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# Overview

The Agency's Statute was approved 60 years ago, in October 1956. With its entry into force in July 1957, the International Atomic Energy Agency was officially established with the objective of accelerating and enlarging the "contribution of atomic energy to peace, health and prosperity throughout the world" while ensuring that "assistance provided by it ... is not used in such a way as to further any military purpose". Six decades on, the Agency continues to make tangible contributions in these areas and remains committed to meeting emerging global challenges in order to improve health, prosperity, peace and security around the world, and to help Member States achieve their development goals. By continuously adapting its diverse programmatic activities, within the framework of its Statute, the Agency has maintained the flexibility to address the evolving needs of Member States.

Under the banner '60 Years of IAEA — Atoms for Peace and Development', commemorative events were organized to mark the Agency's 60th anniversary during the Agency's General Conference in 2016. Among them were a photo exhibition, a special issue of the *IAEA Bulletin*, and a series of documentary films highlighting key areas of activities and the Agency's unique contribution to international peace and development, past and present.

This chapter provides an overview of some of the major global nuclear related developments in 2016 and how they were addressed through the Agency's work. During 2016, programmatic activities focused, in a balanced manner, on developing and transferring nuclear technologies for peaceful applications, enhancing nuclear safety and security, and strengthening nuclear verification and non-proliferation efforts worldwide.

## NUCLEAR TECHNOLOGY

### Nuclear Power

#### *Status and trends*

The global generating capacity of nuclear energy reached 391 gigawatts (electrical) (GW(e)) at the end of 2016. Ten new reactors were connected to the grid during the year, bringing the number of operational nuclear power reactors to 448. Construction started on 3 reactors, with a total of 61 reactors under construction around the world; 3 reactors were permanently shut down.

The Agency's 2016 projections for 2030 showed an increase in global nuclear power capacity of 1.9% in the low case scenario and 56% in the high case scenario. The new capacity to be added by 2030 is expected to greatly exceed the net increase in global nuclear capacity, as new nuclear power reactors replace those scheduled for retirement. Near and

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long term growth prospects remained centred in Asia, home to 40 of the 61 reactors under construction, and 47 of the 55 reactors connected to the grid since 2005.

### *Major conferences*

In May, the Agency organized the International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes, the first major event to address both decommissioning and remediation. More than 540 experts from 54 Member States and 4 international organizations discussed progress made in developing programmes and shared examples of successful decommissioning and remediation. Participants committed themselves to scaling up decommissioning and remediation efforts as more facilities around the world reach the end of their operating life.

In November, the Agency, in cooperation with the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA), organized the Third International Conference on Nuclear Knowledge Management: Challenges and Approaches. Held in Vienna, the event attracted more than 450 participants from 61 Member States and 10 international organizations, and featured 16 satellite events and 25 exhibitions. Participants focused on practical experience and provided examples of how knowledge management supports operational efficiency, reliability and sustainability.

### *Climate change and sustainable development*

The Paris Agreement on climate change entered into force on 4 November 2016, just before the 22nd session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP22), in Marrakesh, Morocco. The Agreement calls for limiting the global temperature rise to below 2°C above pre-industrial levels. At COP22, the Agency highlighted the role of nuclear technology in meeting the 2°C target at a side event held in cooperation with several organizations in the United Nations system. The Agency continued to present technical information about the role nuclear power, as a low carbon energy source, can play in meeting the climate–energy challenge and in contributing to sustainable development.

### *Energy assessment services*

The Agency provided technical support to Member States conducting energy planning studies and assessing the potential role of nuclear power in meeting their future energy needs sustainably. Through national and regional technical cooperation projects, it carried out expert missions and provided energy assessment training and fellowships. The Agency also enhanced and updated its energy planning tools and models, tested a new cloud service for their use, and developed revised projections on global nuclear power capacity for 2030–2050.

Two INPRO (International Project on Innovative Nuclear Reactors and Fuel Cycles) Dialogue Forums held in 2016 drew more than 130 participants from over 35 Member States and 4 international organizations. The first Dialogue Forum, in April, addressed advanced nuclear energy systems; the second, in October, considered legal and institutional issues of global deployment of small modular reactors.

### *Support to operating nuclear power plants*

Wireless technologies for transferring process and diagnostic information offer many potential benefits. To explore their possible adoption by the nuclear sector, the Agency launched a coordinated research project (CRP) aimed at developing and demonstrating advanced wireless communication techniques for use in instrumentation and control

systems of nuclear power plants. The project will address key areas such as relevant codes and standards, nuclear specific environments, computer security and a range of technological issues associated with wireless communication.

### *Launching nuclear power programmes*

The Agency continued to assist some 30 countries that are considering, planning or starting a nuclear power programme. In 2016, Integrated Nuclear Infrastructure Review (INIR) missions were conducted to Kazakhstan and Malaysia, and INIR follow-up missions were conducted to Bangladesh and Poland. The INIR peer review service assists Member States in determining the status of their infrastructure, analysing gaps in the planning process and preparing an Integrated Work Plan for receiving a structured assistance package from the Agency. Since INIR's launch in 2009, 21 missions have been conducted to 15 Member States.

### *Capacity building, knowledge management and nuclear information*

The Agency continued to support Member States with established nuclear power programmes as well as newcomer countries by hosting meetings, workshops, training sessions and schools, and by providing e-learning materials and support to nuclear education networks and master's programmes in nuclear technology management. In 2016, the Agency held courses in the Republic of Korea, Mexico and Tunisia on understanding the physics and technology of advanced reactors using PC based simulators. A new Agency course on the use of computational fluid dynamics for design and safety analysis of nuclear power plants was held in China. The Agency conducted a workshop in Kenya on nuclear technology assessment, designed to assist newcomer countries in evaluating available nuclear power technologies against country specific environments, site requirements and energy needs.

The Agency's International Nuclear Information System (INIS) database, supported by 130 Member States and 24 international organizations, reached a new milestone of 4 million records and 2.7 million views. The IAEA Library continued to coordinate research support and document delivery among the 55 members of the International Nuclear Library Network.

### *Assurance of supply*

Significant progress was made on the IAEA Low Enriched Uranium (LEU) Bank project in 2016. Construction of the IAEA LEU Storage Facility began in early September and is proceeding on schedule. Kazakhstan expects that the IAEA LEU Storage Facility will be commissioned and ready to receive LEU in the second half of 2017. The Agency started activities in preparation for LEU acquisition.

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

### *Fuel cycle*

The Agency organized over 30 meetings and workshops in 2016 aimed at increasing fuel cycle sustainability. This included four Technical Meetings, four Research Coordination Meetings, two training activities and 25 consultancy meetings on uranium exploration, resources and production; environmental remediation of uranium mining activities; fuel engineering; and spent fuel management. In July, the Agency and the OECD/NEA jointly published *Uranium 2016: Resources, Production and Demand*, commonly referred to as the 'Red Book'.

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## *Technology development and innovation*

As a follow-up of the IAEA Action Plan on Nuclear Safety, the Agency organized a Technical Meeting on Phenomenology and Technologies Relevant to In-Vessel Melt Retention and Ex-Vessel Corium Cooling in October. The event provided a forum to exchange the most recent R&D results, and to discuss strategies and measures for retaining molten core material in the reactor or containment vessel. The Agency also released an upgraded version of the Severe Accident Management Guideline Development (SAMG-D) Toolkit and, in December, held a training workshop on understanding the role of severe accident management guidelines.

In September, the Agency held a Technical Meeting on Technology Assessment of Small Modular Reactors for Near Term Deployment, in Beijing, China. The meeting helped Member States to stay informed about advances in small and medium sized or modular reactor (SMR) technology and identify designs available for near term deployment. In December, a Technical Meeting on the Design and Operation Aspects of Pressurized Water Reactor Based Small and Medium Reactors, held in Islamabad, Pakistan, focused on providing developing countries that are launching a nuclear power programme with information on the general design features, system and component descriptions, parameters and integrated plant operation of a 300 MW(e) nuclear power reactor. During the year, the Agency published *Design Safety Considerations for Water Cooled Small Modular Reactors Incorporating Lessons Learned from the Fukushima Daiichi Accident* (IAEA-TECDOC-1785). The report presents common considerations, approaches and measures for enhancing the operational safety performance of SMR designs to cope with extreme natural hazards.

