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Activities of the International Atomic Energy Agency relevant to article IV of the Treaty on the Non-Proliferation of Nuclear Weapons

Background paper prepared by the Secretariat of the International Atomic Energy Agency

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Executive summary

Since its establishment in 1957 as an independent organization within the United Nations system, the International Atomic Energy Agency (IAEA) has functioned as a global intergovernmental organization for international cooperation in the peaceful uses of nuclear energy. Starting from 68 Member States in 1957, the IAEA's membership had risen to 138 at the time of the 2005 Review Conference for the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), and today stands at 151.

The paper describes how, in line with its Statute and the decisions of its policy making organs, the IAEA has endeavoured to fulfil its functions related to fostering international cooperation in the peaceful uses of nuclear energy, especially, since the last NPT Review Conference in 2005.

Although the adoption of the Statute of the IAEA preceded the negotiation of the NPT by more than a decade, a wide array of the IAEA's activities are relevant to Article IV of the NPT. These areas of congruence are explained in Section 1.

The Agency's major goals and objectives relevant to Article IV of the NPT are highlighted in Section 2.

The technical cooperation (TC) programme is the single largest framework through which the IAEA responds to the Statute's call to make more widely available the benefits of nuclear science and technology for peaceful purposes, with particular emphasis on the needs of developing countries. Currently, 125 Member States/Territories avail the benefits of the IAEA's TC programme. The programme is described in Section 3.

Global demographic and economic trends, by creating rising demand for energy, food, water, health care and industrial output, are placing increasing pressure on the natural, human and economic resources of many countries. They are also drivers of climate change, a global phenomenon that is further intensifying these pressures. Since nuclear science and technology offer many unique and cost-effective tools, and have the potential for positive socioeconomic impact, the growing number, variety and sophistication of activities carried out through a number of scientific, technical and legal services of the IAEA is outlined in Section 4.

Finally, in Section 5, the paper concludes by noting the need for continuing support and commitment to the IAEA's activities relevant to Article IV of the NPT.

1. International cooperation for the peaceful uses of nuclear energy: the International Atomic Energy Agency and the Non-Proliferation Treaty

Article II of the IAEA's Statute stipulates that *"The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world."* To fulfil this objective, the IAEA, by Article III of its Statute, is authorized:

> "1. To encourage and assist research on, and development and practical application of, atomic energy for peaceful uses throughout the world; and, if requested to do so, to act as an intermediary for the purposes of securing the performance of services or the supplying of materials, equipment, or facilities...;"
>
> "2. To make provision, in accordance with this Statute, for materials, services, equipment, and facilities to meet the needs of research on, and development and practical application of, atomic energy for peaceful purposes, including the production of electric power, with due consideration for the needs of the underdeveloped areas of the world;"
>
> "3. To foster the exchange of scientific and technical information on peaceful uses of atomic energy;"
>
> "4. To encourage the exchange of training of scientists and experts in the field of peaceful uses of atomic energy."

Article IV of the NPT states:

> "1. Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty."
>
> "2. All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also co-operate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world."

It can be seen from the above that the functions of the IAEA presage Article IV of the NPT, in which the rights of all parties to peaceful nuclear cooperation are confirmed, and there is an obligation on the parties to facilitate the fullest exchange of equipment, materials, scientific

and technological information; and cooperate in contributing to the further development of the peaceful uses of nuclear energy.

While the IAEA is not specifically referred to in Article IV of the NPT, it is widely considered to be the principal means of transfer of technology by international organizations referred to in Article IV.2 of the NPT. The importance of the IAEA's work in the promotion of peaceful uses of nuclear science and technologies has been acknowledged in the final documents of several NPT Review Conferences[1].

[1] See *Principles and Objectives of the 1995 NPT Review and Extension Conference* (NPT/Conf.1995/32/DEC.2 and Final Document (Volume I) of the 2000 NPT Review Conference (NPT/CONF.2000/28(Parts I and II), United Nations, New York (2000).

2. International Atomic Energy Agency framework for peaceful nuclear cooperation

2.1. International Atomic Energy Agency strategic goals

The IAEA's goals are guided by the 2006–2011 Medium Term Strategy (MTS). The goals relevant to Article IV of the NPT emphasize a number of core activities.

For example, it is important that the IAEA continues to be an authoritative, independent source of information, knowledge, capacity building and expertise in support of the peaceful uses of nuclear energy. In this regard, the effective transfer of nuclear technologies and knowledge for sustainable development is achieved through the assessment of relevant technologies, and the improvement of existing nuclear technologies through the expansion of their scope and applicability. Efforts will continue to be required for the development of innovative nuclear technologies and for the formulation of new safety, security, verification, economic and environmental approaches.

In light of growing global demands, Member State interests and concerns regarding nuclear power must be addressed, and innovation fostered in nuclear science, technology and applications. The IAEA's goal is to act as a catalyst to encourage collaboration in international research and development efforts, and expand partnerships to promote innovation.

Safety and security considerations are important for the full utilization and further expansion of the peaceful uses of nuclear technologies and the international transport of nuclear and radioactive material. A nuclear safety culture must continue to be strengthened and a nuclear security culture fostered. The outstanding safety record achieved in the past several years in the nuclear power industry needs to be maintained in a sustainable manner. Minimizing the likelihood of nuclear and radiological accidents that could endanger life, property and the environment and could increase public concern regarding nuclear safety continues to be essential to the wider use of nuclear technology in the future. All aspects of the protection of people and the environment against the effects of ionizing radiation under conditions of increasing power and non-power applications and the related amounts of radioactive waste and spent fuel generated worldwide will continue to require attention.

Potential malicious acts and terrorist threats need urgent and effective responses. The need to work towards a comprehensive and effective international framework for strengthening nuclear security, and to exploit the potential for synergy between aspects of nuclear security and aspects of nuclear safety, remain a matter of high priority.

2.2. Mechanisms for implementation

The IAEA endeavours to meet the goals of the MTS through the provision of a body of scientific, technical, legal, advisory, and support services to its Member States. The services underpin collective efforts for the safe, secure and peaceful promotion of nuclear science and technology. The principal

delivery mechanism is the IAEA's technical cooperation (TC) programme. This programme is developed and managed jointly by the Member States and the Secretariat. All parts of the IAEA play a role in the programme, whether in its development, implementation, monitoring or evaluation. In addition, as part of the IAEA's regular programme of activities, there are other channels for provision of services to Member States.

3. International Atomic Energy Agency Technical Cooperation Programme

3.1. Overview

The IAEA's TC programme is unique in the UN system in that it combines significant technical and developmental competencies. It seeks to forge human and institutional capacities in Member States, so that they can safely and securely maximize the utilization of nuclear technologies to address the array of challenges they face in promoting sustainable socioeconomic development. In this way it contributes to national, regional and international development.

The TC programme contributes to the achievement of the United Nations Millennium Development Goals and the Plan of Implementation of the World Summit on Sustainable Development. All Member States are eligible for support, although in practice TC activities tend to largely focus on the needs and priorities of developing countries.

The strategic goal of the TC programme is to promote tangible socioeconomic impact in an area where nuclear technology holds a comparative advantage. The programme seeks to promote sustainability and self-reliance, and projects address an area of real need in which there is a national programme and government commitment. The guiding vision of the programme is that Member States achieve the human and institutional capacities they need in order to address local needs and global issues through the safe utilization of nuclear technologies.

