Issues and Events in 2006

The Agency's work under the three pillars of its mandate covering ***technology***, ***safety*** and ***verification*** continued to provide the basis for ensuring that nuclear technology contributes to the promotion of "peace, health and prosperity". This chapter reviews significant developments around the world during 2006 as they related to the Agency's own activities.

Technology

Within its nuclear technology programme, the Agency facilitates the exchange of nuclear information and knowledge, builds capacity, and transfers technology to its Member States, mainly through its technical cooperation programme. The aim is to facilitate and contribute to the use of nuclear science and associated technologies to meet, in a sustainable manner, the socioeconomic needs of Member States — through the safe use of nuclear power, and in food production, human health, water resources management, environmental protection and industrial applications.

Nuclear Power: Status and Trends

At the end of 2006, there were 435 nuclear power reactors in operation worldwide, representing approximately 370 gigawatts (GW(e)) of generating capacity and supplying about 16% of the world's electricity. Two new reactors were connected to the grid — in China and India — while eight were retired — two in Bulgaria, one each in Slovakia and Spain, and four in the United Kingdom. There were three construction starts, plus the resumption of active construction at one plant in the Russian Federation, for a total capacity of 23 641 megawatts (MW(e)) under construction by the end of the year. A number of countries announced plans for significant expansion, specifically China, India, Japan, Pakistan, the Russian Federation and the Republic of Korea. In addition, Argentina, France, South Africa, Ukraine and the USA have expressed an intention to expand their existing programmes.

Access to reliable and adequate sources of energy is essential for development. The demand for energy around the world continues to increase rapidly, with the latest projections by the IEA estimating that at current consumption levels, global energy consumption will increase by 53% by the year 2030. Approximately 70% of this growth will come from developing countries. For the first time these projections also recognize that nuclear power, among other energy sources, would not only help to meet the increased demand for energy and enhance the security of energy supply, but would also mitigate the discharge of carbon into the atmosphere, since energy produced from fossil fuels accounts for about half of human-made greenhouse gases. In this context, new medium term projections by the Agency and the IEA point to the possibility of a substantial expansion in the use of nuclear power. The Agency also established an interdepartmental 'Nuclear Power Support Group' to provide coordinated support to interested Member States considering the introduction or expansion of nuclear power.

In the USA, a number of companies and consortia have announced plans for licence applications which mention approximately 30 new reactors. Two site preparation applications were submitted in Canada. An ongoing energy review by the United Kingdom is addressing the issue of whether new nuclear power stations would make a significant contribution to meeting its energy policy goals. Utilities from Estonia, Lithuania and Latvia launched a joint feasibility study of a new nuclear power plant to serve all three countries.

"... 17 of the 29 reactors now being built are in developing countries."

While the use of nuclear power has thus far been concentrated in industrialized countries, the pattern is quite different in terms of *new* construction: 17 of the 29 reactors now being built are in developing countries. For example, India has seven reactors under construction, and is planning a substantial increase in capacity by 2022. China has four reactors under construction and envisages a more than fivefold expansion in nuclear generating capacity by 2020. Some States in the Asia–Pacific region are planning to include nuclear power in their energy mix. For example, Indonesia recently announced that it has decided to build two 1000 MW reactors in central Java, and Vietnam has expressed its intention to move forward with a nuclear power programme. In this connection, a workshop was held under Agency

auspices in December in Vienna on a wide spectrum of issues for the introduction of nuclear power in developing countries.

Life Extension and Reliability of Nuclear Power Plants

While nuclear power plants require significant up-front financial investment, they are relatively inexpensive to operate. There is thus a strong incentive to operate existing well run nuclear plants for as long as it is safe to do so. Through its technical cooperation programme, the Agency assisted Argentina, Hungary, Mexico and Ukraine in extending the operating life of their nuclear power plants through improvements in maintenance scheduling, training, scientific visits and workshops.

In the USA, the Nuclear Regulatory Commission approved licence renewals of 20 years each for eight nuclear power plants. The Netherlands granted a 20 year extension for the Borssele nuclear power plant and, in a shift from the country's earlier nuclear power phase-out policy, set operating conditions for *new* nuclear plants. The French Nuclear Safety Authority conditionally cleared all of Electricité de France's 1300 MW(e) PWRs for an additional ten years of operation. And in Canada, the Point Lepreau plant received a licence renewal until 2011.

Innovative Technologies for Nuclear Power Generation

Investment in R&D is important for the future growth of nuclear power. Scientific and technical research must focus on new designs of reactors of different sizes, with higher efficiency and greater availability, shorter construction times, and lower capital costs.

In January 2006, the Russian Federation announced an initiative to develop a Global Nuclear Power Infrastructure to provide nuclear fuel cycle services — including uranium enrichment — on a non-discriminatory basis and under the supervision of the Agency, taking full account of non-proliferation requirements. Another initiative, the Global Nuclear Energy Partnership (GNEP) — proposed by the USA — seeks to expand the worldwide use of economical nuclear energy to meet growing electricity demand, while reducing the risks of nuclear material being misused. Within this framework, GNEP began initial planning in 2006 on an Advanced Burner Test Reactor.