In the area of fast reactors, the Agency concluded a four year CRP entitled 'Benchmark Analyses of an EBR-II Shutdown Heat Removal Test' and launched a new CRP entitled 'Radioactive Release from the Prototype Fast Breeder Reactor under Severe Accident Conditions'. The Abdus Salam International Centre for Theoretical Physics (ICTP) and the Agency held a joint workshop on the physics and technology of innovative nuclear energy systems for sustainable development, in Trieste, Italy, in August and September.

The Agency continued to support work on non-electrical applications of nuclear power. During the year, it held a meeting of the Technical Working Group on Nuclear Desalination and organized Technical Meetings on the user-vendor interface and the socioeconomic aspects of nuclear cogeneration. The Agency also conducted the third Research Coordination Meeting of its CRP on application of advanced low temperature desalination systems to support nuclear power plants and non-electric applications.

### *Research reactors*

The Agency provided training and carried out expert missions and outreach activities to support Member States in various aspects of planning, construction, operation and maintenance, and utilization of research reactors. During the year, it published *History, Development and Future of TRIGA Research Reactors* (Technical Reports Series No. 482) and a brochure entitled *Research Reactors: Purpose and Future*. The Agency continued to assist Member States, upon request, in minimizing the civilian use of high enriched uranium by supporting the conversion of research reactors and of targets for radioisotope production. In September, the last remaining 61 kilograms of high enriched uranium was repatriated from Poland to the Russian Federation.

### *Radioactive waste management, decommissioning and environmental remediation*

In 2016, the Agency held 68 Technical and Consultancy Meetings aimed at helping Member States to strengthen their capabilities and improve practices in radioactive waste

management, decommissioning of installations and remediation of contaminated sites. It also launched 14 new e-learning modules in English and in Russian on decommissioning, disused sealed radioactive sources (DSRSs) and disposal; developed public areas to provide access to basic information on web sites on the IAEA CONNECT platform; conducted 12 field missions on DSRSs; and updated guidelines and self-assessment questionnaires in ARTEMIS, the Agency's new Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation.

### *Nuclear fusion*

The 26th IAEA Fusion Energy Conference, held in October in Kyoto, Japan, attracted about 1000 participants – the highest number of attendees in the Conference's history. The Agency continued to lead the coordination of global Demonstration Fusion Power Plant (DEMO) related activities in 2016, including through the fourth DEMO Programme Workshop, held in November in Germany.

### *Nuclear data*

In 2016, the Agency provided the nuclear community with relevant nuclear data: under its leadership, new and improved nuclear data libraries for  $^{235}\text{U}$  and  $^{238}\text{U}$  were developed for the Collaborative International Evaluated Library Organization (CIELO).

### *Accelerator applications*

The Agency expanded the Accelerator Knowledge Portal in 2016 to include geographic information on the accelerators listed. It also launched a CRP that will focus on the use of ion beams to analyse objects of art and to simulate damage in materials such as fuel cladding and nuclear waste forms. In December, the Agency held an experts meeting to discuss the effects of radiation on cultural heritage objects; the meeting was also used to plan future activities in this area.

Through the IAEA–Elettra Sincrotrone Trieste X ray fluorescence beamline, the Agency provided research time, training and support to research groups from 18 Member States.

### *Nuclear instrumentation*

In April, the Agency installed an X ray fluorescence ultra-high vacuum chamber (UHVC) at its Nuclear Science and Instrumentation Laboratory at Seibersdorf. The UHVC will be used to train researchers in the use of the IAEA–Elettra Sincrotrone Trieste beamline.

The Agency successfully completed its project to develop an unmanned aerial vehicle (UAV) based mobile gamma spectrometry system to monitor radiation levels in Fukushima Prefecture. The new system was handed over to the Fukushima Prefectural Centre for Environmental Creation in July. During the year, the Agency's mobile spectrometry team carried out missions to Argentina, Japan, Nepal and Zambia. Team members used both a backpack detector based system and, in Argentina and Japan, the new UAV based system to monitor radiation levels on the earth's surface.

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## **NUCLEAR SCIENCES AND APPLICATIONS**

The Agency continued to develop and transfer nuclear technologies to Member States. Efforts in 2016 focused, in particular, on helping Member States use nuclear and isotopic techniques to achieve the Sustainable Development Goals (SDGs) related to food and agriculture, human health, water resources, environment, and radioisotope production

and radiation technology. The Agency also focused on helping to address emerging and urgent Member State needs by providing nuclear derived techniques to areas affected by the Zika virus to help quickly identify and respond to outbreaks of the disease, and by providing expertise to assess the structural integrity of affected buildings in countries hit by earthquakes. These activities were carried out largely through the Agency's CRPs and Collaborating Centres in Member States, with technology transferred through technical cooperation projects.

The Agency also supported Member States through e-learning platforms such as the Human Health Campus and through human health apps. In 2016, the Agency developed two new tools: FIGO, an app that helps doctors evaluate the extent of cancer in women; and NUCARD, an app designed to help medical practitioners choose the right treatment for patients with cardiovascular disease.

### *Renovation of the Nuclear Applications Laboratories (ReNuAL)*

Work on the Renovation of the Nuclear Applications Laboratories (ReNuAL) project progressed on schedule and within budget in 2016. Construction began in March with the installation of the new electrical infrastructure required to support the new laboratory buildings. This work was completed in June and construction began in July. By the end of 2016, the foundation and concrete structure of the Insect Pest Control Laboratory had been completed and work on the interior had begun.

In September, the Agency met its extrabudgetary funding target of €20.6 million to reach ReNuAL's overall €31 million budget, with bilateral contributions from 25 Member States and a collective contribution from the African Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA).

Further construction required to complete the modernization of the Nuclear Applications laboratories in Seibersdorf will be addressed under ReNuAL Plus (ReNuAL+), the follow-up of ReNuAL. By the end of 2016, seven Member States had pledged or provided more than €4 million in additional extrabudgetary funds for ReNuAL+.

## **Food and Agriculture**

### *Diagnosis and control of disease outbreaks*

The Agency, in partnership with the Food and Agriculture Organization of the United Nations (FAO), through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, responded rapidly to help Member States fight outbreaks of several zoonotic and transboundary animal diseases in 2016. These included outbreaks of avian influenza HPAI-H5N1 virus in Burkina Faso, Cameroon, Côte d'Ivoire, Niger and Nigeria, and HPAI-H7N9 virus in China; lumpy skin disease in Eastern Europe and the Balkan region (Albania, Bulgaria, Greece, Montenegro, Serbia and the former Yugoslav Republic of Macedonia); and peste des petits ruminants in China and Mongolia. The Agency continued to help countries in Africa build capacity to prepare for and address potential threats from Ebola virus outbreaks. More than 72 veterinary diagnostic staff from 22 Member States were trained in the detection and differentiation of Ebola virus at the animal-human interface. The Agency also provided training courses on nuclear derived techniques for detecting the Zika virus to 31 participants from 20 Member States. Additionally, 9 training courses with 153 trainees were conducted and 15 emergency toolboxes were provided to African Member States for the containment of emerging transboundary animal and zoonotic diseases. These were facilitated through the VETLAB network of veterinary diagnostic laboratories and the technical cooperation programme.