The TC programme is based on five decades of dialogue and interaction with Member States, and a track record of achievements in the field. The programme focuses on improving human health, supporting agriculture and rural development, helping water resource management, advancing sustainable energy development, including the option of nuclear power for electricity, addressing environmental challenges, and promoting nuclear safety and security.

The TC programme aims to build partnerships at every level, from local counterparts up to other international organizations, in order to leverage all available support. Increasing emphasis is being placed on alignment with activities of other UN system organizations and concerted efforts are being made to participate, wherever possible, in the United Nations Development Assistance Framework process.

3.2. Resources for the Technical Cooperation Programme

The administrative costs of the TC programme and its in-house technical support are borne by the Regular Budget. The cost of TC project components and their delivery is funded by voluntary contributions from Member States. The annual target for contributions to the Technical Cooperation Fund (TCF) is set two years in advance, following consultations among Member States. Since 2000, the TCF target has increased from $73 million, to $85 million in

2009. The total resources available to the TC programme during the same period have increased from $68 million to $112.2 million. (Fig. 1).

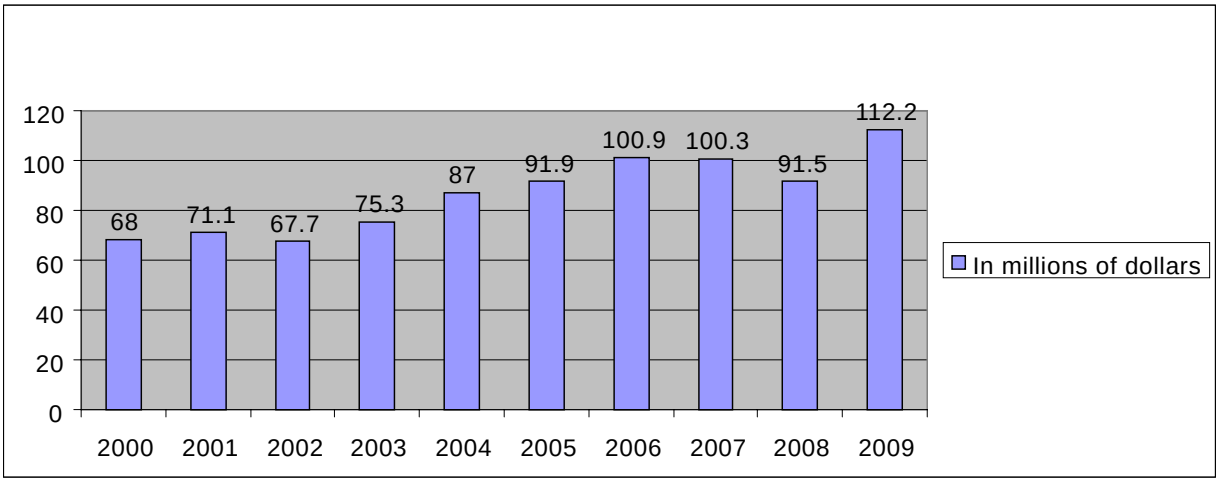

FIG. 1. Total resources for the TC programme: 2000–2009.

3.3. Technical Cooperation Programme in 2009

In 2009, the first year of the 2009–2011 TC programme cycle, 453 new national projects, 124 new regional projects and 6 new interregional projects were initiated. At the same time, 351 projects were closed. Active projects now total 1082, with an additional 256 currently in closure.

Total TCF resources (including TCF payments for previous years, and income) amounted to $86.1 million. Total resources and net new obligations for the 2009 TC programme were high, showing a substantial increase from 2008. However, resources remain insufficient for keeping pace with the requests for support. For example, project components totalling $72.6 million remained unfunded in 2009.

3.4. Recent indicators of programme delivery

The TC programme as a whole, disbursed a total of $85.4 million, and achieved an implementation rate of 77.2%. Non-financial indicators show that in 2009 the programme delivered support to 125 countries and territories; 3698 expert and lecturer assignments were carried out, 5096 participants attended meetings, 2496 people took part in 188 training courses and 1532 benefited from fellowships and scientific visits.

The largest single sector of the TC programme in 2009 was human health, accounting for 20.7% of the programme. The second largest sector was nuclear safety with 15%, followed by food and agriculture at 14.3% (Fig. 2).

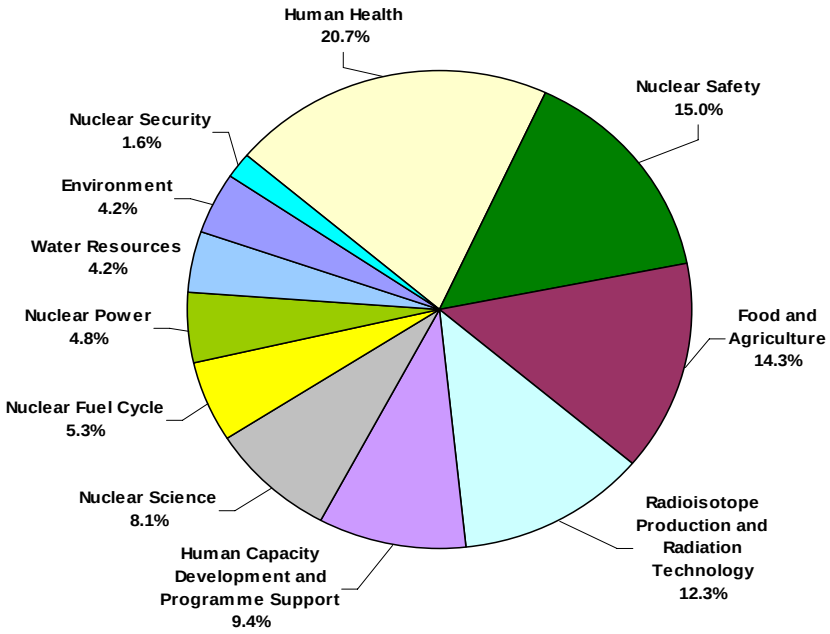

FIG. 2. Overall disbursements by technical field for 2009.

3.5. Regional programming and profiles

The differing regional priorities are reflected in the diverging emphases of different regions in their choice of sectors for national and regional projects. For example, human health accounted for 29% in Africa, 19% in Europe and Latin America and remained at 16% in Asia and Pacific. Food and agriculture shows a greater degree of differentiation, with 26% in Africa, 17% in Asia and the Pacific, 11.3% in Latin America, and just 2.8% in Europe.

The IAEA has developed the TC programme over the last five years to take into account the support that can be garnered through strategic frameworks for regional cooperative planning in Africa, Asia, Europe, and Latin America and the Caribbean. Regional centres of expertise play an important role in sharing the benefits of nuclear science and technology. Through their participation in regional projects, Member States with more developed nuclear sectors share their knowledge and facilities with other countries in the region with a lesser degree of development.

The 2009–2011 technical cooperation programme is the first to be formulated with the support of strategic frameworks for regional cooperative planning for Africa, Europe and Latin America and the Caribbean, developed by the Member States themselves. These frameworks, established over the course of 2007, have served as the basis for the regional components of the 2009–2011 programme, and are important planning tools for setting regional cooperation activities. The frameworks enhance horizontal collaboration among

Member States and cooperation with other partners, and have considerably strengthened a strategic approach to technical cooperation in the regions while also enhancing technical cooperation among developing countries (TCDC).

3.5.1. Africa

Over the last five years the TC programme disbursed $122 million to 38 African States, of which 20 are least developed countries. A total of 3327 participants from Africa attended training courses and there were 2588 fellowship and scientific visitor assignments. As of 31 December 2009, new obligations amounted to $26.4 million. The major areas of focus are shown in Fig. 3.