An international initiative on innovative nuclear technologies, the Generation IV International Forum (GIF), grew to 13 members in 2006 with the addition of China and the Russian Federation.[1] Four 'system arrangements' were signed during the year by GIF members, covering collaborative research and development on fast reactor systems, gas cooled fast reactor systems, very high temperature gas cooled reactor systems and supercritical water cooled reactor systems.

The Agency's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), which provides a forum for studying innovative nuclear energy systems and associated requirements, grew to 28 members with the addition of Belarus, Japan, Kazakhstan and Slovakia.[2] In July, INPRO completed Phase 1 of its work, specifically the development of a methodology to assess innovative nuclear energy systems in terms of economics, safety, environment, waste management, proliferation resistance, physical protection and infrastructure. Phase 2, which began in July 2006, will: further improve the assessment methodology, address infrastructure issues; and include collaborative projects on technical issues to be addressed for improved economics, safety and proliferation resistance.

Energy Assessments

The Agency offers energy assessment services, considering all energy sources, that help build a State's capability for energy analysis and planning. Increasing global demand for energy led to 29 new requests for these services in 2006, a substantial increase over previous years. To cater to these requests, 21 technical cooperation projects, incorporating all of these new requests, were established by the Secretariat and approved by the Board of Governors in 2006. A total of 112 Member States and six international and regional organizations are now using the Agency's energy assessment tools. In terms of building capacity for sustainable energy development and planning, 274 professionals from 51 States were trained by the Agency through various regional and national courses.

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[1] The members of GIF are: Argentina, Brazil, Canada, China, Euratom, France, Japan, the Republic of Korea, the Russian Federation, South Africa, Switzerland, the United Kingdom and the USA.

[2] The 28 members of INPRO are: Argentina, Armenia, Belarus, Brazil, Bulgaria, Canada, Chile, China, the Czech Republic, France, Germany, India, Indonesia, Japan, Kazakhstan, the Republic of Korea, Morocco, the Netherlands, Pakistan, the Russian Federation, Slovakia, South Africa, Spain, Switzerland, Turkey, Ukraine, the USA and the EC.

Uranium Supply: Demand Forecasts

A steady supply of nuclear fuel is required to cope with the anticipated future growth of nuclear power. The Agency and the OECD/NEA together publish biennial projections on the availability of uranium and its production and demand in the future.[3] Total uranium production in 2004 (the most recent year for which complete data are available) amounted to over 40 000 tonnes. Canada and Australia accounted for 51% of production, with five countries (Kazakhstan, Namibia, Niger, the Russian Federation, and Uzbekistan) accounting for 38%. Newly mined uranium provided approximately two thirds of the world requirements of 67 000 tonnes, with the balance being met by secondary sources such as civil and military stockpiles, spent fuel reprocessing, and re-enrichment of depleted uranium. It is estimated that by 2025 the projected growth in the world's nuclear energy capacity would raise the annual uranium requirements to between 80 000 and 100 000 tonnes.

Uncertainty regarding the future availability of secondary sources, improved global prospects for nuclear energy and the lingering effects of low mining investments in the past have led to a substantial rise in spot market prices, by a factor of two in 2006 to $187 per kg U, and a factor of ten since the all-time low (in terms of constant dollars) in 2000. In the longer term, uranium resources are considered to be adequate to meet projected estimates for the growth of nuclear power. The recent rise in the spot price has led to increased exploration worldwide. A number of new mining projects, including those in countries that currently are not uranium producers, have also been announced that could substantially boost global production capacity, and are indeed necessary to meet demand. In response to this the Agency provided guidance and assistance to Member States on different aspects of uranium exploration and production.

Spent Fuel and Waste Management

Spent fuel management is one of the more important factors influencing the future of nuclear energy. The amount of spent nuclear fuel generated annually is about 10 500 tonnes of heavy metal. About one third of this is reprocessed, with the uranium and plutonium contained in the fuel being recycled. The remaining two thirds is kept in safe interim storage awaiting a decision on its future management. The long term management and disposal of this fuel continues to be a challenge in view of the rising expectations for nuclear power and the increasing spent fuel inventories around the world. In June, the Agency organized a conference in Vienna where the recent trends and initiatives on spent fuel management were discussed.

Regardless of which option is chosen for the management of spent fuel, there will always be a need for the deep geological disposal of high level waste, long lived waste or the spent fuel itself. While most experts agree that technical solutions exist for safe permanent disposal, progress in demonstrating these solutions has not been rapid. In 2006, the world's only operating geological repository, the Waste Isolation Pilot Plant in the USA, received its first recertification from the US Environmental Protection Agency since its opening in 1999. France passed new legislation setting goals for the licence application for a deep geological repository with the aim of opening it by 2025, and for a prototype reactor by 2020 to test the transmutation of long lived radioisotopes. The Swedish nuclear fuel and waste management company filed an application for an encapsulation plant — the first step towards final disposal — in Oskarshamn.

"Spent fuel management is one of the more important factors influencing the future of nuclear energy."

Low and intermediate level waste from reactor operations and decommissioning, and from the use of radioactive material in medicine, research and industry, is being well managed in many countries with disposal facilities in operation. Other countries are being supported by the Agency through the assessment of different technologies and the dissemination of information.

