This plant is scheduled to become operational in 2017, with three additional units planned for operation by 2020.

Several other countries took steps in 2012 towards constructing their first nuclear power plant. In June, Belarus hosted an Agency Integrated Nuclear

Infrastructure Review (INIR) mission. In July, Belarus signed a general contract for two WWER units from the Russian Federation. Turkey is also moving forward with its programme: after having signed a contract in 2010 to build four WWER-1200 units at the Akkuyu site, it announced plans to build a second nuclear power plant at Sinop. Other countries have confirmed their intention to proceed with the development of a national nuclear power programme; they have continued building infrastructure and are considering possible contractual arrangements. Some other Member States are actively preparing for a nuclear power programme, but have not taken a final decision.

Two other INIR missions were conducted in 2012, to Jordan and Vietnam. The INIR mission to Jordan in January was a follow-up visit to review the country's plans, developed in response to the recommendations from the first INIR mission in 2009. The mission noted that progress had been made since 2009, especially in activities related to the nuclear power plant project. The INIR mission to Vietnam was conducted in December. The mission found that the programme for introducing nuclear power enjoyed strong government support and recognized the progress achieved, including preparations for the construction of the Ninh Thuan Nuclear Power Project.

Energy assessment services

Designing appropriate national energy strategies to meet development needs and to provide sustainable modern energy services is becoming increasingly complex owing to the growing number of factors influencing energy choices. A comprehensive evaluation of all possible energy supply and demand options in terms of social, economic and environmental impacts is required. Since many Member States, particularly developing countries, lack the expertise and experience to undertake such a task, the Agency has been helping interested Member States increase their capabilities in analysing and planning national energy systems. For those with operating or planned nuclear power programmes, the Agency provides technical support for long term strategic planning of nuclear energy systems.

In 2012, the Agency's tools for analysing and planning national energy systems were used in more than 125 Member States. Over 650 energy analysts and planners from 69 countries were trained in the use of Agency tools for analysing and planning national

energy systems. For long term strategic planning of nuclear energy systems, the Agency's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) provides a methodology, training and assistance in conducting Nuclear Energy System Assessments (NESAs). In 2012, Belarus completed such an assessment, while NESAs for Indonesia and Ukraine are continuing. A 'NESA Support Package' for Member State assessments included an e-learning course on the INPRO methodology.

In 2012, INPRO launched SYNERGIES (Synergetic Nuclear Energy Regional Group Interactions Evaluated for Sustainability). The goal of this project is to identify and evaluate frameworks for globally sustainable nuclear energy systems.

Capacity building

Recruiting a high calibre nuclear workforce for the operation of nuclear power plants is a growing challenge, even for existing nuclear power programmes, because of retirements combined with increasing global demand for qualified staff. Planning the nuclear workforce of the future begins up to ten years before the trained personnel are needed. Also, continuous education and succession planning to take account of turnover is essential. In 2012, the Agency launched a self-assessment methodology to assist Member States in reviewing the adequacy of their existing national capacity building arrangements, and in strengthening them as necessary.

The preservation and management of nuclear knowledge is also a high priority for many Member States. In 2012, the Agency conducted Knowledge Management Assist Visits and workshops in Belarus, Estonia, the UAE and the United Republic of Tanzania. The goal was to increase awareness of the importance of knowledge management in the daily operations of nuclear organizations and to help managers to identify, using methods developed by the Agency, the staff positions most critical in terms of knowledge. Nuclear Energy Management Schools for young professionals from the nuclear sector were held at the Abdus Salam ICTP in Trieste, Italy, in Japan and in the UAE. Additionally, Nuclear Knowledge Management Schools were conducted in Trieste, the Russian Federation and Ukraine to share best practices.

Assurance of supply

In December 2010, the Board of Governors approved the establishment of the IAEA LEU bank. During 2012, the Secretariat continued work on the financial, legal and technical arrangements and site assessments for establishing the fuel bank, which will be located at the Ulba Metallurgical Plant in Kazakhstan. Pledges in excess of \$150 million have been made by Member States, the European Union and the Nuclear Threat Initiative (NTI) for the establishment of the LEU bank. By the end of 2012, pledges had been fully paid by Kuwait (\$10 million),

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Norway (\$5 million), the USA (approximately \$50 million) and the NTI (\$50 million). The European Union had paid €20 million of its pledged €25 million, and arrangements were being finalized with the UAE for its pledge (\$10 million).

Uranium resources

The uranium production cycle, involving exploration, mining and processing technology, and appropriate closure, is an important element in the sustainability of nuclear energy. In addition, the environmental and social impacts have to be minimized through good practices at all stages of the cycle. The 2011 edition of the 'Red Book', *Uranium 2011: Resources, Production and Demand*, issued jointly by the OECD/Nuclear Energy Agency and the Agency, identified conventional uranium resources recoverable at a cost of less than \$130/kg U at 5.3 million tonnes of uranium (Mt U). Uranium production worldwide rose significantly, largely as a result of increased production in Kazakhstan. At the beginning of 2012, uranium spot prices were at \$135/kg U, but finished the year at around \$115/kg U. However, long term prices for uranium remained steady at around \$158/kg U.

Small and medium sized reactors

Although the nuclear industry has historically pursued economies of scale, there is growing interest in small and medium sized reactors (SMRs)¹, partly because they require smaller investments and thus offer lower financial investment risks. Currently, approximately 45 innovative SMR concepts are at some stage of research and development. Two INPRO Dialogue Forums in 2012 brought together technology holders, users and other stakeholders to discuss how innovation in nuclear infrastructure and technology could contribute to the sustainability of nuclear energy.