## *Climate-smart agriculture*

The Agency expanded its climate-smart soil and water management project in the Kassala region of the Sudan to include more than 1000 female farmers. Introduced in 2015 through the Joint FAO/IAEA Division and in cooperation with scientists from the Agricultural Research Corporation (ARC) in the Sudan, the project helps rural female farmers use low-cost drip irrigation technology combined with fertilizer to produce vegetables. Scientists from ARC used nuclear and isotopic techniques to determine the nitrogen fertilizer use efficiency and the vegetable water requirement. By applying appropriate levels of fertilizer and using drip irrigation technology to deliver the right amount of water for the hot and water-scarce climate, the women are able to grow vegetables for their families and increase the nutritional value of their diet. As most of the farmers involved are refugees, the project has drawn the support of organizations such as the Sudanese Red Crescent Society, the Talawiet Organization for Development and the Office of the United Nations High Commissioner for Refugees. It is seen as a way to both help empower women and make rural Sudanese communities stronger, and to promote the sustainable use and protection of precious water and soil resources.

## **Human Health**

### *International Conference on Integrated Medical Imaging in Cardiovascular Diseases*

The second International Conference on Integrated Medical Imaging in Cardiovascular Diseases (IMIC 2016) was held in Vienna in October, aimed at improving the understanding of medical imaging's role in the management of cardiovascular diseases. The conference provided clinicians, scientists and professionals with an international forum for reviewing the latest developments in all aspects of integrated medical imaging as applied to cardiovascular diseases, including the importance of quality management as an integral part of clinical practice. Some 350 professionals from 88 Member States attended the conference, and more than 1000 took advantage of the live streaming of conference sessions. Notably, IMIC 2016 had the support of 17 professional organizations in the field of nuclear medicine, cardiology and radiology. The conference fulfilled the rigorous requirements of the European Union of Medical Specialists' European Accreditation Council for Continuing Medical Education, and participants were awarded 27 European Continuing Medical Education Credits.

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### *Stable isotope techniques to reduce stunting*

Stunting is caused by chronic undernutrition and recurrent infections during the most critical period of childhood growth and development. About 159 million children under five years of age are too short for their age and are considered stunted. In 2016, the Agency established a new four year interregional technical cooperation project entitled 'Contributing to the Evidence Base to Improve Stunting Reduction Programmes', in collaboration with CARE, the Inter-American Development Bank (IADB), the United Nations Children's Fund (UNICEF) and the World Bank. Twelve countries in Africa, Asia and Latin America are taking part in the project. Participants have been trained in using stable isotope techniques to help evaluate interventions to address stunting and are in the process of receiving study supplies and obtaining ethical approval for the different studies. These include studies on the impact of breastfeeding promotion programmes on exclusive breastfeeding rates, and the influence of behaviour change communication, micronutrient supplementation and fortified complementary foods on body composition. The project ultimately aims at

determining the effect of increased rates of exclusive breastfeeding and improved body composition on subsequent stunting prevalence.

## Water Resources Management

### *IWAVE Project pilot phase*

The United Nations estimates that more than two billion people around the world are living under water stress — a number that is likely to increase in the coming decades. In 2016, the pilot phase of the IAEA Water Availability Enhancement (IWAVE) Project, funded through the Peaceful Uses Initiative, was completed in Costa Rica, Oman and the Philippines. The Agency helped each State to develop a comprehensive approach to identifying gaps in its national hydrological information, as well as its capacity for sustainable water resources management, through nation-wide institutions with a mandate on water. The Project provided training in approaches to data sharing, and fostered dialogue and collaboration that led to new data collection and an improved understanding of resource availability. The Agency worked with experts in Costa Rica to develop a national ‘Agenda for Water’ outlining the country’s goals. In Oman, it helped develop a scientifically sound assessment of groundwater in the agriculturally important Samail catchment. In the Philippines, it strengthened the capacity of the National Water Resources Board and the Philippine Nuclear Research Institute to assess groundwater resources and their vulnerability to pollution in two of the country’s nine water stressed regions. The IWAVE methodology as tested in the pilot phase, and lessons learned therein, will be integrated into new technical cooperation projects.

## Environment

### *Thirtieth anniversary of the Marine Environmental Studies Laboratory (MESL)*

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In 2016, the Marine Environmental Studies Laboratory (MESL) in Monaco celebrated its 30th anniversary. MESL was established to help Member States monitor marine pollution in close collaboration with the Regional Seas Programme of the United Nations Environment Programme (UNEP). Over the years, the Agency, through MESL, has developed a comprehensive approach to strengthening Member State capacities that includes proficiency tests to check laboratory performance, the development of analytical methods and training of scientists in the determination of hazardous contaminants, and the establishment of quality assurance and quality control procedures in laboratories. During 30 years of continuous collaboration with UNEP and the Regional Seas Programme, the Agency has trained more than 400 scientists in 59 training courses at MESL and organized 48 proficiency tests and 31 interlaboratory comparison analyses of contaminants in marine environmental samples, contributing to the generation of quality assured pollution data by Member States.

### *Proficiency tests and training courses*

The Agency organized two training courses on the analysis of trace elements and organic contaminants (chlorinated pesticides, polychlorinated biphenyls and petroleum hydrocarbons) in marine samples. Ten scientists from eight Mediterranean Member States participated in the courses, which were developed in collaboration with the UNEP Mediterranean Action Plan. The training courses included theoretical and practical workshops on sampling techniques at sea, sample preparation and the application of analytical methods for the determination of contaminants. The Agency also organized two



proficiency tests, one on the determination of trace elements in marine biota, with the participation of 31 laboratories from 14 Member States, and one on the determination of organic contaminants in marine sediment, with the participation of 23 laboratories from 13 Member States.

## Radioisotope Production and Radiation Technology

The Agency held a Technical Meeting on new ways of producing technetium-99m ( $^{99m}\text{Tc}$ ) and  $^{99m}\text{Tc}$  generators. The meeting was part of the Agency's ongoing efforts to assist Member States in the production of  $^{99m}\text{Tc}$ , the most widely used radioisotope in nuclear medicine. The meeting presented promising non-reactor based technologies for production of molybdenum-99 ( $^{99}\text{Mo}$ ) — the radioactive parent of  $^{99m}\text{Tc}$  — such as through photoactivation of  $^{100}\text{Mo}$  targets using linear accelerators, and preparation of generators using low to medium specific activity  $^{99}\text{Mo}$ , either with novel high capacity adsorbent materials or in tandem with  $^{99m}\text{Tc}$  concentration units.

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## NUCLEAR SAFETY AND SECURITY

### Nuclear Safety

#### *Identifying priorities to strengthen nuclear safety*

The Agency systematically analysed the lessons arising from the Fukushima Daiichi accident, as well as lessons from other relevant sources, to identify priorities for the programme of work to strengthen nuclear, radiation, transport and waste safety, and emergency preparedness and response. These priorities include activities related to, inter alia: external hazards assessment, severe accident management, safety culture, extending the operating life of nuclear power plants, the decommissioning of facilities, the disposal of high level and other radioactive waste, and the safety of radiation sources used in non-power applications.

#### *Safety standards, and peer review and advisory services*

The Agency continued its review of the safety standards. In 2016, it published seven Safety Requirements incorporating lessons from the Fukushima Daiichi accident: *Governmental, Legal and Regulatory Framework for Safety* (IAEA Safety Standards Series No. GSR Part 1 (Rev. 1)); *Site Evaluation for Nuclear Installations* (NS-R-3 (Rev. 1)); *Safety of Nuclear Power Plants: Design* (SSR-2/1 (Rev. 1)); *Safety of Nuclear Power Plants: Commissioning and Operation* (SSR-2/2 (Rev. 1)); *Safety Assessment for Facilities and Activities* (GSR Part 4 (Rev. 1)); *Leadership and Management for Safety* (GSR Part 2); and *Safety of Research Reactors* (SSR-3).

Member State requests for the Agency's peer review and advisory services continued to increase and a large number of missions were conducted across all safety areas. The Agency conducted seven Integrated Regulatory Review Service (IRRS) missions; three IRRS follow-up missions; two Emergency Preparedness Review (EPREV) missions; three Operational Safety Review Team (OSART) missions; five OSART follow-up missions; five Site and External Events Design (SEED) missions; four Safety Aspects of Long Term Operation (SALTO) missions; three SALTO follow-up missions; three Integrated Safety Assessment of Research Reactors (INSARR) missions; one INSARR follow-up mission; and three Education and Training Appraisal (EduTA) missions. The Agency also completed three technical safety reviews: two comparing generic reactor design safety documentation against Agency safety standards and one dealing with probabilistic safety assessment.