Decommissioning of Nuclear Facilities

Roughly three quarters of the world's operating reactors are 20 or more years old. This means that decommissioning decisions and needs are likely to grow in importance over the next two decades. The Agency provides information and guidance to Member States in support of research on strategic, methodological and technological approaches to

[3] *Uranium 2005: Resources, Production and Demand*, A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency, OECD, Paris (2006).

decommissioning, as well as on when to choose decommissioning over licence renewal. In 2006, the Agency provided assistance to 12 Member States through individual technical cooperation projects, in addition to carrying out a large regional project focusing on the decommissioning of nuclear power plants and research reactors. In addition, legal and technical advice and training were provided for the decommissioning and cleanup of former nuclear sites in Iraq through a new project that started in 2006. The project aims to reduce the overall radiological risk to the public and the environment through the remediation of contaminated areas and disposal sites at the former Iraq nuclear complex. The Agency also initiated an international Research Reactor Decommissioning Demonstration Project to assist Member States in decommissioning activities.

The decommissioning of reactor unit 4 at the Chernobyl nuclear power plant remains a technically complex task 20 years after the accident that resulted in its destruction. In 2006, work was completed to stabilize the existing shelter before the start of construction of a new shelter.

As of 2006, nine power plants around the world had been completely decommissioned, with their sites released for unconditional use. Seventeen plants have been partially dismantled and safely enclosed, 30 are being dismantled prior to eventual site release and 30 are undergoing minimum dismantling prior to long term enclosure. Decommissioning was completed at the Big Rock Point nuclear power plant in the USA, and the site was released for unrestricted public use.

During the year, the Agency assisted several Member States in their efforts to dismantle nuclear power plants. For example, at the Ignalina 1 plant in Lithuania, the Agency's efforts were focused on upgrading local capabilities and, in doing so, facilitating Lithuania's coordination with major international donors for this project. At the severely contaminated A-1 nuclear power plant in Slovakia, the Agency's decommissioning assistance focused on the development of remote viewing equipment and remotely operated tools, both of which are essential given the difficulty of access to a number of components and areas.

New Approaches to the Nuclear Fuel Cycle

A number of suggestions have recently been put forward regarding new approaches to the nuclear fuel cycle with the aim of establishing an assured supply of nuclear fuel for all States having nuclear power programmes. The proposals include the following:

- In January 2006, the Russian Federation proposed a 'Global Nuclear Power Infrastructure' to provide nuclear fuel cycle services, including uranium enrichment centres, on a non-discriminatory basis and under the supervision of the Agency.
- In February 2006, the USA proposed a 'Global Nuclear Energy Partnership', which includes, as one of its elements, a mechanism for reliable fuel services.
- In May 2006, the World Nuclear Association, in conjunction with the four commercial enrichment companies, issued a report on *Ensuring Security of Supply in the International Nuclear Fuel Cycle.* The report describes a three level mechanism to assure supplies of LEU.
- In June 2006, six countries that export enriched uranium (France, Germany, the Netherlands, the Russian Federation, the United Kingdom and the USA) circulated a proposal on a 'Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel'.
- In September 2006, Japan proposed an 'IAEA Standby Arrangements System for the Assurance of Nuclear Fuel Supply', under Agency auspices. The United Kingdom proposed an 'Enrichment Bond' to provide prior consent for the provision of enrichment services. The Nuclear Threat Initiative offered a two to one matching grant offer of $50 million to the Agency to set up a fuel reserve. Germany proposed an international enrichment centre at an international site.

The Agency continued in 2006 to facilitate discussions of these proposals with a view to formulating recommendations regarding the establishment of assurance of supply mechanisms for the consideration of the Board of Governors in 2007, with an initial focus on assurances of supply of nuclear fuel for nuclear power plants. In this connection, it organized a special event entitled 'New Framework for the Utilization of Nuclear Energy: Assurances of Supply and Non-Proliferation' during the 50th regular session of the General Conference in Vienna. The discussions at the special event, which involved more than 300 representatives from 61 Member States and various industry and other organizations, indicated that the various international proposals that were recently made were seen to be mutually compatible with each other. However, it was recognized that establishing a fully

developed, multilateral framework that is equitable and accessible to all users of nuclear energy, and that is in accordance with agreed nuclear non-proliferation norms, would be a complex endeavour likely requiring an incremental approach with multiple assurances in place.

Research Reactor Conversion and HEU Repatriation

At an international conference in Oslo in June, strategies were discussed to minimize the use of high enriched uranium (HEU) in the civilian sector. Participants agreed on the feasibility of converting civilian sector activities to the use of low enriched uranium (LEU). However, concerns were voiced that strategies for HEU minimization should not result in a limited number of countries acquiring better scientific results, and therefore a commercial advantage. The need to reduce military stockpiles of HEU was also emphasized as an important contribution to ongoing non-proliferation and disarmament efforts.

In response to Member State requests for assistance in converting research reactors from the use of HEU to LEU fuel, the Triga reactor in Piteşti, Romania, and the RECH 1 facility in La Reina, Chile, were fully converted through national technical cooperation projects. Conversion projects in Portugal and Poland made significant advances, with the Agency conducting international competitive tender processes to procure a new LEU core for Portugal and LEU lead test assemblies for Poland.