Research reactors

Research reactors provide a neutron source for research and various other applications, including education and training, for the production of isotopes and for the irradiation of materials. They are small in comparison with power reactors since they do not produce electricity. As of the end of 2012, there were 247 operational research reactor facilities in the world. In addition, there were 15 research reactors in temporary shutdown mode and 150 in long term shutdown.

“The Agency continued to support efforts to minimize the civilian use of HEU ...”

As older research reactors are decommissioned and replaced by fewer, multipurpose, reactors, the number of operational research reactors is expected to continue to decrease. In 2012, existing research reactor regional networks or coalitions, facilitated by the Agency², helped foster greater international cooperation and assisted research reactors in expanding their stakeholder base.

¹ ‘Small’ refers to reactors less than 300 MW(e). ‘Medium sized’ refers to reactors between 300 and 700 MW(e).

² The Agency has set up research reactor coalitions in the following regions: the Baltic, the Caribbean (which includes participation from Latin America), Central Africa, Central Asia, Eastern Europe and the Mediterranean.

The Agency continued to support efforts to minimize the civilian use of HEU, including the conversion of the Maria research reactor in Poland, and the conversion and fuel repatriation of the TRIGA research reactors operated in Austria and Mexico. The efforts in Austria and Mexico marked the removal of all TRIGA HEU fuel from civilian nuclear applications worldwide. Repatriation shipments of all Russian origin research reactor fuel were also completed from Poland, Ukraine and Uzbekistan.

A new Agency service, the Operation and Maintenance Assessments for Research Reactors (OMARR) service, was launched to: conduct peer reviews of research reactor facilities; verify compliance with existing plant procedures; suggest areas of improvement; and facilitate mutual transfer of knowledge and experience between mission experts and reactor personnel. The first OMARR mission was completed in December at the reactor of the US National Institute of Standards and Technology (NIST) Center for Neutron Research.

Molybdenum-99

During 2012, the supply shortages of the past several years finally abated and production levels returned to normal, although questions remain regarding medium to long term supply. The conversion of medical isotope production processes from HEU to LEU continued with a renewed focus during this period. Australia announced the expansion of its LEU molybdenum-99 production capability, to meet approximately 25% of global demand. South Africa continued its commercial production of molybdenum-99 made from LEU targets as well as the conversion of its processes to the exclusive use of LEU, while two major medical isotope producers (Belgium and the Netherlands) also started implementation of plans to convert their commercial scale production processes from HEU to LEU.

Applications of Nuclear Technology

The application of nuclear technologies in the areas of food security, disease prevention and control, water resources and environmental management has increasing importance in the world today. In 2012, the Agency strengthened its partnerships, responding to the world’s food, environmental and cancer challenges by enhancing State and regional capacities to use relevant technologies for sustainable solutions.

Status

The use of e-learning technology is becoming an important part of the Agency's capacity building activities, with almost all areas of nuclear applications making training materials available remotely to professionals in developing countries. This cost effective approach has been very well received. In addition, the IAEA Collaborating Centres scheme – currently numbering 20 centres – continued to be utilized effectively in 2012, and laboratory networks continued to enhance the contribution of nuclear applications to sustainable development. At the end of the year, there were 114 active CRPs in various nuclear fields, comprising more than 1500 research, technical or doctoral contracts, and research agreements with institutions in more than 100 Member States.

The 50th anniversary of the Agency's nuclear applications laboratories at Seibersdorf was marked with an interactive exhibit highlighting the work of the eight laboratories. A side event was also organized during the 56th General Conference.

In order to build on the achievements over the past half-century, a modernization plan is under way to ensure that the Agency's nuclear applications laboratories in Seibersdorf continue to provide optimum services to Member States.

Food and agriculture

Trypanosomosis, a disease that sickens and kills both livestock and people, is transmitted by the tsetse fly. The disease makes it particularly difficult

to raise productive cattle in tsetse infested regions. Through a technical cooperation project, the Agency supports the Southern Rift Valley Tsetse Eradication Project (STEP) in Ethiopia's Rift Valley. Tsetse suppression activities have significantly reduced the prevalence of trypanosomosis in livestock in communities with about 116 000 farmers and 2.5 million cattle. The goal of STEP is to create a zone free of tsetse and trypanosomosis in an area covering 25 000 km² in the Southern Rift Valley to allow the introduction of mixed farming according to a land use plan being developed by the Ethiopian Government. In addition, this large project has developed the local infrastructure and capacity to mass rear sterile flies for the subsequent application of the sterile insect technique against two major tsetse species.

Determination of the genetic background (i.e. the DNA makeup) based on phenotypic characteristics of farm animals (i.e. those characteristics that can be seen) is a powerful tool for the improvement of productive performance and disease resistance. A 'Goat Radiation Hybrid Panel', which provides a resource for rapid and large scale physical mapping of the goat genome, was developed by the Agency. Now being distributed, the panel facilitates the phenotypic and genetic characterization of indigenous sheep and goat breeds in 16 Member States in Africa, Asia and Latin America. The panel also identifies molecular markers of economic interest, such as those related to improved productive performance, and markers related to improved resistance to infectious and metabolic diseases.

SCIENTIFIC FORUM 2012: FOOD FOR THE FUTURE

For nearly fifty years, applications of nuclear technology have been helping the world's farmers, contributing new varieties of crops, controlling pests, diagnosing livestock disease, improving soil and water management and increasing food safety. The Agency, working closely with FAO, has made these techniques available to farmers and food producers in developing countries.