## Major conferences

*“The Agency organized four major nuclear safety conferences during the year.”*

The Agency organized four major nuclear safety conferences during the year. In February, it held the International Conference on Human and Organizational Aspects of Assuring Nuclear Safety – Exploring 30 Years of Safety Culture, at its Headquarters in Vienna, Austria. The conference was attended by 350 participants from 56 Member States and 7 international organizations. Participants emphasized the benefits of a systemic approach to safety to deal effectively with organizational complexities, and the need to expand work on safety culture to address all nuclear and radiological applications.

In April, the Agency hosted the International Conference on Effective Nuclear Regulatory Systems: Sustaining Improvements Globally, in Vienna, Austria. The conference drew more than 200 participants from 62 Member States and 8 international organizations. Topics of discussion included the lessons and challenges of regulating nuclear installations, radiation sources and radioactive waste. Conference participants noted the importance of increasing Member State adherence to international instruments and highlighted issues for consideration by governments, including ensuring the independence of the regulatory body and providing it with adequate authority, resources and staff.

In May, the International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes took place in Madrid, Spain. The conference, organized by the Agency, was attended by more than 540 experts from 54 Member States and 4 international organizations.

The Agency, in cooperation with the European Commission and the OECD/NEA, organized the International Conference on the Safety of Radioactive Waste Management, held in Vienna in November. The conference drew 276 participants from 63 Member States and 4 international organizations. Participants exchanged information on managing all types of radioactive waste and discussed current and future challenges. Participants also highlighted the need for continued assistance to Member States in building and strengthening the capacities of both regulators and operators.

## Improving regulatory effectiveness

Data collected in 2016 on the IRRS follow-up missions showed that Member States with operating nuclear power plants had implemented most of the recommendations and suggestions from the initial IRRS mission. More than 70% of recommendations and 80% of suggestions had been implemented.

In 2016, the Agency completed its Regulatory Infrastructure Development Project, launched in 2013 to strengthen national regulatory infrastructure for the safe use of radiation sources in Member States in North Africa and the Middle East. As a result of this project, the national regulatory infrastructures for radiation safety of the participating Member States, including their authorization processes and inspection programmes, are better aligned with the relevant Agency safety standards. The Agency continued to address the need for improvement of radiation safety infrastructure in those Member States establishing or enhancing their radiotherapy programmes through the Programme of Action for Cancer Therapy (PACT).

## Operation of nuclear power plants, research reactors and fuel cycle facilities

The Agency published *OSART Guidelines: 2015 Edition* (IAEA Services Series 12 (Rev. 1)). The revision takes into account lessons arising from the Fukushima Daiichi accident and experience gained from the application of the Agency’s safety standards. An increasing number of Member States are requesting Agency safety reviews in the area of long term operation and ageing management; there were nine requests in 2016 compared with four in 2015.

In May, the Agency organized a Technical Meeting on the use of a graded approach in the application of the safety requirements for research reactors at the Agency's Headquarters in Vienna. In July, the Agency published *Safety Reassessment for Nuclear Fuel Cycle Facilities in Light of the Accident at the Fukushima Daiichi Nuclear Power Plant* (Safety Reports Series No. 90), with practical information on performing safety reassessment for all types of nuclear fuel cycle facilities in light of the lessons from the Fukushima Daiichi accident.

### *Incident and emergency preparedness and response*

During 2016, the Agency conducted 13 Convention Exercises involving the active participation of almost 100 Member States and 14 international organizations. Carried out within the framework of the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, these 'ConvEx exercises' are held regularly to practise Member State capabilities to respond to a nuclear or radiological emergency. The Agency also conducted 38 training events on various topics of emergency preparedness and response, including four workshops on notification, reporting and requesting assistance, and four workshops on effective public communication in an emergency. A Technical Meeting to review the Agency's assessment and prognosis procedures for nuclear and radiological emergencies was held in Vienna, Austria, in November–December. Participants discussed the assessment and prognosis process and the associated communication procedures. During the meeting, the Agency provided attendees with access to its on-line assessment and prognosis tools and procedures.

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### *New and expanding nuclear power programmes*

Member States embarking on a new nuclear power programme, or expanding an existing programme, continued to request Agency assistance in establishing and strengthening their national safety infrastructures. The Agency conducted around 200 expert missions, workshops and training courses involving participants from 44 Member States with emerging or expanding nuclear power programmes, providing guidance and information on all elements of establishing an effective safety infrastructure. The Agency continued to assist these Member States in establishing and strengthening their national nuclear safety infrastructures through peer reviews, such as the IRRS, and advisory services, such as for site selection and site evaluation.

### *Leadership and management for safety and safety culture*

The Agency issued two publications relating to safety culture assessment during 2016. The first, *Performing Safety Culture Self-assessments* (Safety Reports Series No. 83), provides information on how an organization can develop in-house understanding of, and insights into, its safety culture. Such insights provide opportunities to proactively improve safety awareness and performance. The second, *OSART Independent Safety Culture Assessment (ISCA) Guidelines* (IAEA Services Series 32), provides guidance on how to independently assess safety culture during OSART missions.

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

During 2016, the Agency conducted 122 capacity building activities across its programme of work for nuclear, radiation, transport and waste safety, and emergency preparedness and response, with some 2000 participants from over 150 Member States. These training activities were carried out at the national, regional and international levels, and included two Schools of Radiation Emergency Management, held in Austria and Japan. Initiated in

2015, these Schools train qualified professionals from organizations involved in emergency preparedness and response in the basic elements of preparing for and responding to nuclear or radiological emergencies.

### *Strengthening global, regional and national networks and forums*

Member States have increased their interest in and use of the Global Nuclear Safety and Security Network (GNSSN) and its associated networks: in 2016, the web site hosting the GNSSN platform had some 42 000 visitors, compared with 38 000 visitors in 2015. The Agency expanded the GNSSN platform during the year, establishing a portal to provide Member State counterparts secure access to the ARTEMIS peer review service. With the newly established European and Central Asian Safety (EuCAS) Network and Global Nuclear Safety and Security Communicators Network, the GNSSN platform now gathers 22 global, regional and thematic networks, as well as 20 national nuclear safety knowledge platforms.

During the year, the Agency issued *Guidelines on Devising a Programme for Competence Acquisition and Development among Nuclear Regulators* (IAEA-TECDOC-1794) in both English and Spanish. The guidelines were jointly developed with the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO).

### *Radiation protection*

In 2016, the Agency organized two Technical Meetings on radiation exposure in medicine, providing participants an opportunity to discuss and share experience related to the safety implications of the medical application of radiation. The first meeting, held at the Agency's Headquarters in Vienna in March, addressed justification of medical exposure in diagnostic imaging. The second meeting, held in Vienna in May, focused on patient dose monitoring and the use of diagnostic reference levels for the optimization of protection in medical imaging. Also in May, the Agency, in cooperation with the World Health Organization (WHO) and the National Nuclear Regulator of South Africa, organized a workshop in Cape Town, South Africa, on the Control of Public Exposure in Compliance with the International Basic Safety Standards (IAEA Safety Standards Series No. GSR Part 3).

### *Radioactive waste management, decommissioning and environmental assessments*

In June, the Agency organized a Technical Meeting on remediation techniques and strategies in post-accident situations, in Vienna, Austria. Participants shared knowledge and experience related to the remediation and recovery of contaminated areas and application of the Agency's safety standards. They discussed the identification of appropriate remedial actions to reduce radiation exposures, verification of the results of such actions, and considerations for management of waste generated during remediation activities.

### *Safety conventions*

In relation to the Convention on Nuclear Safety (CNS), several meetings were held in preparation of the upcoming Seventh Review Meeting of the Contracting Parties to the CNS. This included a 'turnover meeting' held in Vienna in March, where the officers of the CNS Sixth Review Meeting shared their experience with the officers elected for the CNS Seventh Review Meeting and provided feedback on the preparation and conduct of the previous review meetings.