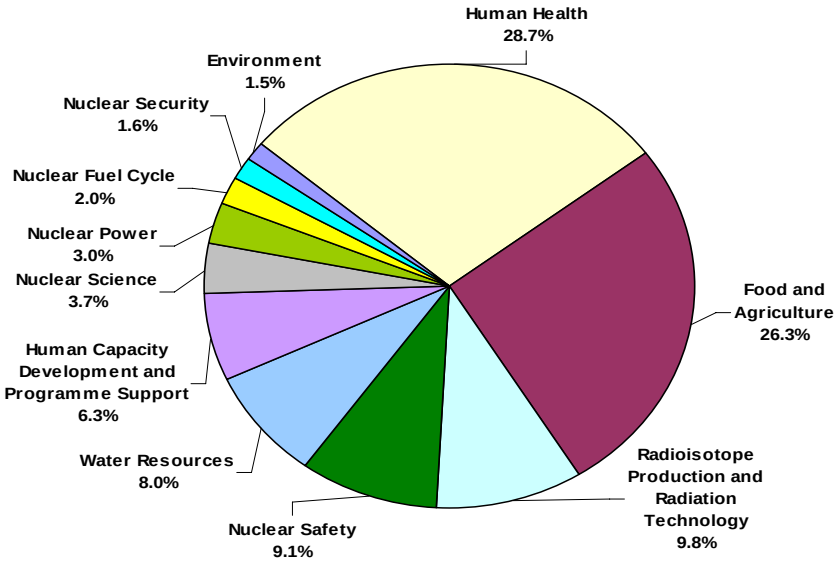

FIG. 3. Disbursements by technical field for 2009 —Africa.

In Africa, human health is the top sectoral priority, with significant activity in support of cancer treatment facilities and the establishment or upgrade of nuclear medicine facilities in several African Member States. Agricultural productivity and food security is also high on the agenda in the region, with crop improvement, water resource management and soil fertility, and livestock breeding all being significant areas of IAEA activities.

In the last few years, building human resource capacity is the single most important area of activity of the TC programme in Africa, in every sector. To address this need for skilled staff and well trained human resources, an increasing number of fellowships, scientific visits, and training courses are being offered to African Member States. In addition, innovative mechanisms, for example, distance learning, offering opportunities for continuous professional development, support for curriculum development in Member

States, and a proactive approach to educational partnerships have ensured the participation of a wide spectrum of specialized organizations and networks.

Also, in partnership with the United Nations Development Programme/Global Environment Facility (UNDP/GEF), the IAEA is supporting the management of the Nubian Aquifer and the Nile River Basin covering nine Member States.

3.5.2. Asia and the Pacific

During the last five years, a total of $96 million was disbursed through the TC programme to 30 States from the Asia and the Pacific region of which 4 are least developed countries. The IAEA trained 3404 participants from the region, and there were 2037 fellowship and scientific visitor assignments. As of 31 December 2009, new obligations amounted to $24 million. The major areas of focus are indicated in Fig. 4.

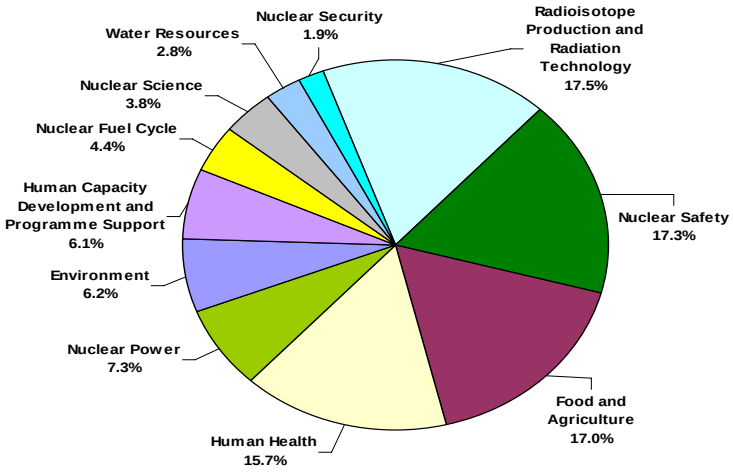

FIG. 4. Disbursements by technical field for 2009 —Asia and the Pacific.

In Asia and the Pacific, there is growing interest among States in making nuclear power part of their energy mix strategy for electricity and heat generation as well as for water desalination. The three States that invited the IAEA's recently introduced Integrated Nuclear Infrastructure Review (INIR) missions to review the status of infrastructural preparedness for nuclear power were from this region. Also, seven countries received assistance in carrying out a comparative assessment of electricity generation options.

Major areas for disbursement in the region are split evenly between human health, food and agriculture, nuclear safety, and radioisotope production and radiation technology. The emphasis has been on establishing cyclotron and positron emission tomography (PET) centres to strengthen nuclear medicine and diagnostic techniques for the management of cancer.

3.5.3. Europe

Over the last five years, the TC programme disbursed a total of $141 million to 32 States from Europe. The IAEA trained 2754 participants from the region, and there were 1723 fellowship and scientific visitor assignments. As of 31 December 2009, new obligations amounted to $30.7 million. The major areas of focus are shown in Fig. 5.

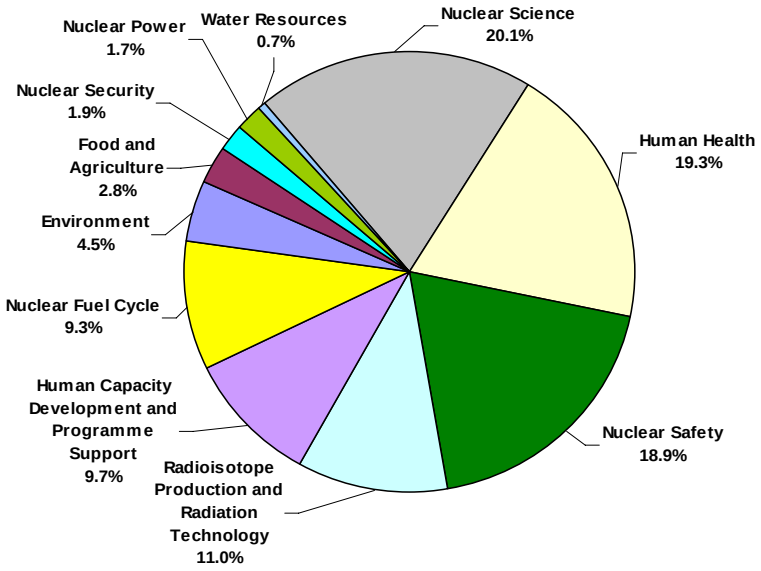

FIG. 5. Disbursements by technical field for 2009 —Europe.

In Europe, reinforcing nuclear and radiation safety infrastructure in accordance with IAEA safety standards is a key priority for Member States. Emphasis is on nuclear installation safety and on the control of radiation sources. Particular attention is provided to radioactive waste management and decommissioning using the modalities of training and exchange of experience.

Success stories, since 2005, in the region relate to assistance provided in the safe repatriation of high enriched uranium (HEU) fuel to the countries of origin from research reactors in as many as ten Member States in the region. This also includes the ongoing

activities at the Vinča research reactor in Serbia, which is the single largest national project in TC history with a total cost of more than $50 million.