The topic of the Scientific Forum at the 56th regular session of the General Conference in September addressed Agency activities in the fields of food production, food protection and food safety. The two day event on 'Food for the Future: Meeting the Challenges with Nuclear Applications' brought together experts and policy makers to consider how best to use nuclear techniques to increase food production, to control animal and plant diseases that threaten food supplies and to guard against food contamination.

The Forum was opened by the Agency's Director General and ministers from Indonesia, Kenya and Vietnam. The FAO Director-General, Mr. Graziano da Silva, delivered a video address. Each session featured a panel of experts who presented and discussed the benefits of nuclear techniques in food and agriculture.

Human health

In 2012, the Agency continued to improve and refine its educational resources in radiation medicine. The Human Health Campus, an educational web site for health professionals in radiation medicine, continues to receive great attention from practitioners in all Member States, including developed countries. Web based seminars (webinars) were tested as a new type of educational resource to provide Member States with regular material for strengthening and improving standards of practice. They will be conducted in partnership with major international scientific societies such as the Society of Nuclear Medicine and Molecular Imaging and the American Society of Nuclear Cardiology. Two webinars were conducted in 2012 with the attendance of 283 and 385 participants, respectively.

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An initiative called the ‘Nuclear Medicine Global Initiative’ was launched in 2012 to combat non-communicable diseases (NCDs) as a joint effort of the Agency and various scientific societies. This initiative aims to promote health and better management of NCDs, such as cardiac diseases and cancers, by: promoting the use of nuclear medicine techniques, including molecular imaging; encouraging global collaboration in education and harmonization of procedures and guidelines; and improving quality and safety in the use of nuclear medicine.

Programme of Action for Cancer Therapy (PACT)

The Agency set up the Programme of Action for Cancer Therapy in 2004 to leverage the impact of global partnerships in cancer control and technology transfer in radiation medicine. For the first time, representatives of the eight PACT Model Demonstration Sites (PMDS) — Albania, Ghana, Mongolia, Nicaragua, Sri Lanka, United Republic of Tanzania, Vietnam and Yemen — met in Vienna in

November with the Agency and its main partners in cancer control, including WHO, the International Agency for Research on Cancer and the Union for International Cancer Control, to review lessons learned and plan for the future.

The provision of the integrated missions of PACT (imPACT) as an Agency service to address Member State demand for comprehensive cancer control capacity and needs assessment continued to remain a priority. Thirteen Member States received imPACT missions in 2012, bringing the total number to 47 since PACT’s inception.

The pilot project for Africa of the Virtual University for Cancer Control and Regional Training Network (VUCCnet) entered a new phase in 2012 with the adoption of a policy harmonization framework by the six participating Member States. The adoption of the framework illustrates the commitment of the Member States to establishing, operating and sustaining VUCCnet in the region, a major step towards addressing the critical shortage of cancer professionals in Africa.

Water resources

The water resources programme assists Member States in the use of nuclear and isotope techniques to accurately assess water resources in order to better manage them. In collaboration with counterparts from Argentina, Brazil and Argonne National Laboratory in the USA, the first measurements of the long lived radionuclide krypton-81 were conducted in 2012 in the Guarani transboundary aquifer, where water ages above 500 000 years were found in deep ground waters. The information gathered in this study has important implications for understanding and modelling water flow and transport in large sedimentary basins and for the management of water resources in similar systems.

The Agency released a new software package to facilitate isotope data processing and standardization in isotope hydrology laboratories in 2012. Additionally, a new, low cost and compact tritium enrichment system for measuring low levels of environmental tritium in water samples was built and is being evaluated for potential transfer to Member States.

Environment

Nuclear techniques have an important role to play in the management of the environment. Activities in capacity building and training in 2012 by the

IAEA Environment Laboratories in Monaco and Seibersdorf included the production of new Certified Reference Materials according to ISO Guides 34 and 35, running inter-comparison exercises and proficiency tests, preparing methodologies and manuals, organizing training courses, and backstopping national, regional and interregional technical cooperation projects.

In response to the global challenges of ocean acidification, the Agency launched a project to support the Ocean Acidification International Coordination Centre (OA-ICC) at the IAEA Environment Laboratories in Monaco. Announced at Rio+20 in June 2012, the OA-ICC project brings together stakeholders concerned with ocean acidification, including scientists and researchers, policy makers and academics, the media and the general public. Supported by the Peaceful Uses Initiative, a funding vehicle to support the Agency's work in the peaceful application of nuclear technology, the goal of the project is to coordinate international efforts that aim at developing response strategies to the growing threat of ocean acidification.

NUCLEAR SAFETY AND SECURITY

Nuclear Safety

Status and trends

The world nuclear community made noteworthy progress in strengthening nuclear safety in 2012. For example, an overwhelming majority of Member States with operating nuclear power plants have undertaken and essentially completed comprehensive safety reassessments ('stress tests') with the aim of evaluating the design and safety aspects of plant robustness to protect against extreme events. As a result, many have introduced additional safety measures including mitigation of station blackouts and construction of higher protective walls. As of the end of 2012, safety performance indicator data on the 437 operating nuclear power plants showed that the operational safety level remained high. Of these plants, 162 have been in operation for more than 30 years, and 22 have been in operation for more than 40 years. Thus, long term operation and ageing are ongoing challenges for regulators, operators and utilities. Additionally, there are growing expectations that older nuclear reactors should meet enhanced safety objectives that are closer to those of recent reactor designs. The Fukushima Daiichi accident has shown the importance of applying new

safety knowledge to existing nuclear power plants throughout their lifetimes.