In September, a topical meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

(Joint Convention) took place at Agency Headquarters on ‘Challenges and Responsibilities of Multinational Radioactive Waste Disposal Facilities’. A meeting to discuss feedback from Contracting Parties to improve the review process for the Joint Convention was held in October.

### *Civil liability for nuclear damage*

The International Expert Group on Nuclear Liability (INLEX) serves as the Agency’s main forum for questions related to nuclear liability. The 16th Meeting of INLEX took place in Vienna, Austria, in May. The Group finalized, inter alia, its discussion on the legal regime applicable to liability for damage caused by radioactive sources and reiterated its recommendation that licences for at least Category 1 and 2 sources should include a requirement that the licensee take out insurance, or other financial security, to cover its potential third party liability. The Group also discussed liability issues relating to long term storage and disposal facilities and to the transport of nuclear material, as well as the scope of application of the Agency’s nuclear liability conventions as regards nuclear fusion installations and SMRs. In this respect, the Group concluded that although international nuclear liability conventions are the relevant instruments for addressing third party liability of SMRs, the low risk involving nuclear fusion installations does not justify their inclusion within the scope of such conventions.

The Fifth Workshop on Civil Liability for Nuclear Damage was held in Vienna in May. The workshop provided participants with an introduction to the international legal regime of civil liability for nuclear damage.

Other outreach activities in 2016 included a joint IAEA–INLEX mission to China to raise awareness of the international legal instruments relevant for achieving a global nuclear liability regime, as well as a Subregional Workshop on Civil Liability for Nuclear Damage for Pacific Island States, held in Sydney, Australia, in March to provide participants with information on the existing international nuclear liability regime and to advise on the development of national implementing legislation.

## **Nuclear Security**

### *Amendment to the CPPNM*

The Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM) entered into force in May 2016, requiring States Parties to establish, implement and maintain a physical protection regime to protect nuclear facilities and nuclear material in domestic use, storage and transport. The Agency organized the Second Meeting of the Representatives of the States Parties to the CPPNM and its Amendment in December. The meeting was held in Vienna and participants from 71 Parties to the CPPNM discussed the new obligations arising from the entry into force of the Amendment, focusing on issues relating to information sharing. The need to promote universal adherence to the Amendment was also highlighted during the meeting.

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*“The Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM) entered into force in May 2016”*

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### *International Conference on Nuclear Security*

The Agency organized the International Conference on Nuclear Security: Commitments and Actions, held in Vienna, Austria, in December. The conference, comprising a ministerial segment and a scientific and technical programme, was attended by some 2100 participants from 139 Member States, 47 of which were represented at Ministerial level. A Ministerial Declaration<sup>1</sup> was adopted that, inter alia, reasserted national responsibility for nuclear

<sup>1</sup> Available at: [https://www.iaea.org/sites/default/files/16/12/english\\_ministerial\\_declaration.pdf](https://www.iaea.org/sites/default/files/16/12/english_ministerial_declaration.pdf)

security; underlined the importance of keeping pace with the evolving challenges and threats to nuclear security; and recognized the Agency's central role in facilitating and coordinating international cooperation in nuclear security.

### *IPPAS*

To mark the 20th anniversary of the first International Physical Protection Advisory Service (IPPAS) mission, the Agency organized the second International Seminar to Share Experience and Best Practices from Conducting International Physical Protection Advisory Service Missions, held in November in London, United Kingdom. The participants shared the lessons identified and discussed the benefits received from IPPAS missions and their follow-up activities, and considered options for enhancing the service. The Agency carried out six IPPAS missions in 2016, bringing to 75 the total number of IPPAS missions conducted since 1996.

### *Capacity building*

In 2016, the Agency conducted 92 security related training activities — 39 at the international or regional level and 53 at the national level — providing training to more than 1400 participants. It also launched four new e-learning modules: Introduction to and Overview of IAEA Nuclear Security Series Publications; Radiation Basics and Consequences of Exposure to Radiation; Categorization of Radioactive Material; and Introduction to Radioactive Sources and Their Applications. In addition, the Agency donated 736 handheld radiation detection instruments to States, and assisted the deployment of nine radiation portal monitor systems.

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*“In 2016, the Agency conducted 92 security related training activities... providing training to more than 1400 participants.”*

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## **NUCLEAR VERIFICATION** <sup>2,3</sup>

### *Implementation of safeguards in 2016*

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

In 2016, safeguards were applied for 181 States<sup>4,5</sup> with safeguards agreements in force with the Agency. Of the 124 States that had both a comprehensive safeguards agreement (CSA) and an additional protocol (AP) in force<sup>6</sup>, the Agency drew the broader conclusion that all nuclear material remained in peaceful activities for 69 States<sup>7</sup>; for the remaining 55 States, as the necessary evaluation regarding the absence of undeclared nuclear material and activities for each of these States remained ongoing, the Agency concluded only that declared nuclear material remained in peaceful activities. For 49 States with a CSA but

<sup>2</sup> The designations employed and the presentation of material in this section, including the numbers cited, do not imply the expression of any opinion whatsoever on the part of the Agency or its Member States concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

<sup>3</sup> The referenced number of States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons is based on the number of instruments of ratification, accession or succession that have been deposited.

<sup>4</sup> These States do not include the Democratic People's Republic of Korea (DPRK), where the Agency did not implement safeguards and, therefore, could not draw any conclusion.

<sup>5</sup> And Taiwan, China.

<sup>6</sup> Or an additional protocol being provisionally applied, pending its entry into force.

<sup>7</sup> And Taiwan, China.

with no AP in force, the Agency concluded only that declared nuclear material remained in peaceful activities. For those States for which the broader conclusion has been drawn, the Agency is able to implement integrated safeguards: an optimized combination of measures available under CSAs and APs to maximize effectiveness and efficiency in fulfilling the Agency's safeguards obligations. During 2016, integrated safeguards were implemented for 57 States<sup>8,9</sup>.

Safeguards were also implemented with regard to nuclear material in selected facilities in the five nuclear-weapon States party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) under their respective voluntary offer agreements. For these five States, the Agency concluded that nuclear material in selected facilities to which safeguards had been applied remained in peaceful activities or had been withdrawn from safeguards as provided for in the agreements.

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

As of 31 December 2016, 12 States Parties to the NPT had yet to bring CSAs into force pursuant to Article III of the Treaty. For these States Parties, the Agency could not draw any safeguards conclusions.

### ***Conclusion of safeguards agreements and APs, and amendment and rescission of small quantities protocols***

In 2016, the Agency continued to implement the *Plan of Action to Promote the Conclusion of Safeguards Agreements and Additional Protocols*<sup>10</sup>, which was updated in September 2016. During 2016, two APs entered into force.<sup>11</sup> Two States<sup>12</sup> amended their operative small quantities protocols (SQPs) to reflect the revised standard text. Additionally, the Board of Governors approved a CSA with an SQP and an AP for one State.<sup>13</sup> This means that, by the end of 2016, safeguards agreements were in force with 182 States and APs were in force with 129 States. Moreover, 62 had accepted the revised SQP text (which was in force for 56 of these States) and seven States had rescinded their SQPs.

### ***Verification and Monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)***

In 2016, the Agency continued monitoring and verification in the Islamic Republic of Iran (Iran) in relation to the nuclear-related measures set out in the Joint Plan of Action (JPA) until being informed, on 19 January 2016, by China, France, Germany, the Russian Federation, the United Kingdom, the United States of America (E3+3) and Iran, on

<sup>8</sup> Albania, Andorra, 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, South Africa, Spain, Sweden, the former Yugoslav Republic of Macedonia, Ukraine, United Republic of Tanzania, Uruguay and Uzbekistan.

<sup>9</sup> And Taiwan, China.