In the Europe region, the European Union (EU) is a key partner. The European Commission has provided extrabudgetary contributions on behalf of the EU to several projects in the region, financed by the former Technical Assistance to the Commonwealth of Independent States (TACIS) programme and more recently by the Instrument of Pre-Accession Assistance (IPA).

3.5.4. Latin America and the Caribbean

Over the last five years, the TC programme disbursed $75 million to 22 States in the Latin America and Caribbean region. The IAEA trained 2093 participants from the region and there were 1599 fellowship and scientific visitor assignments. As of 31 December 2009, new obligations amounted to $17.2 million. The major areas of focus are shown in Fig. 6.

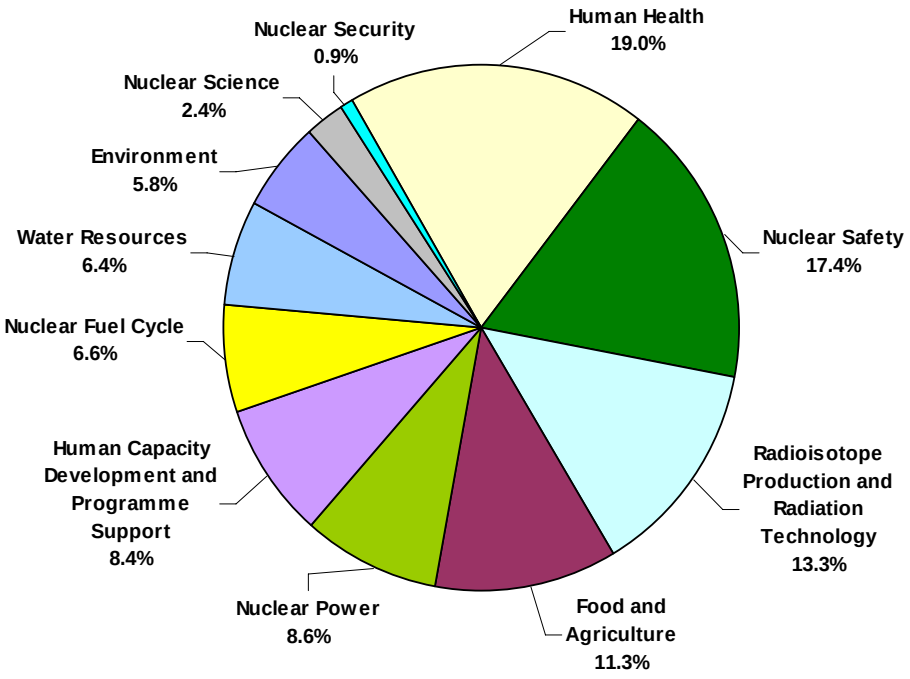

FIG. 6. Disbursements by technical field for 2009 —Latin America.

In recent years, an upswing in activity related to the food and agriculture sector is reflective of how the food security crisis is affecting the region. The sterile insect technique is being widely applied in support of the fruit and horticultural sectors, and nuclear techniques are

helping Member States deal with the incidence of harmful algal blooms, a major problem for areas with an economic dependence on fisheries.

Childhood obesity in Latin America has reached epidemic proportions, and a five year regional project has raised public awareness of the importance of appropriate nutrition and established baseline data for intervention programmes.

Also, in cooperation with the Latin American Energy Organization (OLADE), the IAEA is providing advice and training on energy planning for sustainable development to 18 Member States.

3.6. Challenges facing the Technical Cooperation Programme

The contribution that nuclear science and technology can make to national development is not always well recognized and nuclear development issues are frequently considered separately from mainstream development issues, resulting in limited integration of TC projects in national development plans The IAEA is helping this issue to be addressed by moving away from a focus on individual projects towards an integrated programme at the country level that includes all relevant services, thus achieving a more cohesive and efficient delivery of assistance to Member States.

The TC programme also lacks international recognition for its contributions, in part due to a widespread perception of the IAEA as an organization with only a verification role. The IAEA is working to raise public awareness of its technical cooperation activities, and is placing considerable emphasis on outreach to appropriate partners in the UN system. Closer partnerships and linkages at the national level with other partners from the UN system would be effective in leveraging nuclear technology to address development issues. In light of the increasing relevance of nuclear science and technology for development, and the increase in the numbers of Member States and their requirements for TC support, there remains the need for considering means and mechanisms to ensure that resources for TC are stable, assured and predictable.

4. Promotion of peaceful nuclear cooperation

4.1. Nuclear energy

The principal peaceful benefit that the founders of the IAEA had in mind was nuclear power, which remains the most prominent peaceful application of nuclear energy and the one with the greatest quantifiable economic benefit. In accordance with priorities of Member States, as reflected in the MTS of 2006-2011, activities in this area can be summarized as follows:

- Helping interested Member States build their **capacity for comprehensive energy system planning**.
- Offering a **roadmap for exploring or introducing nuclear power** by assessing readiness and progress, and providing training, technical advice and peer reviews.
- Helping to **improve the performance of operating reactors or fuel cycle facilities** by: disseminating experience, new knowledge and best practices; providing training; establishing authoritative guidelines; and conducting peer reviews.
- Working to **catalyse innovation** in nuclear technologies.
- Assisting in **research reactor** planning, operation and utilization.

4.1.1. Capacity-building for energy analysis and planning

Reducing poverty and promoting sustainable development require clean and affordable energy services and supplies. Expanding access to such services requires careful planning. Interested Member States are helped to build their energy planning capabilities. The IAEA develops and transfers planning models and data; it trains local experts; and it helps establish local expertise to chart national paths to sustainable development.

Comprehensive training customized to reflect the country's current situation and development priorities is offered, with the aim of putting the right tools into the hands of local experts. To date, more than 115 Member States have received assistance in using the IAEA's energy models. In 2009, over 500 energy analysts from 74 countries were trained in 28 courses, mostly organized through TC projects.

The models and training cover energy demand, supply, environmental impacts, finance, system optimization, and indicators for sustainable development. They are 'technology neutral', i.e. there is no special focus on nuclear power. For many of the Member States that use the models, nuclear power is likely not to be a cost effective near-term option, and it is

essential that the models help those countries, as well as others, to identify their effective energy strategies.

The IAEA prepares annually two projections of future nuclear power developments, one ‘low’ and one ‘high’. Recently, these have been revised upwards each year as the experts assembled by the IAEA to make the projections have shared the rising expectations for nuclear power expressed by many political and industry leaders (Fig. 7). It also contributes to international studies, negotiations and deliberations that set the global context for the use of nuclear power. These include the studies and deliberations of, among others, the Intergovernmental Panel on Climate Change (IPCC), the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) and the Commission on Sustainable Development (CSD).