In 2006, the Agency provided support to Member States participating in international programmes to return research reactor fuel to the country of origin. Within the framework of the Russian Research Reactor Fuel Return Programme, and under contracts arranged by the Agency, three shipments containing more than 300 kg of fresh HEU fuel were returned to the Russian Federation from Poland, Germany and the Libyan Arab Jamahiriya. In addition, the Agency assisted in the first shipments of irradiated Russian research reactor fuel from Uzbekistan in early 2006. The Agency also made significant progress towards the safe removal of irradiated Russian research reactor spent fuel from the Vinča Institute in Serbia to the Russian Federation.

Applications of Nuclear Science and Technology

Achieving sustainable food security

The Agency continues to assist Member States in building capacity to produce food crops with improved characteristics. A good example is in Peru, where nine mutant varieties of barley, developed with Agency support, now cover 90% of the barley producing area. These crops are being planted in the Andes in harsh and extreme climatic conditions. Since gaining access to these improved varieties of barley, the Andean population has been experiencing a sustained improvement in food and economic security.

Cancer therapy

It is estimated that by the year 2020, approximately 150 million cases of cancer will occur in developing countries out of a projected worldwide total of 260 million cases. Although cancer prevention is the single most cost effective strategy in many developing countries, comprehensive early detection and diagnosis of cancer — and especially its treatment by radiotherapy — remain a necessity (Fig. 1).

In 2006, the Agency — in cooperation with WHO — initiated studies to compare radiotherapy techniques for breast cancer, which is the most common cause of cancer related deaths in the world among women, and new research was started on radiation treatments for cancer of the oesophagus. Educational and training materials were developed, covering, for example, radiation oncology, clinical research, and radiotherapy planning and delivery.

"The Agency's Programme of Action on Cancer Therapy (PACT) seeks to assist developing countries in integrating radiotherapy into the broader framework of cancer prevention and control."

The Agency's Programme of Action on Cancer Therapy (PACT) seeks to assist developing countries in integrating radiotherapy into the broader framework of cancer prevention and control. In 2006, it helped raise awareness of the growing cancer epidemic in the developing world and the need for comprehensive and multidisciplinary cancer control planning through Nobel Peace Prize special events in Bangkok and Cape Town. In addition, relationships have been built with leading organizations in the field of cancer control and research — for example the International Agency for Research on Cancer, the International Union Against Cancer and WHO — to

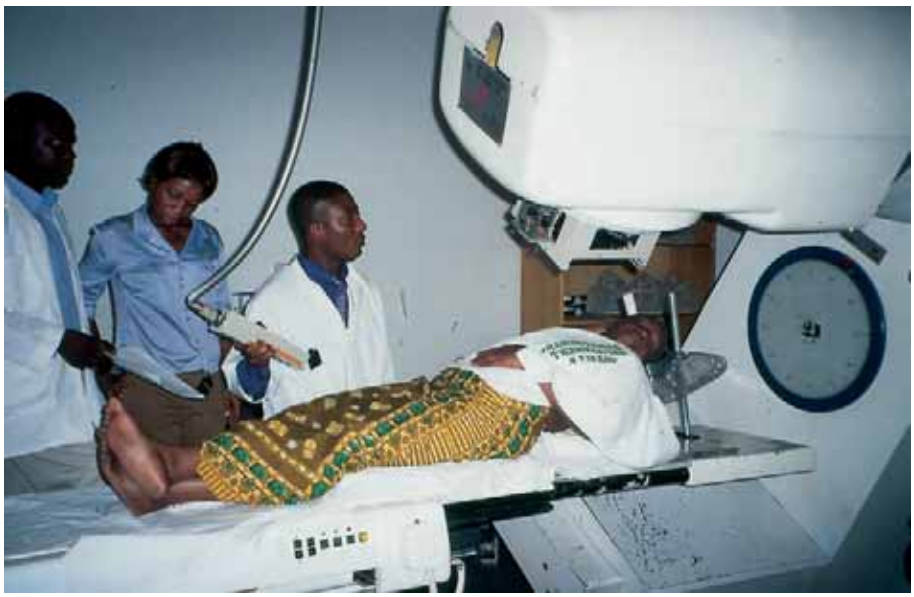

FIG. 1. Agency assistance, through its technical cooperation programme, is helping to raise the level of cancer care in Zimbabwe.

assist Member States with comprehensive cancer control programmes. Training syllabuses for doctors and nurses working in radiation oncology were also prepared in 2006. Progress was also made towards the establishment of PACT Model Demonstration Sites in Nicaragua and the United Republic of Tanzania, in collaboration with WHO and other partners.

PACT's fundraising efforts throughout the year secured a number of grants, donations and in-kind contributions. These included $500 000 from the OPEC Fund for International Development, $500 000 from the USA, $200 000 from the US National Cancer Institute, and radiotherapy machines from Nordion, Canada. In addition, PACT received more than $1 000 000 in extrabudgetary contributions from various Member States in 2006.

Improving the Nutrition and Health of Children

The IAEA Nobel Cancer and Nutrition Fund was established by the Board of Governors using the Agency's share of the award money from the 2005 Nobel Peace Prize and other contributions. In addition to cancer related projects, the fund focuses on training programmes on the use of nuclear techniques to determine the role of nutrition in helping to ensure the healthy development of children. In 2006, the Agency set up IAEA Nobel Peace Prize Fund Schools for Nutrition in Latin America and Africa. The theme for each of these information sharing and training events reflected priority areas in nutrition during early life of special relevance to the region. Thus, in Guatemala the theme was 'Combating the Double Burden of Malnutrition', while in Uganda it was 'Integrating Nutrition into the Management of HIV/AIDS'.