<sup>10</sup> Available at: <https://www.iaea.org/sites/default/files/16/09/plan-of-action-2015-2016.pdf>

<sup>11</sup> Cameroon and Côte d'Ivoire.

<sup>12</sup> Afghanistan and Saint Kitts and Nevis.

<sup>13</sup> Liberia.

behalf of the E3/EU+3 and Iran, that — with the start of the implementation of the Joint Comprehensive Plan of Action (JCPOA) — the JPA was no longer in effect.<sup>14</sup>

On 16 January 2016, the Director General reported to the Board of Governors and in parallel to the United Nations Security Council that the Agency had verified that Iran had taken the actions specified in paragraphs 15.1–15.11 of Annex V of the JCPOA. Implementation Day occurred on the same day.

Also on 16 January 2016, Iran began to provisionally apply the Additional Protocol to its Safeguards Agreement in accordance with Article 17(b) of the Additional Protocol, pending its entry into force, and to fully implement the modified Code 3.1 of the Subsidiary Arrangements to its Safeguards Agreement.

Since Implementation Day, the Agency has been verifying and monitoring Iran's nuclear-related commitments under the JCPOA. During 2016, the Director General submitted six reports to the Board of Governors and in parallel to the United Nations Security Council entitled *Verification and Monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)* (GOV/INF/2016/1, GOV/2016/8, GOV/2016/23, GOV/2016/46, GOV/2016/55 and GOV/INF/2016/13).

### *Syrian Arab Republic (Syria)*

In August 2016, the Director General submitted a report to the Board of Governors entitled *Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic* (GOV/2016/44) covering relevant developments since the previous report in August 2015 (GOV/2015/51). The Director General informed the Board of Governors that no new information had come to the knowledge of the Agency that would have an impact on the Agency's assessment that it was very likely that a building destroyed at the Dair Alzour site was a nuclear reactor that should have been declared to the Agency by Syria.<sup>15</sup> In 2016, the Director General renewed his call on Syria to cooperate fully with the Agency in connection with unresolved issues related to the Dair Alzour site and other locations. Syria has yet to respond to these calls.

On the basis of the evaluation of information provided by Syria and all other safeguards relevant information available to it, the Agency found no indication of the diversion of declared nuclear material from peaceful activities. For 2016, the Agency concluded for Syria that declared nuclear material remained in peaceful activities.

### *Democratic People's Republic of Korea (DPRK)*

In August 2016, 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/2016/45–GC(60)/16), which provided an update of developments since the Director General's report of August 2015 (GOV/2015/49–GC(59)/22).

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

<sup>14</sup> In January 2016, the Director General submitted to the Board of Governors a report entitled *Status of Iran's Nuclear Programme in relation to the Joint Plan of Action* (GOV/INF/2016/3).

<sup>15</sup> The Board of Governors, in its resolution GOV/2011/41 of June 2011 (adopted by a vote) had, inter alia, called on Syria to urgently remedy its non-compliance with its NPT Safeguards Agreement and, in particular, to provide the Agency with updated reporting under its Safeguards Agreement and access to all information, sites, material and persons necessary for the Agency to verify such reporting and resolve all outstanding questions so that the Agency could provide the necessary assurance as to the exclusively peaceful nature of Syria's nuclear programme.



On 6 January 2016, the DPRK announced that it had conducted a nuclear test and on 9 September 2016 the DPRK announced that it had conducted another nuclear test.

In 2016, no verification activities were implemented in the field, but the Agency continued to monitor the DPRK's nuclear activities by using open source information, including satellite imagery and trade information. The Agency maintained operational readiness to resume safeguards implementation in the DPRK, and continued to further consolidate its knowledge of the DPRK's nuclear programme.

During 2016, the Agency continued to observe indications which were consistent with the operation of the Yongbyon Experimental Nuclear Power Plant (5 MW(e)) at Yongbyon. This followed a period between mid-October and early December 2015 when there were no such indications. This period was sufficient for the reactor to have been de-fuelled and subsequently re-fuelled. Based on past operational cycles, a new cycle commencing in early December 2015 can be expected to last about two years.

From the first quarter of 2016, there were multiple indications consistent with the Radiochemical Laboratory's operation, including deliveries of chemical tanks and the operation of the associated steam plant. Such indications ceased in early July 2016. In previous reprocessing campaigns, the Radiochemical Laboratory's operation involved the use of the spent fuel discharged from the Yongbyon Experimental Nuclear Power Plant (5 MW(e)).

At the Yongbyon Nuclear Fuel Rod Fabrication Plant there were indications consistent with the use of the reported centrifuge enrichment facility located within the plant. Additional construction work around the building that houses this reported facility has been ongoing.

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

The continuation and further development of the DPRK's nuclear programme and related statements by the DPRK, including those about continuing to "boost" its "nuclear force", are a major cause for concern. The DPRK's nuclear activities, including those in relation to the Yongbyon Experimental Nuclear Power Plant (5 MW(e)) and the Radiochemical Laboratory, and the use of the building which houses the reported enrichment facility are deeply regrettable. Such actions are clear violations of relevant United Nations Security Council resolutions, including resolutions 2270 (2016) and 2321 (2016). The DPRK's fourth and fifth nuclear tests, announced on 6 January and 9 September 2016, respectively, are also in clear violation of United Nations Security Council resolutions and deeply regrettable.

### *Enhancing safeguards*

During 2016, the Agency completed updating State-level safeguards approaches for the remaining States in the original group of 53 States that were already under integrated safeguards at the start of 2015. In addition, it developed State-level safeguards approaches for: eight States with a CSA and an AP in force and a broader conclusion; two States with a CSA and AP in force but without a broader conclusion; and one State with a voluntary offer agreement and an AP in force. In developing and implementing a State-level safeguards approach, consultations are held with the relevant State and/or regional authority, particularly on the implementation of in-field safeguards measures.

### *Cooperation with State and regional authorities*

To assist States in building capacity for implementing their safeguards obligations, the Agency conducted nine international, regional and national training courses for those responsible for overseeing and implementing the State and regional systems of accounting for and control of nuclear material. The Agency also participated in several other training

activities organized by Member States on a bilateral basis. In 2016, the Agency carried out two INIR missions that included, inter alia, advice on how to systematically enhance the capabilities necessary for the application of safeguards while embarking on a nuclear power programme.

### *Safeguards equipment and tools*

Throughout 2016, the Agency ensured that the instrumentation and monitoring equipment installed in nuclear facilities around the world vital to effective safeguards implementation continued to function as required. The Agency continued with the next generation surveillance system implementation campaign, replacing outdated surveillance units.

### *Safeguards analytical services*

In 2016, the Agency collected 603 nuclear material samples, all of which were analysed by the Agency's Nuclear Material Laboratory (NML). It also collected 474 environmental samples during the year, which were analysed by the Network of Analytical Laboratories, including at the Agency's Environmental Sample Laboratory and the NML. Proficiency tests and quality procedures were applied to ensure the correctness and accuracy of all results.

### *Developing the safeguards workforce*

In 2016, the Agency conducted over 160 safeguards training courses to provide safeguards inspectors and analysts with necessary technical and behavioural competencies. These included two Introductory Courses on Agency Safeguards held at Agency Headquarters for 23 newly recruited safeguards inspectors, and numerous courses held at nuclear facilities to enhance practical competencies for safeguards implementation in the field.

### *Information technology: MOSAIC*

During 2016, the Agency introduced new IT tools and capabilities, completed the enhancement of all legacy safeguards IT applications and strengthened the information security of safeguards data as part of the Modernization of Safeguards Information Technology (MOSAIC) project. The new and refurbished IT tools have enabled the Agency to increase effectiveness, find efficiencies and enhance security, while meeting the ever increasing demand for its services.

### *Preparing for the future*

In 2016, the Agency published *Development and Implementation Support Programme for Nuclear Verification 2016–2017*. The programme provides a detailed picture of all development work that is expected to take place in 2016–2017. To address the near term development objectives and to support the implementation of its verification activities, the Agency continued to rely on Member State Support Programmes in implementing many of these activities. At the end of 2016, 20 States<sup>16</sup> and the European Commission had formal support programmes with the Agency.