IAEA Action Plan on Nuclear Safety

The IAEA Action Plan on Nuclear Safety (the 'Action Plan') was adopted by all Member States at the 55th session of the General Conference in September 2011. Since its adoption, significant progress has been made in several key areas, such as assessments of safety vulnerabilities of nuclear power plants, strengthening of the Agency's peer review services, improvements in emergency preparedness and response capabilities, strengthening and maintaining capacity building, and widening the scope and enhancing communication and information sharing with Member States, international organizations and the public.

Significant progress has also been made in reviewing the Agency's safety standards, which have been widely applied by regulators, operators and the nuclear industry in general. The Agency has devoted greater attention to certain critical areas such as accident prevention, in particular severe accidents, and emergency preparedness and response. In addition, progress has been made in improving public information and enhancing transparency and communication during emergency situations.

"As of the end of 2012, safety performance indicator data on the 437 operating nuclear power plants showed that the operational safety level remained high."

The Agency also continued to share lessons learned from the Fukushima Daiichi accident with the nuclear community. Most notably, it convened three international experts meetings, on reactor and spent fuel safety, on communication in the event of a nuclear or radiological emergency, and on protection against extreme earthquakes and tsunamis.

In December 2012, the Fukushima Ministerial Conference on Nuclear Safety, organized by the Government of Japan in co-sponsorship with the Agency, was held in Fukushima Prefecture, Japan. The principal objective of the conference was to contribute to strengthening nuclear safety worldwide by providing another opportunity to share with the

international community, at the ministerial and expert levels, further knowledge and lessons learned from the Fukushima Daiichi accident, and to further enhance transparency, including the implementation of the Action Plan. The Conference provided yet another opportunity for the international community to reconfirm the importance of nuclear safety and to maintain and enhance the momentum towards strengthening nuclear safety worldwide. The conference was attended by over 700 delegates from 117 countries and 13 international organizations. Forty-six of these delegates attended at the level of minister or equivalent high rank, or as a head of organization.

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Improving regulatory effectiveness

Four Integrated Regulatory Review Service (IRRS) missions took place in 2012, bringing the total number of such missions since 2006 to 44. These missions seek to improve the effectiveness of a Member State’s regulatory structure. To meet the requirements set by the Action Plan, the Agency has developed and evaluated the efficiency and effectiveness of IRRS performance indicators. A series of nine meetings were held in 2012 with 28 international experts to review thematic modules and to enhance IRRS programme efficiency.

Operation of nuclear power plants and research reactors

Eight Operational Safety Review Team missions were conducted with the aim of improving operational safety of nuclear power plants. The focus of these missions continued to be on safety culture enhancement, severe accident management and long term operational management. With respect to safety culture, the Agency prepared a training course for self-assessment.

Given that 37% of the world’s nuclear power plants and 70% of research reactors have been

in operation for more than 30 years, ageing management continues to be an important issue. The Agency conducted three missions through its Safety Aspects of Long Term Operation of Water Moderated Reactors Peer Review Service.

Protection of patients from high radiation doses

Protecting people and the environment from the harmful effects of ionizing radiation and providing for high levels of safety are an integral part of the Agency’s activities. On the whole, the exposure of the global population has risen rapidly, almost wholly due to the medical uses of radiation. There is thus an urgent need to protect patients and medical staff from unnecessary and unintended exposure to high radiation doses. In 2012, the Agency organized an international conference, co-sponsored by WHO and held in Bonn, Germany, on ‘Radiation Protection in Medicine – Setting the Scene for the Next Decade’. The conference issued the ‘Bonn Call for Action’, which urged international bodies to support the goal of “the highest benefit with the least possible risk to all patients and appropriate use of ionizing radiation for diagnosis and treatment”.

Code of conduct on radioactive material

Radioactive material that has been inadvertently incorporated into scrap metal and semi-finished metal products may have potentially severe health, environmental and financial consequences. In 2012, the Agency further developed and sent for Member State comments a draft Code of Conduct on the Transboundary Movement of Radioactive Material Inadvertently Incorporated into Scrap Metal and Semi-Finished Products of the Metal Recycling Industries. The goal is to facilitate an international consensus that will harmonize Member State approaches regarding this issue.

Incident and emergency preparedness and response

To support building emergency preparedness in Member States, the Agency published four publications and training materials, and made significant progress in the process to revise the Safety Requirements publication *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GS-R-2). In assisting Member States in applying its standards and guides, the

Agency also held training courses and workshops, and conducted Emergency Preparedness Review (EPREV) missions. Under the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and the Convention on Early Notification of a Nuclear Accident, the Agency also organized various levels of exercises, referred to as 'Convention Exercises' (ConvEx).

The EPREV service assists Member States in appraising their preparedness for nuclear and/or radiological emergencies, irrespective of the causes. EPREV missions can cover all aspects of the emergency preparedness arrangements at a specific installation to a full appraisal of all arrangements in a requesting Member State, including on-site, off-site and national arrangements. In 2012, EPREV missions were conducted in Armenia, Bosnia and Herzegovina, Croatia, Kazakhstan, Lithuania, Serbia, Uruguay and Vietnam, while the regulatory aspects of national radiation emergency preparedness systems were assessed in Finland, Greece, Slovakia and Sweden within the framework of IRRS missions.

The Response and Assistance Network expanded in 2012, with three new members registering their National Assistance Capabilities and existing members adding new capabilities to their registrations. The Agency also published an *Operations Manual for Incident and Emergency Communications*. All of these activities supported the response to a number of radiological emergencies, some of which required assistance missions organized by the Agency.