"Under a regional technical cooperation project, countries throughout Central America have used the sterile insect technique (SIT) as part of an environmentally friendly programme for controlling fruit flies."

Sterile Insect Technique

Under a regional technical cooperation project, countries throughout Central America have used the sterile insect technique (SIT) as part of an environmentally friendly programme for controlling fruit flies. In addition to reducing insecticide use, the result in many cases is far greater capacity to produce and export fruit and vegetables. For example, Nicaragua initiated commercial shipments of capsicum to the USA in 2006.

In the southern Rift Valley, tsetse population suppression carried out by local farmers and

the Ethiopian Government, in preparation for sterile tsetse fly releases, has already reduced the prevalence of nagana disease in livestock in certain areas. The UN Trust Fund for Human Security, funded by Japan, has awarded $1.7 million to the Agency's tsetse eradication project, and the USA contributed an additional $1.6 million.

Faster and More Economical Diagnosis of Avian Influenza

The early, rapid and sensitive diagnosis of diseases originating from animals and that infect people has received special attention because of the renewed importance given to potential natural disasters. Agency activities in this area, carried out through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, have also shifted focus on how to respond in a more timely and proactive manner to potential threats to animal and human security. With respect to the threat posed by avian influenza, a major contribution was the development in 2006 through an Agency CRP of a new approach to identify these pathogens that takes less than one hour, is rugged and simple enough for use in the field, allows the results to be transmitted remotely, and is cost effective. This nuclear based method offers significant advantages over traditional methods, which require samples to be sent to a central laboratory, often taking up to one week for receipt of the results. It has the added advantage of avoiding handling of and exposure to the live virus. The technique is planned to be released for commercial use in the second half of 2007. In this connection, developing Member States received assistance from the Agency's Laboratories, Seibersdorf, in analyses of avian influenza samples for primary diagnosis or for confirmation of strains.

Management of Water Resources

Isotope hydrology is an effective tool in managing water resources that uses isotope dating techniques to help determine the availability and capacity of underground aquifers and other water resources. At the 4th World Water Forum, held in Mexico City in March 2006, a major theme was 'Water for Growth and Development'. Hydrological variability — that is, periodic changes in water availability — was considered to be a significant factor influencing economic growth. The role of the Agency in this area was recognized through its promotion of isotope techniques to provide information for understanding the atmospheric water cycle and for managing groundwater resources.

Agency assistance to Member States in 2006 included regional technical cooperation projects covering Chile, Colombia, Costa Rica, Ecuador, Nicaragua, Peru and Uruguay for managing groundwater resources in Latin America. Through this project, hydrogeological maps were developed, conceptual models were validated and associated databases were made available and are now in use in the participating institutions.

Nuclear Science Serving the Arts

A novel application of nuclear techniques is in the conservation of objects of art and the protection of cultural heritage. A portable X ray fluorescence spectrometer was designed and constructed at the Agency's Laboratories, Seibersdorf, as part of a CRP. Following a request from the Museum of Fine Arts in Vienna, the instrument was used in 2006 to examine the famous 16th century gold sculpture 'Saliera' by Benvenuto Cellini. The spectrometer provided data on the chemical composition of the various parts of this sculpture in support of evaluations of the optimum conservation strategy.

"A novel application of nuclear techniques is in the conservation of objects of art and the protection of cultural heritage."

In China, four ancient production kilns from the Tang dynasty were discovered, and shards from them were characterized to determine their mineral composition. In Lebanon, Byzantine amphorae were analysed to establish their origin and place of production. And in Peru, nuclear techniques were used on Inca pottery samples to distinguish fraudulent from authentic samples, identify the place of production and shed light on the production process.

Safety and Security

A demonstrated high standard of nuclear, radiation, transport and radioactive waste safety is essential to sustain the future growth of nuclear power and technology. As part of this pillar, the Agency supports Member States in their efforts to attain a high level of safety and security by promoting adherence to international legal

instruments prescribing the basic norms for the safe use of nuclear technology and the wide application of internationally accepted standards reflecting best practices.[4]

Nuclear Safety: Major Trends and Issues

Member State efforts to maintain a high level of safety continued to be successful in 2006. Overall, the safety performance at nuclear power plants remained strong. Occupational radiation protection indicators showed improvement over 2005, with no worker or member of the public receiving a significant radiation dose as a result of the operation of a nuclear power plant. In addition, there were no events at any power plant that resulted in a release of radioactivity that would cause harm to the environment. Research reactors also continued to be operated safely during the year. The safety record for the transport of radioactive material remained good. As shipments continue to be denied, an International Steering Committee on Denial of Shipments of Radioactive Material, comprising Member States and international organizations, was constituted to coordinate international efforts in this area.