<sup>16</sup> 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.

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*“In 2016, the Agency conducted over 160 safeguards training courses to provide safeguards inspectors and analysts with necessary technical and behavioural competencies.”*

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## MANAGEMENT OF TECHNICAL COOPERATION FOR DEVELOPMENT

### *The technical cooperation programme in 2016*

The technical cooperation programme is the Agency's key mechanism for transferring technology and building capacities in the peaceful use of nuclear science and technology, helping Member States to achieve their development goals and to address a range of global challenges. In 2016, health and nutrition accounted for the highest proportion of actuals — that is, disbursements — through the technical cooperation programme, at 25.8%. This was followed by safety at 23.1%, and by food and agriculture at 17.3%. By the end of the year, financial implementation of the Technical Cooperation Fund (TCF) stood at 84.6%. Regarding non-financial implementation, the programme supported, inter alia, 3777 expert and lecture assignments, 193 regional and interregional training courses, and 1701 fellowships and scientific visits.

Through its technical cooperation programme, the Agency continued to support Member States in building their human capacity for sustainable development. The programme focused on improving programme and project quality, building partnerships, strengthening regional cooperation, and enhancing radiation safety and security for the peaceful application of nuclear energy. It also increased efforts to enhance governmental and regulatory safety infrastructure, and the radiation protection capacities of end users of ionizing radiation. Demonstrating a high degree of responsiveness and flexibility through the technical cooperation programme, immediate support was provided to Member States in response to outbreaks of disease such as lumpy skin disease in Europe and Zika in Latin America, and to natural disasters such as the earthquake in Ecuador.

The technical cooperation programme is guided by the priorities expressed in individual Country Programme Frameworks and national development plans, as well as by regional programme frameworks and priorities. The programme also aims to contribute to globally agreed development objectives, such as the SDGs. Under the 2016–2017 technical cooperation cycle, nine new Member States have benefited from their first ever national technical cooperation programmes.

### *Overview of regional activities*

In Africa, support for Member States focused on human resource capacity building activities, networking, knowledge sharing and partnership facilitation, and on the procurement of equipment. Interventions concentrated on human health, agriculture and food security, environmental sustainability, and legal and regulatory frameworks.

In human health, significant improvements were made in the establishment, re-establishment or expansion of radiotherapy services in several countries, including Botswana, Madagascar, Senegal and Uganda, where the Agency supported the design and implementation of quality assurance programmes and the establishment of training and education programmes in medical physics as it applies to nuclear medicine. In November, the Agency issued *Enhancing Patient Care in Africa through Safe Medical Imaging* (IAEA Brief No. 2016/1) on the role of the medical physicist in medical imaging. The brief encourages Member States to establish policies to ensure better safety and greater effectiveness in diagnostic imaging.

With Agency support, several national veterinary laboratories enhanced their capacity to detect veterinary drug residues in 2016. This has improved food safety in national markets and is supporting food exports from, for example, Benin, Botswana and Morocco. In the field of animal diseases, improved capacities in molecular diagnostic techniques are contributing to increased food safety and better control of transboundary diseases. In 2016, the Botswana National Veterinary Laboratory was recognized as a reference laboratory for contagious bovine pleuropneumonia by the World Organisation for Animal Health.

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In Cameroon, the Yaoundé Annex of the National Veterinary Laboratory (LANAVET) was opened, bringing diagnostic services closer to the animal breeders in the south of the country. LANAVET, a leading national and subregional actor in the fight against emerging zoonotic diseases, is training scientists from other African Member States, under the technical cooperation programme, in biosafety and biosecurity with regard to emerging zoonotic diseases such as Ebola and highly pathogenic avian flu.

Environmental sustainability and water availability are among the priorities in the Africa region. In 2016, the Agency's regional Sahel project completed a first, broad overview of groundwater resources in the Sahel region. The 13 participating Member States produced five transboundary aquifer/basin reports, important for formulating major recommendations to improve water resource management in the Sahel.

In the Asia and the Pacific region, the priority thematic areas for the 2016–2017 technical cooperation cycle were human health and nutrition, safety and security, food and agriculture, industrial applications, and water and the environment. Under human health, the technical cooperation programme helped Member States build capacity and competence in the use of emerging multimodality molecular diagnostic imaging and therapeutic nuclear medicine techniques to manage and treat non-communicable diseases, including cancer. The safe and secure application of nuclear medicine techniques was further emphasized through regional capacity building and support for the application of quality assurance systems.

Regional projects in radiation safety focused on helping Member States in the region to establish and sustain robust national infrastructure for radiation safety via review missions, the development of national plans, and capacity building for regulatory bodies and users of radiation technology. The programme also helped enhance the radiation safety and dosimetry capacities of hospitals to ensure radiation protection of patients and workers in diagnostic and interventional radiology and nuclear medicine.

In Europe and central Asia, technical cooperation activities in 2016 focused on the development of institutional and human resource capacities, and on enhancing cooperation among Member States. Four areas were prioritized: nuclear and radiation safety; nuclear energy; human health; and isotope and radiation technology applications, including environmental, agricultural and industrial applications.

Demand continued to increase in the region for technical cooperation related to nuclear power as an option to supply safe, economical and reliable energy. Requests also increased for cooperation in the areas of radioactive waste management, spent fuel management and the decommissioning of nuclear facilities. Support in connection with nuclear medicine and cancer treatment remained in high demand, as did activities related to stakeholder involvement in regulatory decision making processes.

The Agency was able to provide Member States in the Europe region with emergency assistance in response to an outbreak of lumpy skin disease in 2016. This highly infectious cowpox virus is common in Africa and Asia, and has been spreading through south-eastern Europe since 2013. Through the technical cooperation programme, experts in the region were trained in how to detect the virus quickly and accurately.

In the Latin America and the Caribbean region, the priority thematic areas for the 2016–2017 technical cooperation cycle were health and nutrition (with a focus on cancer), followed by nuclear safety, food and agriculture, and water and the environment. More than 70% of core funding was allocated to these areas.

Ecuador suffered a catastrophic earthquake on its Pacific coast in April 2016. The technical cooperation programme provided immediate assistance in the form of expert advice on the use of non-destructive testing as part of the emergency response, and provided mobile X ray equipment for medical diagnoses.

The outbreak of Zika virus disease also posed a challenge for the region. With Agency assistance, state of the art equipment was procured for the rapid detection of Zika and other vector transmitted viruses. A complementary four year regional technical cooperation project was also approved, which will support implementation of the sterile insect technique

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*“The Agency was able to provide Member States in the Europe region with emergency assistance in response to an outbreak of lumpy skin disease in 2016.”*

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to suppress the mosquito population. Eleven Zika affected Member States are benefiting from equipment and training under this project.

The spread of the Mediterranean fruit fly in the Dominican Republic required immediate Agency cooperation through the technical cooperation programme. With firm government intervention and support through the technical cooperation programme, the outbreak was controlled after six months, and commercial activities were restored in 2016.

### *Programme of Action for Cancer Therapy (PACT)*

Through its Programme of Action for Cancer Therapy (PACT), the Agency, in collaboration with key partners, helps low and middle income Member States to improve access to radiation medicine as part of a comprehensive cancer control framework. Activities in 2016 focused on strengthening the skills of health professionals and mobilizing additional resources for quality, safe, effective and sustainable cancer services.

During the year, the Agency established new and intensified existing partnerships with Member State institutions, the private sector, relevant foundations and civil society organizations to support Member States in addressing the global cancer burden effectively and in a cohesive and coordinated manner.

Eight Member States received integrated missions of PACT (imPACT) reviews to assess their national cancer control capacities. The Member States were provided with recommendations for addressing their cancer burdens.