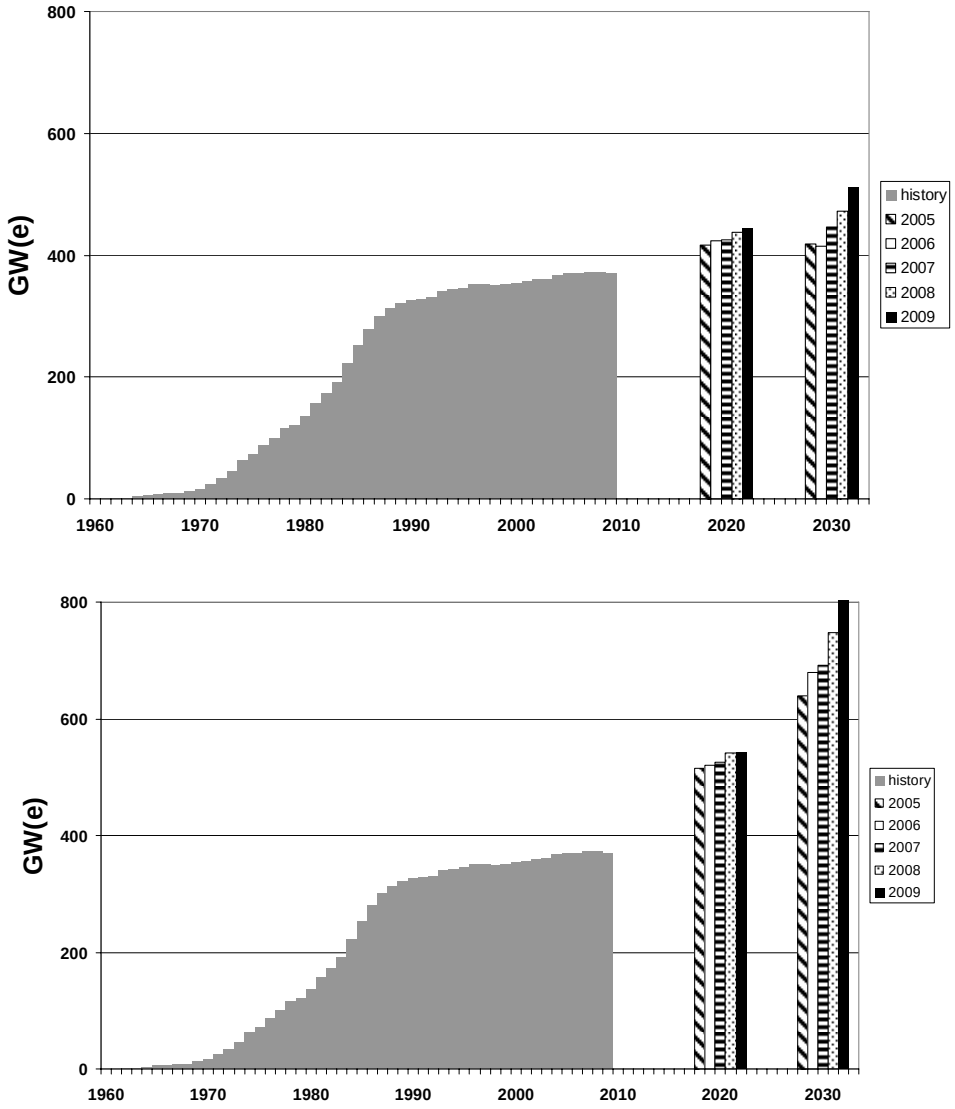

FIG. 7. Historical growth in the world's installed nuclear power capacity (grey) and projections for 2020 and 2030 made in 2005 (diagonal stripes), 2006 (white), 2007 (horizontal stripes), 2008 (dots) and 2009 (black). The top panel shows the IAEA's low projection and the bottom panel the high projection. The increase in the projections from year to year reflects rising expectations for nuclear power. (GW(e): gigawatts (electric).)

4.1.2. Assisting countries considering or introducing nuclear power

Historically, interest in nuclear power has fluctuated considerably. Recently, there has been a surge of interest in nuclear energy, as States endeavour to satisfy growing energy demands and mitigate the threat of climate change.

Currently there are 437 nuclear power plants in 29 countries — mostly in developed countries — providing 14% of the world's electricity. However, more than 60 countries — mostly in the developing world — have expressed interest in launching nuclear power programmes. Seventeen of these are actively preparing national nuclear power programmes, two had active bidding processes in 2009 on their first nuclear power plants, and one is constructing its first nuclear power plant. The increased interest has led to a three-fold increase in TC projects related to nuclear power in the current 2009–2011 TC cycle in comparison with the 2007–2008 cycle. Fifty-eight Member States are participating in regional or national technical cooperation projects related to the introduction of nuclear power.

The time horizons for the introduction of nuclear power are long, and the requirements for the regulatory and industrial infrastructure are challenging. The process of building nuclear infrastructure can take ten years or longer. To support Member States exploring or introducing nuclear power, the IAEA offers the following assistance or services:

- A set of milestones[2] and 19 associated issues[3] for planning such an introduction;
- Assessment methods for evaluating progress relative to the milestones;
- Training;
- Integrated Nuclear Infrastructure Review (INIR) missions, offered since 2009, to follow up self-assessments;
- Supplementary documents, as well as conferences and technical meetings, on such topics as workforce planning, bid evaluation, nuclear safety, nuclear law, technology assessment, and site selection activities.

[2] The milestones reflect the stages of preparation — what should have been accomplished to make a commitment to a nuclear power programme; what should have been accomplished to invite bids for the first nuclear power plant; and what should have been accomplished to commission and operate the first nuclear power plant.

[3] The 19 issues are: national position; nuclear safety; management; funding and financing; legislative framework; safeguards; regulatory framework; radiation protection; electrical grid; human resources development; stakeholder involvement; site and supporting facilities; environmental protection; emergency planning; security and physical protection; nuclear fuel cycle; radioactive waste; industrial involvement; and procurement.

Proposals on assurance of supply of nuclear fuel continued to be discussed under the IAEA's auspices during 2005–2009. In November 2009, the IAEA Board of Governors authorized the IAEA Director General to conclude and subsequently implement the Agreement with the Russian Federation to establish a reserve of 120 metric tons of LEU, sufficient for two full cores of fuel for a 1000 MWe power reactor. In this regard, the Director General of the IAEA signed the Agreement with the Russian Federation on 29 March 2010. Discussions and consultations on other proposals, including an IAEA LEU Fuel Bank, continued.

4.1.3. Support for existing nuclear power programmes

Continuously improving the performance, safety and security of nuclear power plants and fuel cycle facilities throughout their life cycles is essential. For nuclear power plants, activities target improvements in quality management, maintenance, on-line monitoring, instrumentation and control, modernization programmes, plant life extension, outage management, corrosion control, structural integrity, staff training, and knowledge management.

The IAEA develops and publishes standards and guidelines. On request, expert teams are assembled to conduct peer reviews of facilities to identify potential improvements. Databanks on technologies and operating experience are maintained and training courses are offered for sharing operating experience, new knowledge and best practices.

For the front end of the nuclear fuel cycle, information on uranium resources, exploration, mining and production is assembled and disseminated in order to promote best practices in uranium mining and production to minimize environmental impacts.

Regarding the back end of the fuel cycle, spent fuel inventories continue to grow due to limited reprocessing and delays in disposal. The IAEA facilitates the development of guidance and exchange of information on methods to increase the capacity of existing facilities and to accommodate extended interim storage durations.

To improve the flow of knowledge and experience among those engaged in waste management and disposal and to encourage organizations in developed Member States to contribute to the activities of Member States requiring decommissioning and waste management assistance, the IAEA has established a number of networks. These include the Underground Research Facilities Network (URF Network) for research on deep geological final repositories, the International Decommissioning Network (IDN), the International Low Level Waste Disposal Network (DISPONET) and the IAEA Network on Environmental Management and Remediation (ENVIRONET).

4.1.4. Innovation

The future expansion of nuclear power will require continued design advances and technological innovation. The IAEA serves as a catalyst, coordinating research and promoting the exchange of information for current reactor lines and for innovative nuclear energy systems. It also seeks to stimulate innovation through activities in four areas:

- Encouraging technological progress for light water, heavy water, fast and gas cooled reactors;
- Conducting the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), which provides a forum for experts and policy makers from industrialized and developing countries to discuss the development and deployment of innovative nuclear energy systems;
- Organizing research projects on small and medium sized reactors[4];
- Investigating non-electric applications such as hydrogen generation and desalination using nuclear energy.