Harmonizing Safety Standards

In September, the Board of Governors approved the publication of the *Fundamental Safety Principles*, a set of ten new principles that consolidate and replace the earlier safety fundamentals publications and constitute the basis on which to establish requirements for the safety of facilities and activities to protect people and the environment against exposure to ionizing radiation. These new principles were co-sponsored by a number of other international organizations.[5]

Strengthening Regulatory Infrastructures by Sharing Knowledge

In line with the unified approach of the Safety Fundamentals, the Agency developed a new safety review initiative known as the Integrated Regulatory Review Service (IRRS). This service is designed to: facilitate the exchange of experience and mutual learning among regulatory bodies; contribute to the enhancement of Member State legislative and regulatory infrastructures; harmonize regulatory approaches; and review a Member State's self-assessment. During the year, the Agency conducted IRRS missions of limited scope to Romania and the United Kingdom, and a full scope mission to France.

The peer review mechanism established under the safety conventions is another important instrument for sharing experience and for mutual learning. In May, the Agency hosted the second review meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The Parties emphasized the importance of: fostering improvements to national strategies for spent fuel and radioactive waste management; engaging stakeholders, including the public, on waste issues; and enhancing the control of disused sealed sources. By the end of 2006, the Joint Convention had 42 Contracting Parties, up from 35 in 2005.

An international conference on effective nuclear regulatory systems, held in February in Moscow, provided a forum for senior nuclear safety, radiation safety and nuclear security regulators to share knowledge and experience in improving regulatory effectiveness. The key challenges identified included: the need to ensure regulatory independence; the complexity of coordinating safety and security priorities; and the importance of securing adequate financial and human resources for regulatory work, particularly in view of expectations for expansion in the use of nuclear power.

Regional safety networks are providing important opportunities for sharing and learning from experience. The Ibero-American Nuclear and Radiation Safety Network became operational in 2006, and the Asian Nuclear Safety Network has continued to expand its range of activities in China, Japan and the Republic of Korea and in national centres in other participating countries.

The number of commitments by States to use the Code of Conduct on the Safety and Security of Radioactive Sources continued to increase, from 79 to 88 States as of the end of 2006. A number of Member States have amended, or are in the process of strengthening, their national legislation to take into account the recommendations given in the Code. The number of Member States agreeing to implement the Code's supplementary Guidance on the Import and Export of Radioactive Sources also continued to grow, from 17 States in 2005 to 37 States at the end of 2006.

Incident and Emergency Response

Emergency preparedness and response arrangements are vital in ensuring the safety and security

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[4] The status of participation by States in multilateral treaties for which the Director General is depositary is given in Tables A7 and A8 in the Annex.

[5] The other organizations are the EC, FAO, ICAO, ILO, OECD/NEA, PAHO, UNEP and WHO.

of the public. Although only a small number of the incidents that occurred in 2006 involved significant exposure to ionizing radiation, there is a continuing need to promote the worldwide exchange of information on the causes and lessons learned from incidents and emergencies. In this regard, the Agency cooperates with Member States in harmonizing the relevant international communication and assistance systems. In 2006, the Agency's Incident and Emergency Centre underwent a major upgrade, resulting in an enhancement of Agency capabilities as a global focal point for nuclear and radiological emergency preparedness and response.

Civil Liability for Nuclear Damage

Responding to increased interest among States, the Agency's International Expert Group on Nuclear Liability (INLEX) discussed new developments in the field of civil liability for nuclear damage, and considered the need to further develop the nuclear liability regime to address gaps and ambiguities in the scope and coverage of the existing instruments. In this respect, it concluded that the gaps should be addressed by way of issue specific actions, such as clarification during outreach activities, the development of guidelines and generic minimum legislation to assist States, and by States setting limits beyond the standards contained in the international nuclear liability instruments or adopting common standards. The Group recommended the establishment of new maximum limits for the exclusion of small quantities of nuclear material from the scope of application of the relevant nuclear liability instruments. The maximum limits will require the approval of the Board of Governors, as foreseen in the relevant instruments.

The second Regional Workshop on Liability for Nuclear Damage, held in Lima in December, sought to foster greater adherence to the international nuclear liability regime and facilitated discussions on possible difficulties, concerns or issues that States in the region may have with the regime. In particular, the participants — although aware of the advantages of having a special liability regime in order to avoid the intricacies of private international law and also to strengthen the assurances of compensation for damage in cases of accidents — identified issues preventing States from acceding to the existing international nuclear liability instruments.

"... the Agency cooperates with Member States in harmonizing the relevant international communication and assistance systems."

Nuclear Security

Through its nuclear security programme, the Agency continued to help Member States implement the enhanced regime of international legal instruments relevant to nuclear security. International legal instruments provide a strategic framework and a common platform for States to work together to enhance their collective nuclear security. The obligations on States that flow from these international instruments are being addressed by a combination of national and international activities. These instruments include: the Convention on the Physical Protection of Nuclear Material (CPPNM) and the Amendment thereto; the International Convention for the Suppression of Acts of Nuclear Terrorism; and UN Security Council resolution 1540 (2004) on preventing the proliferation of weapons of mass destruction.

The Agency continued to implement an updated version of its Nuclear Security Plan, which came into operation in 2006 and will run until 2009. The importance given to nuclear security activities is reflected in the extrabudgetary funding provided by a range of donor States and organizations. In 2006, the Agency supported national efforts to enhance nuclear security through prevention measures — comprising both protection and risk reduction components — as well as detection and response measures.