The Agency continued to build its own, as well as inter-agency, emergency preparedness capabilities. This included training for staff members in the Incident and Emergency System, and cooperation with international organizations through exercises to strengthen the inter-agency framework for preparedness for and response to radiation emergencies.

Conventions: A status report

In August 2012, the Contracting Parties to the Convention on Nuclear Safety (CNS) met in Vienna for their Second Extraordinary Meeting to discuss, inter alia, the lessons learned from, and the actions taken in response to, the Fukushima Daiichi accident, reviewed the effectiveness of the CNS, and considered a set of future actions for strengthening nuclear safety. An organizational meeting for the Sixth Review Meeting, to be held in 2014, was also convened.

The Fourth Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management was held in May with the participation of 54 Contracting Parties. The meeting discussed proposals to increase the effectiveness of the Convention, including several amendments to the guidelines regarding the review process, and agreed to continue discussions at inter-session meetings.

The Sixth Meeting of the Representatives of Competent Authorities Identified 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 took place in Vienna in April. Discussions were held on, inter alia, the effectiveness of the conventions. In addition, there was agreement to explore proposals to enhance the implementation of notification and information sharing arrangements.

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Civil liability for nuclear damage

The International Expert Group on Nuclear Liability (INLEX) continues to serve as the Agency's main forum for questions related to nuclear liability. At its 12th regular meeting in May, INLEX finalized its “recommendations on how to facilitate achievement of a global nuclear liability regime”, as requested by the Action Plan.

Five IAEA-INLEX missions aimed at informing national policy makers about the relevant international legal instruments for achieving a global nuclear liability regime were dispatched to Jordan, Republic of Korea, South Africa, Ukraine and Vietnam. Informal discussions continue to be held with other Member States interested in hosting an IAEA-INLEX mission. A workshop on civil liability for nuclear damage was held in May at Headquarters and provided participants with an introduction to the subject.

Nuclear Security

Strengthening the nuclear security infrastructure

During the year, the Agency continued to assist States in strengthening and supporting nuclear security through guidance, education and training, advisory services and peer reviews. Increased emphasis was given to assisting States in their development of the requisite nuclear security infrastructure, including cyber security and nuclear forensics. The Agency's important role in nuclear security was reflected in a number of different forums, including the Second Nuclear Security Summit (in March), the 16th Summit of the Non-Aligned Movement (in August) and the High-Level Meeting on Countering Nuclear Terrorism (in September).

In 2012, States reported two incidents involving HEU in unauthorized activities to the Incident and Trafficking Database. There were also three incidents involving IAEA Category 1–3 radioactive sources (i.e. sources posing a very high risk to human health if not managed safely and securely), two of which were thefts. Such incidents underline the need for continued efforts to improve nuclear security globally.

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Implementing the Nuclear Security Plan

The Agency continued to encourage Member State involvement in the development and review of IAEA Nuclear Security Series publications. To this end, it established the Nuclear Security Guidance Committee (NSGC). At its first meeting, the NSGC approved the *Nuclear Security Fundamentals*, which include the essential elements for a State's national nuclear security framework, and which was subsequently endorsed by the Board of Governors and the General Conference.

The Amendment to the Convention on the Physical Protection of Nuclear Material has yet

to enter into force. Given the importance of the entry into force of the Amendment, the Agency, in the course of the year, organized three regional workshops and other national workshops to make States aware of the importance of this instrument. It also encouraged States to make full use of the assistance available for this purpose through active participation in its nuclear security programme.

The Agency started preparations for the International Conference on Nuclear Security, to be held in Vienna in July 2013. It was decided that the Conference will be at the ministerial level and will provide a global forum for ministers, policy makers and experts from all areas of nuclear security. The aim is to review experience and achievements to date, enhance understanding of current approaches and formulate views on future priorities.

NUCLEAR VERIFICATION

Implementation of Safeguards in 2012

At the end of each year, based upon an evaluation of all safeguards relevant information available to it for that year, the Agency draws a safeguards conclusion for each State for which safeguards are applied. In 2012, safeguards were applied for 179 States³ with safeguards agreements in force with the Agency.^{4, 5}

For the Agency to be able to conclude that all nuclear material in a State remained in peaceful activities, both a comprehensive safeguards agreement (CSA) and an additional protocol (AP) should be in force, and the Agency must have been able to conduct all necessary verification and evaluation activities. By the end of 2012, of the 114 States with both a CSA and AP in force, the Agency was able to draw such a conclusion for 60.⁶ For the other 54 States, the Agency was only able to conclude that *declared* nuclear material remained in peaceful activities, as all the necessary evaluations had yet to be completed.

³ The 179 States do not include the Democratic People's Republic of Korea, where the Agency did not implement safeguards and, therefore, could not draw any conclusion.

⁴ And Taiwan, China.

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

⁶ And Taiwan, China.

For the 57 States with a CSA, but with no AP in force, the Agency was only able to conclude that *declared* nuclear material remained in peaceful activities, as the Agency did not have sufficient tools to provide credible assurances regarding the absence of *undeclared* nuclear material and activities.

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 and APs. For these States, the Secretariat concluded that nuclear material to which safeguards had been 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 Secretariat concluded that the nuclear material, facilities or other items to which safeguards were applied remained in peaceful activities.

The Secretariat could not draw any safeguards conclusions for the 13 NPT non-nuclear-weapon States without safeguards agreements in force.