4.1.5. Research reactors

Fifty per cent of all operating research reactors are now over 40 years old. The IAEA provides assistance related to research reactor ageing, modernization and refurbishment, and maintains a database to share experience related to research reactor ageing. As older research reactors are retired and replaced by fewer, more multipurpose reactors, greater international cooperation will be required to ensure broad access to these facilities and their efficient use. Progress is being made on the development of cooperative networks in the Mediterranean, Eastern European, Caribbean and Central Asian regions.

The IAEA supports Member States participating in international programmes to return research reactor fuel to its country of origin and to reduce the use of HEU. It arranges contracts for repatriating fuel, publishes guidance, and provides training and advice. In connection with the Russian Research Reactor Fuel Return (RRRFR) Programme and the US Foreign Research Reactor Spent Nuclear Fuel Acceptance Programme, the IAEA has assisted, since 2005, in repatriating Russian and US origin fuel from 13 Member States. The Reduced Enrichment for Research and Test Reactors (RERTR) Programme, under the Global Threat Reduction Initiative, is the major effort in converting research reactor fuel and targets used in the production of molybdenum-99 from HEU to Low Enriched Uranium (LEU). In 2009, the programme's scope was expanded from 129 research reactors to 200. By the end 2009, 67 research reactors around the world that had been operating with HEU fuel were shut down or converted to LEU fuel, and another 36 were planned for conversion with existing qualified LEU fuels.

4.2. Nuclear applications

Nuclear science and technology offer many unique and cost effective tools, and have the potential for positive socioeconomic impact in responding to development challenges in key areas such as food and agriculture and human health, as well as water resource and environmental management. This has led to increased demands for science and technology

[4] Thirty per cent of the power reactors now in operation are small (300 MW(e) or less) or medium sized (300–700 MW(e)). Of the 56 power reactors under construction, 20% are small or medium sized.

based capacity building assistance from Member States that do not have a nuclear power programme.

The IAEA has its own scientific laboratories located in Austria and Monaco. They play a fundamental role in supporting the aforementioned activities by providing the necessary scientific and technical expertise, equipment and resources.

4.2.1. Human health

The focus of the IAEA's Human Health programme is on enhancing capabilities for the prevention, diagnosis and treatment of disease through the safe and effective application of nuclear techniques. The programme now accounts for more than 20% of all TC projects. Since 2005, the Human Health programme has supported approximately 220 training courses covering all areas of its work that have been attended by more than 3000 trainees.

The rising prevalence in recent years of chronic and non-communicable diseases has led to an equally rapid rise in demand for technical assistance in the use of nuclear and radiation technologies to combat them. At the same time, the prevalence of malnutrition and hunger is still unacceptably high, in particular in infants and children. Nuclear and isotopic techniques offer uniquely effective means to help manage many major groups of chronic diseases, which account for more than half of all deaths worldwide, and to develop and monitor interventions to combat malnutrition in all its forms.

Cancer kills more people every year than tuberculosis, malaria and HIV/AIDS combined, affecting most severely low and middle income countries and poses a significant risk to the health and development goals of many Member States. During the last decade, cancer has become the principal focus of the IAEA's human health activities. In 2004, it established the Programme of Action for Cancer Therapy (PACT) to enable developing countries to introduce, expand or improve their cancer care capacity and services by integrating radiotherapy into a sustainable, comprehensive cancer control programme.

PACT brings together all of the IAEA's cancer related expertise and services under a single organizational umbrella to support the building and strengthening of a global coalition of partners that implements cancer control projects and mobilizes funds in a coordinated manner. It has established formal partnerships with 16 other organizations in the public, private and non-governmental sectors. Working with its partners, PACT builds capacity and long term support for continuous education and training of cancer care professionals, as well as for community based action by civil society to combat cancer. PACT has conducted 28 comprehensive needs assessment missions in 21 Member States and since its inception has raised the equivalent in funds and gifts of nearly $28 million.

In 2009, the IAEA and the World Health Organization (WHO) launched a Joint Programme on Cancer Control, thereby strengthening their contributions to cancer control and formally linking the responses of the two organizations to the cancer crisis in developing countries.

The IAEA also has a dosimetry laboratory at its facilities in Seibersdorf, Austria, that provides calibration and dosimetry verification services, aligned with international safety standards and measurement systems, for radiotherapy machines that are used to treat cancer. In recent years, between 450 and 500 radiation beams have been audited each year to ensure appropriate calibration of equipment and delivery of correct radiation doses in Member States, many of which have no other access to such services. This laboratory also maintains a global Secondary Standards Dosimetry Laboratory network, which has grown significantly since 2005 and now consists of 80 laboratories in 67 Member States. They participate in calibration and verification exercises and help to disseminate best practices.

4.2.2. Food and agriculture

The IAEA and the Food and Agriculture Organization of the United Nations (FAO) operate the oldest partnership in the UN system, the Joint FAO/IAEA Programme on Nuclear Techniques in Food and Agriculture. This programme assists in the safe and appropriate use of nuclear techniques and related biotechnologies to increase and sustain food and agricultural production as well as food safety. It includes plant breeding to develop crop varieties able to grow under harsh environmental conditions, support for sustainable land management and water use efficiency in agriculture, control of insect pests and animal diseases, conservation of natural resources, and the promotion of food quality and safety through irradiation and other techniques.

In 2009, the IAEA implemented nearly 250 TC projects and 24 active coordinated research projects (CRPs) in food and agriculture. Over the past five years, an average of 25 training courses and 20 workshops and seminars with more than 500 trainees were held annually.

The socioeconomic impact of such activities is noteworthy. It includes: savings in fertilizer use made possible through the use of nuclear techniques to more effectively determine optimal application and timing; higher yielding, disease and drought resistant food and industrial crops through mutation assisted plant breeding techniques; use of nuclear techniques to assess land degradation and soil erosion in support of soil conservation strategies; widespread use of technologies to monitor the effectiveness of national livestock vaccination programmes, and; the creation of fruit fly free areas that have brought benefits of increased food production, access to exports markets and better employment opportunities.

There has also been a substantial increase in the use of radiation as a replacement for chemical and other methods to treat foodstuffs for safety and phytosanitary purposes, which also generates access to export markets as well as employment.

The FAO/IAEA Agriculture and Biotechnology Laboratory (ABL), in Seibersdorf, provides scientific and technical support in the conception, adaptation and improvement of nuclear and related techniques and technologies, and strengthens capacity in the use of these applications through international cooperation in research and training. The laboratory also provides guidance on the introduction of analytical quality control and quality assurance measures in Member State laboratories, and training in the maintenance of equipment and instruments. During the past five years, more than 500 trainees from 84 Member States were trained.

4.2.3. Water resources

Concern about the vulnerability of water resources is increasing worldwide, and water supplies and quality conditions are already critical in many areas. The use of nuclear techniques is an efficient and cost effective way to provide key information that water managers and policy makers can use to sustainably manage their water resources. Responding to the needs identified by the World Water Forum and the UN World Water Development Report, the IAEA works in partnership with organizations such as the United Nations Environment Programme (UNEP) and FAO and with institutes and national authorities responsible for the study and management of water.