Work was completed with the Russian Federation and the USA on a tripartite initiative to secure and manage radioactive sources in countries of the former Soviet Union. A significant amount of radioactive material has been secured, and the effort has resulted in much greater regional awareness of this problem. During the year, the Agency also arranged for the recovery of over 100 high activity and neutron sources in Africa and Latin America.

Activities aimed at developing nuclear security guidance were strengthened through the publication of a series of reports containing recommendations and practical arrangements that incorporate best practices as contributed by experts from Member States. The first three guidance publications — covering *Technical and Functional Specifications for Border Monitoring Equipment*, *Nuclear Forensics Support* and *Monitoring for Radioactive Material in International Mail* — were issued in 2006.

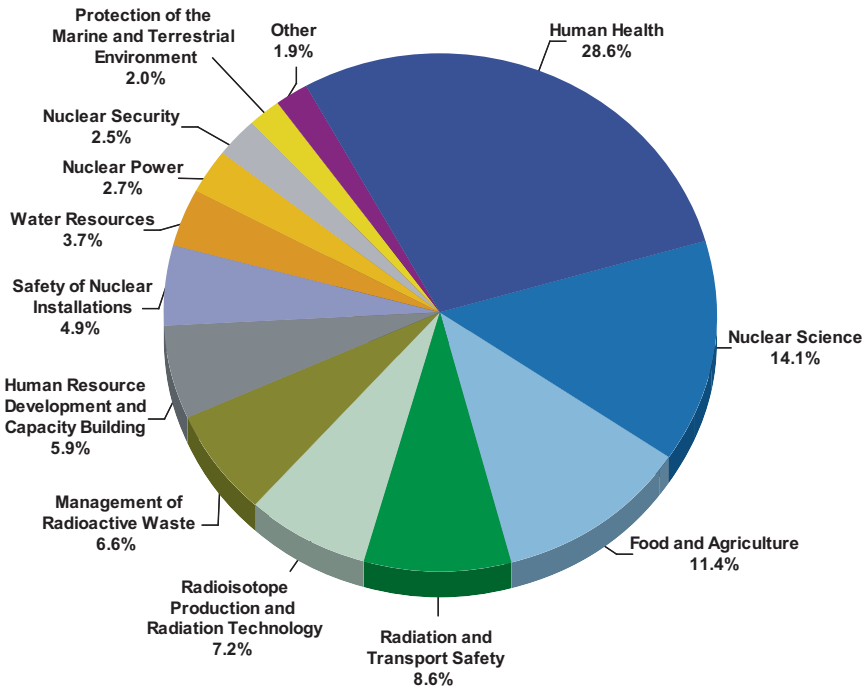

FIG. 2. Distribution of technical cooperation disbursements in 2006 by Agency programme.

Technical Cooperation

To encourage greater self-reliance in Member States, the Agency helps to build, strengthen and maintain national and regional capacities for using nuclear technology in a safe, secure and sustainable manner. The technical cooperation programme helps developing nations, in matching appropriate technologies to identified needs, building relevant technical competences and expertise, and promoting scientific and technical cooperation between countries.

The main areas of work in 2006 were human health, food and agriculture, radiation and transport safety, nuclear science, physical and chemical applications, water resources, and the management of radioactive waste (Fig. 2). The programme is funded by voluntary contributions to the Technical Cooperation Fund (TCF), as well as extrabudgetary contributions, government cost sharing and contributions in kind. All of these resources are applied directly to technical cooperation projects. In 2006, a total of $97 million was disbursed in over 115 countries, 172 training courses were arranged for 2477 participants, 3041 expert missions were organized, 1697 fellows and scientific visitors were trained, and $51.8 million worth of equipment and supplies were provided.

Overall, new resources reached a record high of $101 million in 2006, with $76.8 million for the TCF, $22.3 million in extrabudgetary resources and $1.9 million of in-kind contributions. Net new obligations during the year were $104.5 million, which represented an increase of more than 30% over 2005.

Verification

Another pillar of the Agency's programme is concerned with providing assurances to the international community regarding the peaceful use of nuclear material. The Agency's verification programme is at the centre of multilateral efforts to curb the proliferation of nuclear weapons.

At the end of each year, the Agency draws a safeguards conclusion for each State with a safeguards agreement in force, based upon the evaluation of all information available to it for that year. With regard to States with comprehensive safeguards agreements (CSAs), the Agency seeks to conclude: (1) that there is no indication of diversion of declared nuclear material from peaceful activities; and (2) that there is no indication of undeclared nuclear material and activities for the State as a whole. To be able to draw the 'broader conclusion' that *'all* nuclear material remained in peaceful activities', both a CSA and an additional protocol (AP) must be in force, and the Agency must have been able to conduct all necessary verification

and evaluation activities. For States that have CSAs in force but no APs, the Agency, based on its verification activities, draws a conclusion, for a given year, with respect to whether *declared* nuclear material remained in peaceful activities.[6]

For those States for which the broader conclusion was drawn and a State level integrated safeguards (IS) approach has been approved, the Secretariat is able to implement IS — the optimum combination of all safeguards measures available to the Agency under CSAs and APs which achieves maximum effectiveness and efficiency within available resources.