During 2012, the Director General submitted four reports to the Board of Governors on the implementation of the NPT Safeguards Agreement and relevant provisions of United Nations Security Council resolutions in the Islamic Republic of Iran (Iran). While the Agency continued throughout 2012 to verify the non-diversion of declared nuclear material at the nuclear facilities and locations outside facilities declared by Iran under its Safeguards Agreement, as Iran did not provide the necessary cooperation, including by not implementing its Additional Protocol, as required in the binding resolutions of the Board of Governors and the United Nations Security Council, the Agency was unable 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. In light of the Board of Governors' November 2011 resolution, during 2012 the Agency and Iranian officials held seven rounds of talks in Vienna and Tehran aimed at reaching agreement on a structured approach for the clarification of all outstanding issues related to Iran's nuclear programme. On 13 September 2012, the Board, in resolution GOV/2012/50 (adopted by a vote), stressed that it was essential for Iran to immediately conclude and implement such an approach. Nevertheless, no agreement was reached

and substantive work on the outstanding issues did not begin.

In August 2012, the Director General submitted a report to the Board of Governors on the Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic (Syria). The Director General informed the Board that the Agency had not received any new information from Syria or other Member States 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. In February 2012, in response to an Agency proposal to hold further discussions to address all the outstanding questions, Syria indicated that it would provide a detailed response at a later time, noting the difficult prevailing security situation in the country. The Agency has taken note of Syria's position and has reiterated its request to Syria to hold further discussions to address all the outstanding questions. For 2012, the Agency was able to conclude for Syria that declared nuclear material remained in peaceful activities.

“By the end of 2012, of the 114 States with both a CSA and AP in force, the Agency was able to draw such a conclusion for 60.... For the other 54 States, the Agency was only able to conclude that declared nuclear material remained in peaceful activities, as all the necessary evaluations had yet to be completed.”

In August 2012, the Director General submitted a report to the Board of Governors and General Conference on the application of safeguards in the Democratic People's Republic of Korea (DPRK), which provided an update of developments since the Director General's report of September 2011. As the Agency has not been able to implement any verification measures in the DPRK since April 2009, it could not draw any safeguards conclusion regarding the DPRK. Statements by the DPRK about uranium enrichment activities and the construction of a light water reactor in the DPRK continue to be deeply troubling. The Agency continued to monitor the DPRK's nuclear activities by using open source information, satellite imagery and trade information, and 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.

Conclusion of Safeguards Agreements and Additional Protocols

The Secretariat continued to implement its *Plan of Action to Promote the Conclusion of Safeguards Agreements and Additional Protocols*, which was updated in September 2012. Outreach events in 2012 included a briefing on the Agency's safeguards for States in the Pacific region (held in Fiji in June 2012), and a regional seminar on safeguards for States in the greater Caribbean region with limited nuclear material and activities (held in Mexico City in June 2012).

"In the Clean Laboratory Extension building, the Agency's first multi-collector inductively coupled plasma mass spectrometer was brought into service to further improve the precision of analysis of uranium and plutonium particles collected through environmental sampling."

In 2012, CSAs entered into force for one State and APs for five States. Small quantities protocols that reflect the revised text were brought into force in four States.

Other Developments

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 *Research and Development Programme for Nuclear Verification 2012–2013*. At the end of 2012, 21 States had formal support programmes with the Agency, supporting over 300 tasks, valued at over €20 million per annum. During 2012, the Secretariat finalized the review of its R&D activities implemented in 2010–2011 and published the *Biennial Report on the Research and Development Programme for Nuclear Verification 2010–2011*.

During the year, the Agency conducted 117 safeguards training courses for safeguards staff, including its revised 'Introductory Course on Agency

Safeguards', and its long-standing, ten month Safeguards Traineeship Programme graduated six participants — from Central African Republic, Chile, Malaysia, Namibia, South Africa and Sudan.

The project entitled 'Enhancing Capabilities of the Safeguards Analytical Services (ECAS)' achieved significant progress. Construction of the Nuclear Material Laboratory (NML) building at Seibersdorf progressed on schedule and within budget, reaching 70% completion in 2012. The building is expected to be ready for commissioning in mid-2013, with a year long transfer of scientific functions from the old laboratory to follow. In the Clean Laboratory Extension building, the Agency's first multi-collector inductively coupled plasma mass spectrometer was brought into service to further improve the precision of analysis of uranium and plutonium particles collected through environmental sampling.

MANAGEMENT OF TECHNICAL COOPERATION FOR DEVELOPMENT

The Global Development Context

The technical cooperation programme is the primary vehicle for the delivery of Agency capacity building services to Member States, through which it contributes to the achievement of the UN Millennium Development Goals (MDGs). In 2012, the global development context for the Agency's technical cooperation programme included the initiation of United Nations system-wide deliberations on the post-2015 development agenda — the target date for the attainment of the MDGs. Global discussions were informed by the preliminary assessment of advances towards the achievement of the MDGs, as well as by the findings and resolutions passed at Rio+20. Science, technology and innovation — significant Agency strengths — have played an important role and are expected to play a larger role in development initiatives after 2015.

In many areas of the Agency's technical cooperation programme, nuclear technology offers important advantages and complementarities. As a large part of this programme addresses areas where the Agency does not have the lead mandate in the United Nations system, partnerships with relevant actors are crucial for the Agency to meet its strategic goal of promoting tangible socioeconomic impact in Member States. Over the past five years, the Agency has made a particular effort to participate in the United Nations Development Assistance

Framework (UNDAF) processes and to build on complementarities with the activities of UN country teams in support of national development priorities, including the achievement of the MDGs.