More than 110 TC projects dealing with transboundary aquifers, groundwater and surface water resource management involving 64 Member States have been implemented since 2005, with nearly 200 scientists trained in isotope hydrology techniques.

Archiving and distributing isotope data from precipitation, rivers, and groundwaters is another important activity. An example is the Global Network of Isotopes in Precipitation database established in 1961 as a joint service of the IAEA and the World Meteorological Organization, which has now expanded to consist of over 920 reporting stations worldwide that generate 120 000 isotope records each month. The database is valuable for a number of scientific purposes, including the development of global assessments of climate variability and change.

Isotope hydrology atlases for Africa, the Americas and the Asia–Pacific region have been published during the last five years. These, for the first time, have brought together tens of thousands of isotope records from across these regions and dating back several decades. They are unique archives and references that are helping water managers in these regions to better understand the complexity of the problems.

The IAEA has an Isotope Hydrology Laboratory in Vienna. The laboratory develops and improves analytical and sampling methods for the application of nuclear techniques and provides training and technical support to other laboratories. It also plays a role in assuring the quality of stable and radioisotope analyses through its coordination of intercomparison tests with laboratories around the world.

4.2.4. Environment

To promote sound environmental management and protection, the IAEA provides assistance in developing a greater understanding of, and better analytical capacities regarding, key phenomena in the marine and terrestrial environments. These phenomena include the movement and fate of various pollutants in the oceans, with a particular focus on coastal zones and effects on marine organisms; the impacts of climate change and rising atmospheric concentrations of carbon on marine ecosystems and resources; and the movement, fate and environmental effects of pollutants released into the atmosphere by industrial and mining activities. The IAEA conducts these activities at its environmental laboratories in Monaco and Seibersdorf.

The establishment, strengthening and coordination of worldwide networks of environmental laboratories to address these issues are important areas of work. For example, the Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA) network, which monitors environmental radioactivity worldwide, has expanded from 40 Member State laboratories in 2006 to 120 at the end of 2009.

The environmental laboratories play a crucial role in assuring the quality of radionuclide analyses through the coordination of intercomparison tests with laboratories around the world. They also develop, maintain and distribute international reference materials that serve as global benchmarks for the accurate analysis of radionuclides and stable isotopes in environmental samples.

4.2.5. Radioisotope production and radiation technologies

The IAEA supports the production of radioisotopes and related products for health care and industry, and for industrial applications of radiation technologies. Assistance in building the necessary scientific and technical capacities and infrastructure improves the availability of quality radiopharmaceuticals that are essential in the diagnosis and treatment of diseases such as cancer. Such assistance also helps to improve the use of radiation and radioisotopes that increase the safety, quality and environmental friendliness of industrial processes and products.

The IAEA's Nuclear Spectrometry and Applications Laboratory in Seibersdorf provides training facilities for Member States as well as quality assurance methods and tools for the study of materials used for nuclear power generation systems and other applications. The use of these techniques to help study and preserve cultural heritage objects has been an area of great interest to a number of developing Member States.

Since 2006, more than 200 TC projects have been implemented involving more than 300 fellowships and scientific visits. Over 100 participants in radiation processing technology and operations have also been trained. Coordinated research activities during this period involved teams from over 150 institutions, resulting in new technical methodologies and products for use in health care and industry, as well as R&D capacity building in the participating teams.

4.3. Nuclear safety

The growing use of nuclear technology brings significant benefits, but also entails potential risks. Maintaining a high level of nuclear safety and security is crucial in using nuclear technology to meet the essential needs of Member States. Ensuring safety and security is primarily the responsibility of each State. However, the recognition of far reaching and transboundary consequences of any accident has strengthened global arrangements to address these risks.

The IAEA continues to help develop and strengthen the global nuclear safety and security regime, which is based on strong national infrastructures, international instruments, safety standards and security guidelines, and is implemented through peer reviews, advisory services, knowledge networks and capacity building activities.

4.3.1. Safety standards

By its Statute, the IAEA is authorized to establish safety standards and provide for their application. A new standard, the *Fundamental Safety Principles*, was published by the IAEA in 2006 jointly with a number of other international organizations. These principles constitute the conceptual basis for the body of the IAEA's safety standards and provide the rationale for a wider safety and security programme.

In 2007, the revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the BSS) was initiated to bring it up to date. The process of developing and updating other safety standards continues. From 2006 to 2009, more than 30 standards were published.

4.3.2. Emergency preparedness and response

The IAEA responds to an increasing number of requests from Member States to assist in minimizing the impact of nuclear or radiological incidents and emergencies. In 2006, the IAEA Incident and Emergency Centre (IEC) was established, providing a 24/7 capacity to provide timely response to requests for assistance in cases of nuclear emergencies.

In 2007, to help Member States strengthen their preparedness arrangements in the event of a nuclear or radiological emergency, the IAEA published a safety guide entitled Arrangements for Preparedness for a Nuclear or Radiological Emergency jointly with other international organizations. The IAEA also conducted training courses, workshops and exercises at the national and regional levels to assist in the application of this publication. Furthermore, to test and evaluate the exchange of information and coordination of emergency assistance on an international scale, small and large scale exercises were conducted in 2007 and 2008.

The Response Assistance Network (RANET), comprising specialized professionals capable of rapidly and effectively responding with expert assistance in the event of a radiation incident or emergency was launched in 2006. By the end of 2009, 16 countries registered their national assistance capabilities with RANET. Furthermore, almost half of all RANET registered Member States participated in ShipEx-1 (2009), which tested current and existing capabilities for safe and expeditious international transport of blood samples subjected to biological dosimetry assessment.

4.3.3. Safety of nuclear power installations

As a result of the increased interest in and demand for nuclear power installation services, a new Integrated Regulatory Review Service (IRRS) was launched in 2006. It was designed to: facilitate the exchange of experience and mutual learning among senior regulators; promote high quality self-assessments; and strengthen Member State legislative and regulatory infrastructures. To date, 30 IRRS missions have been conducted in 28 countries.

After an earthquake in Japan in 2007, an International Seismic Safety Centre (ISSC) was established in October 2008 to address safety concerns. The ISSC has aided in the analysis of the impacts of earthquakes on nuclear installations.

Assistance is also provided to enhance self-assessment capabilities, to improve the exchange of information on operating experience and to address general operational safety aspects through a range of services, including the: Incident Reporting System for Research Reactors (IRSRR); the Research Reactor Information Network (RRIN); and the Integrated Safety Assessment of Research Reactors (INSARR) Service. In 2007, the International Decommissioning Network was launched to provide a forum for sharing of practical decommissioning experience.

From 2006 to 2009, the IAEA's OSART (Operational Safety Review Team) missions visited 20 nuclear power plants in 14 countries. The missions reported that the managements of most of the plants and utilities visited were committed to improving and maintaining a high level of operational safety.

4.3.4. Radiation and transport safety

Every year, radioactive sources that are not under regulatory control ('orphan' sources) are discovered at ports of entry and metal recycling facilities around the world. Many Member States do not have sufficient expertise, or resources, to characterize such radioactive material or to reestablish regulatory control over orphaned sources. This challenge is addressed by promoting the wider application of the Code of Conduct on the Safety and Security of Radioactive Sources. Agreement to use the Code has continued to grow (97 States as of February 2010), and the IAEA has continued to assist Member States in its implementation.

To support regulatory control and inventory of radiation sources, the IAEA offers the Regulatory Authority Information System (RAIS). Its latest version, the 'RAIS Web Portal', released in 2008, can be used by field offices of regulatory bodies and by authorized representatives of facilities to access facility data.