"During 2006, the Agency continued to facilitate the conclusion of comprehensive safeguards agreements and additional protocols."

Safeguards Conclusions for 2006

At the end of 2006, safeguards were applied for 162 States with safeguards agreements in force with the Agency (Fig. 3). Seventy-five States had both CSAs and APs in force. For 32 of these States, the Agency concluded that *all* nuclear material remained in peaceful activities. For eight States — Austria, Chile, the Czech Republic, Greece, Ireland, Luxembourg, Mali and Portugal — this conclusion was drawn for the first time. For 43 of the States, the Agency had not yet completed all the necessary evaluations under their APs, and concluded that the *declared* nuclear material remained in peaceful activities. For 78 States with CSAs in force but without APs, the Agency was able to draw the conclusion that declared nuclear material remained in peaceful nuclear activities.[7]

For three States that had item specific safeguards agreements in force in 2006, the Secretariat concluded that the nuclear material, facilities or other items to which safeguards were applied remained in peaceful activities. Safeguards were implemented with regard to declared nuclear material in selected facilities in four of the five nuclear weapon States that had voluntary offer safeguards agreements in force. For these four States, the Agency concluded that nuclear material to which safeguards were applied in selected facilities was not withdrawn, except as provided for in the agreements, and remained in peaceful activities.

The Secretariat could not draw any safeguards conclusions for States without safeguards agreements in force.

Integrated safeguards were implemented during 2006 in Australia, Bulgaria, Hungary, Indonesia, Japan, Norway, Peru, Slovenia and Uzbekistan, while implementation was initiated in Latvia and Poland. In addition, an approved IS approach for Canada was awaiting initial implementation in early 2007, and approaches were developed and approved for Bangladesh and Ghana.

Conclusion of Safeguards Agreements, Additional Protocols and Small Quantities Protocols

During 2006, the Agency continued to facilitate the conclusion of CSAs and APs. In this connection, the Secretariat convened regional seminars during the year in Quito and Sydney. The Agency also

FIG. 3. Agency safeguards inspectors examining a fresh fuel basket at a nuclear facility.

[6] The status with regard to the conclusion of safeguards agreements, APs and small quantities protocols is given in Table A6 in the Annex. The status of participation by States in multilateral treaties for which the Director General is depositary is given in Tables A7 and A8.

[7] The Secretariat was not able to perform verification activities in the Democratic People's Republic of Korea in 2006, and could therefore not draw any safeguards conclusions for that State.

convened an interregional seminar in Vienna on the role of State systems of accounting for and control of nuclear material (SSACs) in implementing safeguards in States with small quantities protocols (SQPs).

As a result of these and other activities, the number of States that had yet to conclude CSAs in accordance with their obligations under the NPT decreased from 36 (at the end of 2005) to 31 (as of 31 December 2006). The year was also noteworthy in terms of the conclusion of APs, which entered into force for seven States. By the end of 2006, a total of 78 States had APs in force. Of the two States that, at the end of 2005, were implementing APs pending their entry into force, one brought its protocol into force, while the other informed the Agency that it would no longer implement it. One State acceded to the safeguards agreement between non-nuclear-weapon States of Euratom, Euratom and the Agency, as well as the AP thereto. The Board of Governors also approved an item specific safeguards agreement for a State in respect of a nuclear power plant under construction.

Following a decision by the Board of Governors in 2005, the Agency initiated exchanges of letters with all States with SQPs with a view to amending or rescinding their SQPs to reflect the revised standardized text and changed eligibility criteria. The Secretariat continued to communicate with States throughout 2006 in order to implement the Board's decision. During the year, SQPs were amended with nine of the 98 States with SQPs and rescinded with one State. By the end of the year, 11 States had accepted the revised standardized SQP text.

Committee 25

A committee established by the Board of Governors to consider ways and means to strengthen the effectiveness and efficiency of the safeguards system met three times in 2006 and considered documents produced by the Secretariat on further strengthening safeguards.

Public Outreach

The Agency's public outreach visibility continued to increase during the year, particularly in the area of verification. There was heightened media interest in the meetings and deliberations of its Policy-making Organs, mainly as a result of a number of topical events dealing with non-proliferation issues. In addition, the Agency's public web site, *iaea.org*, was selected as one of three winners of the 2006 'Web4Dev Awards'. Sponsored by the World Bank, this award recognizes excellence in web site design and management. The Agency shared this honour with two other UN organizations.

The 50th regular session of the General Conference, held from 18 to 22 September, visibly set the scene for the start of the Agency's 50th anniversary year in 2007, with a high level of participation and a number of special displays and presentations by Member States and the Secretariat, including a special exhibit during the conference entitled 'Nuclear Technologies for the Environment: Protecting Air, Earth and Oceans', which reflected the multi-faceted work of the Agency on the environment and highlighted its contributions to the UN Millennium Development Goals.

Conclusion

The role of the Agency continues to expand, and with it the need for adequate resources to deal effectively with the many problems within its mandate, such as hunger, disease and poverty, and with issues of nuclear safety, security, verification and disarmament. By partnering with its stakeholders — Member States, international organizations, non-governmental organizations, national counterparts and the public — the Agency will seek to further contribute to sustainable strategies that help in addressing and alleviating the problems and furthering the causes of peace and development. ■