In addition to the Agency's established partnership with the FAO through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, and the WHO-IAEA Joint Programme on Cancer Prevention and Control, cooperation with UNIDO was established in 2012 in the field of cleaner industrial production processes, and further collaboration is expected in energy planning. In the field of nutrition, collaboration was established with UNICEF and WHO. In the fight against desertification, land degradation and drought, cooperation was established with UNDP, the United Nations Convention to Combat Desertification, the World Overview of Conservation Approaches and Technologies, and the Global Soil Partnership. Furthermore, collaboration with WHO and the Pan American Health Organization was expanded in the areas of cancer, medical physics, NCDs and nutrition.

The Technical Cooperation Programme in 2012

In 2012, health and nutrition accounted for the highest proportion of 'actuals', or disbursements, in the technical cooperation programme, at 26.2%. This was followed by safety and security at 22.6%, and by food and agriculture at 14.8%. By the end of the year, financial implementation of the Technical Cooperation Fund (TCF) stood at 76.5% (Fig. 1).

At the regional level, in Africa, Agency assistance focused on meeting basic human needs through the safe utilization of nuclear technology, and on supporting human and institutional capacity building. Continued efforts were made to align Agency support with Member State national development plans and the AFRA Regional Strategic Cooperative Framework, concentrating mainly on food and agriculture, human health, water resources management, industrial applications, environment, energy and safety. The application of nuclear techniques in these areas contributed to increased food and water security, improved health care and environmental management, and enhanced productive capacity in the region. In addition, the Agency also prioritized building and strengthening partnerships with, for example, the Organization of Islamic Cooperation and the Islamic Development Bank on cancer control in Africa, and mobilized

initial resources to begin a large scale water project in the Sahel region. Special attention was also given to helping African Member States strengthen their nuclear safety and national regulatory infrastructure.

“Over the past five years, the Agency has made a particular effort to participate in the United Nations Development Assistance Framework (UNDAF) processes and to build on complementarities with the activities of UN country teams in support of national development priorities, including the achievement of the MDGs.”

In Asia and the Pacific, the technical cooperation programme continued to focus on the most prevalent development needs of individual countries and on addressing global and emerging issues of regional significance. Some ten countries are currently taking steps towards building nuclear power infrastructure in preparation for launching nuclear power programmes in the future. Support to countries embarking on this path, and for the assessment of energy options, continued to be one of the main priorities for the region. Member States are re-emphasizing human health related applications, for example, upgrading the use of nuclear technologies in the diagnosis and treatment of diseases, focusing on the safe use of ionizing sources, and adopting quality assurance practices. In this respect, the programme promoted strong regional cooperation to enhance capacities in Asia and the Pacific, seeking to further strengthen the existing centres of excellence and regional resource centres, and to enable South-South cooperation and complementarity in knowledge, expertise, products and services.

In Europe, technical cooperation activities covered the development of nuclear power, applications in health care and industry, and environmental protection and remediation. Major emphasis was placed on maintaining appropriate levels of safety and security in all aspects of the peaceful use of nuclear technology.

In Latin America the key thematic areas for the region continue to be safety, food and agriculture, environmental management and human health. During 2012, management focused on enhancing

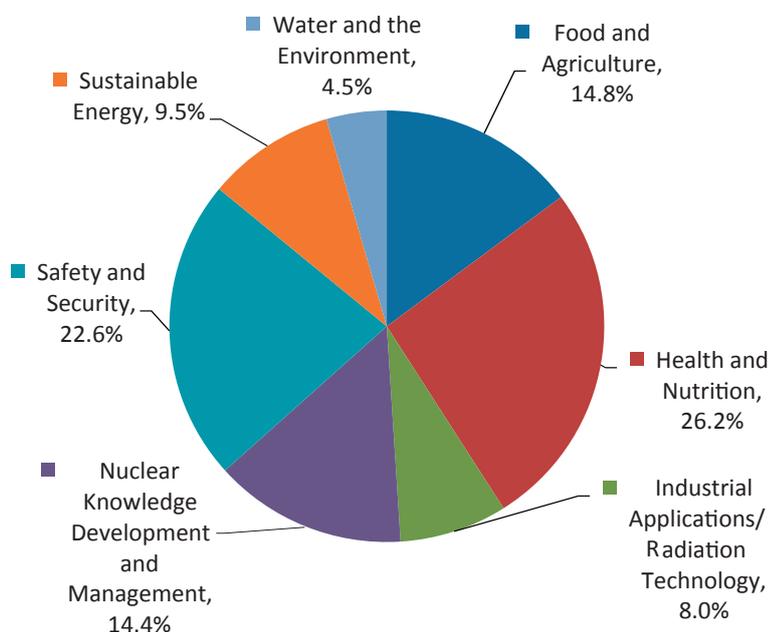


FIG. 1. Actuals by grouped fields of activity in 2012 (percentages in charts may not add up to 100% due to rounding). Nuclear safety includes transport safety and the safe management of radioactive waste. Nuclear fuel cycle includes predisposal and disposal of nuclear fuel waste.

“Cooperative arrangements in all regions continue to be key strategic mechanisms to expand cooperation, collaboration and coordination with other partners at the regional and international levels.”

accountability for results, improving work planning and management capabilities, and programme integration. For instance, the project formulation process for the 2014–2015 technical cooperation programme cycle began in close association with the priorities reflected in the 2007–2013 ARCAL Regional Strategic Profile for Latin America and the Caribbean, and with the ARCAL management committee. Stakeholder participation in the project preparation process was also a management priority. The application of quality criteria continued to guide planning and design, as did new approaches to results based budgeting, minimum technical criteria for regional projects and a more strategic approach to procurement. The management strategy in the Latin America region is emphasizing synergy between national and regional programmes, and highlighting the regional programme as a means to promote long

term technical collaboration between institutes, as well as technical self-reliance and leadership within the region.