One of the major issues in transport safety is denial or delay of shipment of radioactive substances, such as radioisotopes used in nuclear medicine, industry and research. Due to the short half-life (on the order of hours or days), these expensive and often scarce radioisotopes lose their usefulness every hour they are delayed. The IAEA has been working with transportation companies to sensitize them about the safe handling of radioactive material, and supports development of a database on denials of shipments. The IAEA also periodically has facilitated informal discussions with coastal and shipping States with a view to maintaining dialogue and consultation aimed at improving mutual understanding, confidence building and communication in relation to the safe maritime transport of radioactive material.

4.3.5. International safety conventions

All States operating land based nuclear power plants are amongst the 67 Contracting Parties to the Convention on Nuclear Safety, which aims at achieving and maintaining a high level of

safety by setting international benchmarks to which States subscribe. At the last review meeting held in April 2008, after review of the information provided by the contracting parties on steps and measures taken to implement their obligations, it was concluded that there was a high degree of compliance.

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management aims to achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management resulting from civilian nuclear activities. At the third review meeting held in May 2009, there were constructive exchanges and sharing of knowledge testifying to the usefulness of the review process. By the end of 2009, there were 53 parties and 42 signatories of the Joint Convention.

4.4. Nuclear security

Ensuring security is primarily the responsibility of each State. However, the recognition of far reaching and transboundary consequences of any malicious act has strengthened global arrangements to address these risks. The IAEA has supported the efforts of States to improve nuclear security whenever nuclear or other radioactive material is in use, storage and/or transport. This assistance has taken the form of capacity building, publication of guidance documents, human resource development, sustainability and risk reduction.

4.4.1. Nuclear Security Plan

The IAEA has provided assistance to States and supported their national efforts to establish and improve nuclear security since the early 1970s when it began providing ad hoc training in physical protection. The IAEA's first comprehensive plan of action to protect against nuclear terrorism, the Nuclear Security Plan, was approved in 2002 along with the creation of a voluntary funding mechanism, the Nuclear Security Fund, in order to help implement the Plan. The second Plan adopted in 2005 was for 2006-2009 and the third Plan adopted in 2009 is for the period 2010-2013

4.4.2. Physical protection

At the 2000 NPT Review Conference, States Parties to the Treaty noted the paramount importance of effective physical protection of all nuclear material, and called upon all States to maintain the highest possible standards of security and physical protection of nuclear materials. In 2005, the States Parties to the Convention on the Physical Protection of Nuclear Material (CPPNM) agreed an Amendment to the convention which, upon its entry into force, will extend the physical protection measures of the CPPNM to nuclear facilities and material in peaceful domestic use, storage and transport. While the Amendment to the CPPNM has received strong political support, only 33 States had formally accepted the Amendment as of December 2009.

In order to assist States to carry out needs assessment, the IAEA carries out, upon request, evaluation missions. Seventy-five missions were conducted, as well as a number of shorter

technical visits. In the four year period between 2006 and 2009, IAEA nuclear security teams visited — in an advisory or implementation capacity — 60 nuclear sites.

Through its Illicit Trafficking Database (ITDB) programme, the IAEA collects information on incidents of illicit trafficking and other unauthorized activities and events involving nuclear and other radioactive material. The scope of the ITDB information is broad, covering any acts or events that involve any type of nuclear or radioactive material outside legitimate control and protection. The database tracks events that occurred intentionally or unintentionally, including unsuccessful or thwarted acts. Between 2006 and 2009, 23 new States had joined the ITDB programme, bringing the total number of participants to 109.

From 1 January 2006 to 31 December 2009, 975 incidents were reported to the ITDB; 799 of these were reported to have occurred during this period and the remaining 176 were reports of prior incidents. Seventy-five incidents reported to have occurred between 2006 and 2009 involved illegal possession, including attempts to sell or smuggle nuclear material or radioactive sources.

4.4.3. Other activities

Acting in the framework of the Nuclear Security Plan and at the request of States, the IAEA has, inter alia, between 2006 and 2009:

- Published new and revised recommendations and guidelines, in the IAEA's Nuclear Security Series of publications, for use by States in the establishment of their national nuclear security systems. To date, the IAEA has issued 12 such publications.
- Offered education, training and equipment upgrades to over 300 international, regional and national training courses and workshops involving over 6000 participants from 87 States. Training topics focused on physical protection and the prevention of malicious acts, including security objectives and fundamental principles, physical protection principles and methodologies, protection of nuclear facilities against theft and sabotage, establishing effective radiation detection capabilities at border crossing points and methods to respond to seizures of nuclear and other radioactive material.
- Supplied approximately 3000 detection and border monitoring instruments to 55 States.
- Completed, or was in the process of completing, physical protection upgrades in 30 States.
- Developed long term national work plans that consolidate an individual State's range of nuclear security needs and the steps required to meet them in an Integrated Nuclear Security Support Plan (INSSP). As of December 2009, the Secretariat had prepared 50 INSSPs.

As part of its support for security measures at major public events, the IAEA assisted Brazil in its preparations for the 2007 Pan-American Games and China for the 2008 Summer Olympic Games.

The IAEA's nuclear security activities are funded by its regular budget and by voluntary contributions, but mostly by the latter. Over the last four years, contributions to the Nuclear Security Fund totaled more than $72.5 million.

4.5. Nuclear law

The global framework for nuclear law is expanding rapidly. Over the past decades, States have adopted more than a dozen international legal instruments in the fields of nuclear safety, security, safeguards and liability for nuclear damage. Recognizing that comprehensive national legal frameworks are essential for ensuring the safe and peaceful uses of nuclear energy, the IAEA assists States, upon request, in developing nuclear legislation. This assistance covers all areas of nuclear law such as nuclear safety, nuclear security, safeguards, and civil liability for nuclear damage, and is provided through international, regional and national workshops and seminars, bilateral assistance in drafting national laws, training of individuals and the development of reference material.

From 2005 to 2009, more than thirty international and regional workshops were organized. Further, since 2005, country specific bilateral legislative assistance has been provided to more than sixty Member States.

At the request of Member States, individual training has also been provided since 2005 to more than twenty legal experts through short term visits to IAEA Headquarters, as well as longer term fellowships allowing the trainees to gain further practical experience in nuclear law.

5. Conclusion

Since the last NPT Review Conference in 2005, the IAEA has continued its efforts to respond to the evolving requirements of its Member States. As can be seen from this survey, the range of IAEA activities related to Article IV of the NPT is diverse.

Over the years, the IAEA's roles, responsibilities and services have grown in response to the issues, challenges and opportunities facing its members and the international community. Its programme of work has increased in response to demands and expectations, as have efforts to critically assess and optimize its services for reasons of effectiveness, and efficiency. As the IAEA looks to the future and responds to the demands and expectations of its Member States, it can expect to see increasing requests for support to the introduction of nuclear power, a greater focus on human health, food safety and security and sustainable management of natural resources.

To extend the reach of its activities and multiply their benefits, the requirement for agreements and working relationships with partner organizations in and outside the UN system is likely to grow. It can also be expected that certain activities will be phased out as technology matures or moves into the hands of the private sector, or as Member States acquire their own technological capacities.

In light of the expanding use of nuclear power and other nuclear applications for meeting basic human needs, expectations that all such nuclear activities should be carried out in the safest and most secure manner will continue. For the IAEA to fulfil these expectations, it will require the strong commitment and continued support of its Member States.