The Agency also facilitated and supported training for health professionals in a broad range of cancer related subjects. Namibia and Rwanda received valuable expert advisory support on the development of their national cancer control plans. In El Salvador and Myanmar, the Agency and WHO convened national workshops to support Member State priorities in, and to cost, cancer control activities. The Agency further developed the courses available on the Virtual University for Cancer Control e-learning platform, including a master's level course in clinical oncology, in preparation for the platform's expansion to additional sub-Saharan countries.

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*“Eight Member States received integrated missions of PACT (imPACT) reviews to assess their national cancer control capacities.”*

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### *Legislative assistance*

In 2016, the Agency continued to provide legislative assistance to its Member States through the technical cooperation programme. Country specific bilateral legislative assistance on drafting national nuclear legislation was provided to 19 Member States, while 2 regional and 5 national workshops on nuclear law were organized during the year.

The Agency also organized the sixth session of the Nuclear Law Institute in Baden, Austria, from 10 to 21 October 2016, which is designed to meet the increasing demand by Member States for legislative assistance and to enable participants to acquire a solid understanding of all aspects of nuclear law. Fifty-eight participants from Member States from all four regions attended the training.

### *Technical cooperation programme management*

In 2016, several measures were taken to further improve the programme quality of the current and future technical cooperation cycles. The Agency revised and updated its technical cooperation programme quality criteria, which are applicable across all phases of the programme cycle. It released a new tool for Programme Management Officers, National Liaison Officers and project counterparts, providing guidance to project teams on the requirements for high quality project design. Finally, it conducted a first quality review of project documents for the 2018–2019 programme cycle, providing project teams with feedback and recommendations for enhancing the quality of their projects.

As part of the new framework for monitoring the outcomes of technical cooperation projects, the Agency developed outcome monitoring plans, which are being implemented for selected pilot projects. A tool for the electronic submission of Project Progress Assessment Reports (PPARs), developed to facilitate effective and efficient reporting of project results, was piloted in the 2016 submission round. Agency efforts to build project management capacity focused strongly on new Member States, with the provision of training in results based management using the logical framework approach, monitoring and evaluation. Practical project design workshops were conducted for Programme Management Officers, technical officers, National Liaison Officers and project counterparts. The overall aim was to prepare and implement projects, in line with the guidance of the Agency's Policy-Making Organs, that better respond to Member State needs and priorities, and that are of high quality, with measurable, attainable and timely objectives.

### *Technical cooperation and the global development context*

Following the adoption of the Sustainable Development Goals (SDGs) the Agency has identified nine SDGs where it can support Member States in addressing their development challenges through its technical cooperation projects and a wide range of programmatic activities.

In July, the Agency attended the 2016 United Nations High-level Political Forum on Sustainable Development (HLPF), using the occasion to outline the benefits of nuclear science and technology and its contribution to the attainment of the SDGs, and hosting a side event on food security. During the meeting, the Agency participated in a panel debate on maximizing the impact of SDG 9 (Infrastructure and Industry) on other goals. As part of the lead-up to the 2017 HLPF, the Agency also took part in an expert meeting on 'Readying Institutions and Policies for Integrated Approaches to the 2030 Agenda', held in Vienna in December.

### **SCIENTIFIC FORUM**

'Nuclear Technology for the Sustainable Development Goals' was the theme of the 2016 Scientific Forum, held at the Agency's Headquarters during the 60th regular session of the General Conference. Leading experts, academics and industrial representatives outlined many of the ways that nuclear technology can be used to help achieve the Sustainable Development Goals.

The forum highlighted the importance of global access to radiation medicine, the pursuit of nuclear science partnerships and the use of nuclear technology to boost crop yield. It also outlined the beneficial roles of nuclear energy in the pursuit of low carbon technologies as well as the use of radioactive isotopes in global natural resource management. A key message of the forum was that nuclear technology will bring more tangible benefits if it is integrated into broader development strategies.

The Agency took part in the European Development Days (EDDs) held in Brussels in June, and hosted an Interactive Lab Debate under the EDD topic 'Planet'. The debate focused on water, the energy and food nexus, and climate change, as well as on the connection between global challenges, sustainable development and nuclear technologies. The Agency also participated in the EDD Global Village, showcasing three projects conducted through the Agency's technical cooperation programme and the Joint FAO/IAEA Division.

In November, the Agency participated in the United Nations Convention to Combat Desertification (UNCCD) Committee for the Review of the Implementation of the Convention, in Nairobi, Kenya. The Agency is recognized as a scientific partner of UNCCD and works to coordinate technical cooperation project activities with UNCCD efforts on

the ground and to build relationships with national UNCCD focal points in national environment ministries.

In 2016, the Agency signed a Delegation Agreement with the European Commission, which supports continued work with the European Union on regional and interregional projects to address the development needs of Agency Member States in the area of nuclear safety. It also signed a cooperation agreement with the International Renewable Energy Agency (IRENA) aimed at coordinating joint energy planning capacity building and training, including joint events and the exchange of experts in the field of energy planning.

In response to Member State requests, the Agency issued a document entitled *Addressing the Challenges Facing Least Developed Countries in the Peaceful Application of Nuclear Energy through the Technical Cooperation Programme*. The document, presented at the November meeting of the Technical Assistance and Cooperation Committee, highlighted how the Agency helps countries to address these challenges and their development needs. In December, the Agency brought together several small island developing States from the Asia and the Pacific and the Latin America and the Caribbean regions to discuss how the technical cooperation programme could support addressing their challenges and contribute to their sustainable development.

Twenty Country Programme Frameworks and ten United Nations Development Assistance Frameworks (UNDAFs) were co-signed in 2016.

### *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 €101.1 million in 2016, with approximately €81.6 million for the TCF (including assessed programme costs (APCs), National Participation Costs<sup>17</sup> (NPCs) and miscellaneous income), €18.7 million in extrabudgetary resources, and about €0.8 million representing in kind contributions.

The rate of attainment for the TCF stood at 93.6% on pledges and at 92.9% on payments at the end of 2016, while payment of NPCs totalled €2.8 million.

### *Actuals*

In 2016, approximately €85.2 million was disbursed to 146 countries or territories, of which 37 were least developed countries, reflecting the Agency's ongoing effort to address the development needs of those States.

## **MANAGEMENT ISSUES**

### *Efficiency gains – Partnership for Continuous Improvement*

In 2016, the Agency continued to streamline business processes and eliminate unnecessary bureaucracy through the Partnership for Continuous Improvement initiative. Greater use of off-site arrangements for translation reduced travel and associated costs. Streamlined work processes reduced processing times in procurement and budget and finance.

<sup>17</sup> 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.

### *Gender equality and gender mainstreaming*

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*“The proportion of women in professional and higher categories reached 29% by the end of 2016, and the percentage of women in senior management positions (D level or higher) reached 28%, the highest in the Agency’s history.”*

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The proportion of women in professional and higher categories reached 29% by the end of 2016, and the percentage of women in senior management positions (D level or higher) reached 28%, the highest in the Agency’s history. During the year, the Agency implemented a Gender Action Plan that included events to promote gender awareness and activities to build a talent pipeline. Departmental level reporting on gender related staffing and programmatic activities was strengthened, and the gender focal point programme was revitalized.

### *Agency-wide Information System for Programme Support (AIPS)*

The AIPS Plateau 4 systems for Travel, Events and Performance Management were completed in 2016. The Travel system became fully operational in September, with no significant business disruption. At the end of the year, the Agency launched the Events Management system and the new Performance Management system was ready to be used for work plans for 2017. Work continued during 2016 on the final component, a new portal for Member States.

### *IT information security*

In 2016, the Agency began implementing an initiative to strengthen the security of its information systems. The projects include strengthening information security rules and procedures, increasing security awareness through staff training and implementing stronger security controls on the Agency’s information technology infrastructure.

### *Partnerships and resource mobilization*

In 2016, the Agency’s implementation of the *Strategic Guidelines on Partnerships and Resource Mobilization*, approved by the Board of Governors in June 2015, contributed to a more coordinated and comprehensive approach to partnerships and resource mobilization activities. The Agency continued to seek opportunities to mobilize resources and expand its partnerships, including with the private sector.