Cooperative arrangements in all regions continue to be key strategic mechanisms to expand cooperation, collaboration and coordination with other partners at the regional and international levels.

Programme Quality

The Agency continued to focus on further improving programme quality and transparency, responding to Member State requests for better programme monitoring and efficiency. Training for programme management officers, national liaison officers and technical officers was provided to ensure that all project proposals submitted to the technical cooperation programme for consideration would be of high quality in terms of consistency, clarity and logic, with specific, measurable, attainable, realistic and timely objectives. Special efforts were made to ensure that Member States received systematic feedback and information in a timely fashion. Further efforts to improve monitoring of the implementation of technical cooperation projects will be put into practice

in 2013, including 'project progress assessment reports', a field monitoring mission and a project self-evaluation methodology.

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 €70.7 million in 2012, with approximately €58.1 million for the TCF (including assessed programme costs (APCs), national participation costs⁷ (NPCs) and miscellaneous income), €11.4 million in extrabudgetary resources, and about €1.2 million representing in-kind contributions.

The rate of attainment⁸ for the TCF stood at 89.3% on pledges and at 88.3% on payments at the end of

2012, while payment of NPCs totalled €2.8 million (Fig. 2).

Actuals

In 2012, approximately €68.8 million was disbursed to 125 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 Draft Programme and Budget 2014–2015

In developing the proposals for the Agency's draft Programme and Budget 2014–2015, the

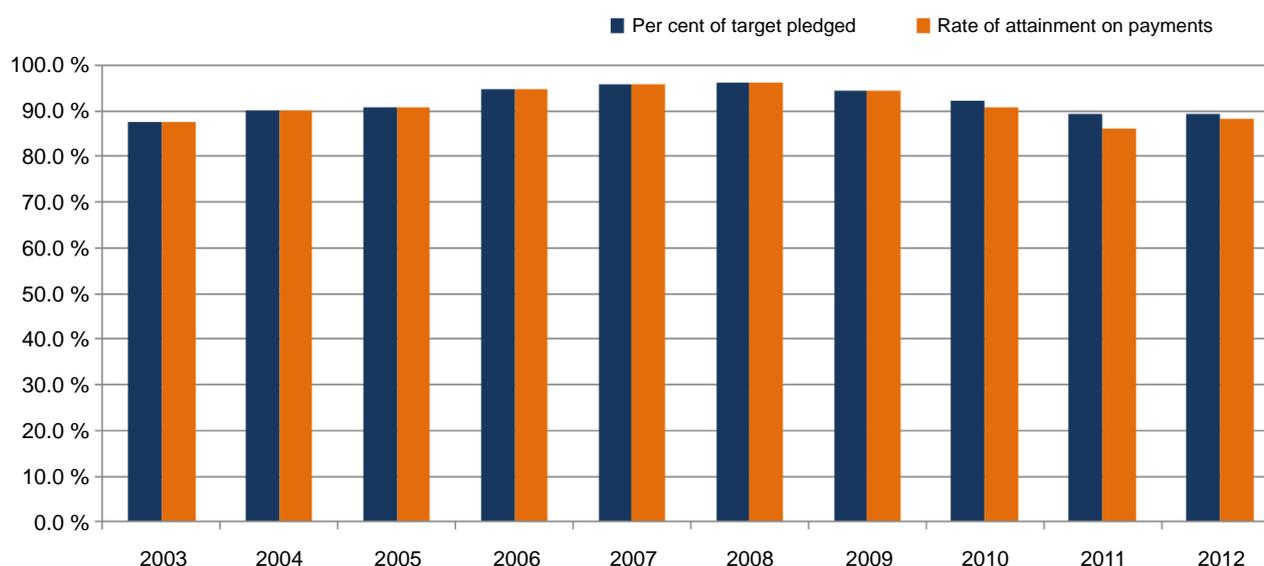


FIG. 2. Trends in the rate of attainment, 2003–2012.

⁷ *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 of the assessed amount for the programme must be paid before contractual arrangements for the projects may be made.

⁸ 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.

Secretariat focused in 2012 on maximizing efficiency, prioritizing tasks and finding an appropriate balance among the Agency's activities. At the same time, due consideration was given to meeting the continuing demand from Member States for the Agency's services.

AIPS

The Agency-Wide System for Programme Support (AIPS), an enterprise resource planning system that is being used to re-engineer the Secretariat's business processes, is now half-way through its implementation cycle. The new system fully implements the results based

management approach, integrating the Agency's goals, as contained in its *Medium Term Strategy 2012–2017*, with the planning and execution of programmes and projects and the assessment of their effectiveness. In 2012, the project concluded its second phase with the introduction of a new system for planning the Agency's budgets, expenditure forecasting, assessment and registering of risk. For the first time, the Agency's draft Programme and Budget 2014–2015 was prepared using the 'Oracle Hyperion Planning' tool. Under the second phase of the project, information relating to contacts such as suppliers, customers and meeting participants

will be centrally controlled using sophisticated management tools.

The Agency's Financial Statements

For the first time, *The Agency's Financial Statements for 2011* were in compliance with International Public Sector Accounting Standards, known as IPSAS. The External Auditor released an unqualified opinion on the Financial Statements. The successful introduction of IPSAS represents a milestone in the Agency's management reform efforts.