THE IAEA PARTNERSHIP:

Sharing the Peaceful Uses of Nuclear Technology

IAEA

Atoms for Peace: The First Half Century
1957–2007

TABLE OF CONTENTS

Atoms for Peace 3

IAEA at a Glance 5

Addressing the Global Energy Imbalance 6

Putting Safety and Security First 8

Nuclear Security: Guarding Against Terrorism 11

Stemming the Spread of Nuclear Weapons 12

IAEA and the Democratic People's Republic of Korea 15

Working for Sustainable Development 16

Employing Nuclear Sciences and Applications 18

"I don't think any of the problems we are facing today — whether countries trying to develop nuclear weapons, developing nuclear fuel cycles, the question of the physical protection of nuclear materials, the desire by terrorists to acquire these materials, the stagnation in nuclear disarmament — on all these issues, I don't think we can move an inch forward without putting our heads together, without working together in unity of purpose and clear understanding that we are either going to succeed together or fail together."

Carnegie Endowment for International Peace, Washington, D.C., November 2005

IAEA Director General Mohamed ElBaradei

ATOMS FOR PEACE

The *International Atomic Energy Agency (IAEA)* is the world's foremost forum for scientific and technical cooperation in the peaceful uses of nuclear technology. Established as an independent organization under the United Nations (UN) in 1957, the IAEA represents the realization of US President Eisenhower's visionary 'Atoms for Peace' speech to the UN General Assembly in 1953. He proposed the creation of an international body to both control and promote the use of atomic energy. These ideas helped to shape the IAEA Statute, which 81 nations unanimously approved in October 1956. The Statute outlines the three pillars of the Agency's work — nuclear verification, safety and security, and technology transfer.

Statute of the IAEA *(Article II)*

"The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world.

It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose."

In 1961 the IAEA opened its Laboratory in Seibersdorf, Austria, creating a channel for cooperative global nuclear research. That year the Agency signed a trilateral agreement with Monaco and the Oceanographic Institute headed by Jacques Cousteau for research on the effects of radioactivity in the sea, an action that eventually lead to the creation of the IAEA's Marine Environment Laboratory.

Committed to Non-Proliferation

As more countries mastered nuclear technology, concern deepened that they would sooner or later acquire nuclear weapons. Following Russia, the UK and the USA, two additional nations had done so; France in 1960 and China in 1964. The safeguards prescribed in the IAEA's Statute, designed chiefly to cover individual nuclear plants or supplies of fuel, were clearly inadequate to deter proliferation. There was growing support for international, legally-binding, commitments and comprehensive safeguards to stop the further spread of nuclear weapons and to work towards their eventual elimination.

This found regional expression in 1968 with the approval of the *Treaty on the Non-Proliferation of Nuclear Weapons (NPT)*. The NPT essentially freezes the number of declared nuclear weapon States at five (China, France, Russia, UK and USA). Other States are required to forswear the nuclear weapons option and to conclude comprehensive safeguards agreements with the IAEA on their nuclear materials.

In 1991, the discovery of Iraq's clandestine weapon programme sowed doubts about the adequacy of IAEA safeguards, but also led to steps to strengthen them, some of which were put to the test when the Democratic People's Republic of Korea (DPRK) became the second country that was discovered to be violating its NPT safeguards agreement.

The Three Mile Island accident and especially the Chernobyl disaster persuaded governments to strengthen the IAEA's role in enhancing nuclear safety.

Recognized Service for Peace

The Norwegian Nobel Committee awarded the 2005 Nobel Peace Prize to the IAEA and Director General ElBaradei "for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy for peaceful purposes is used in the safest possible way".

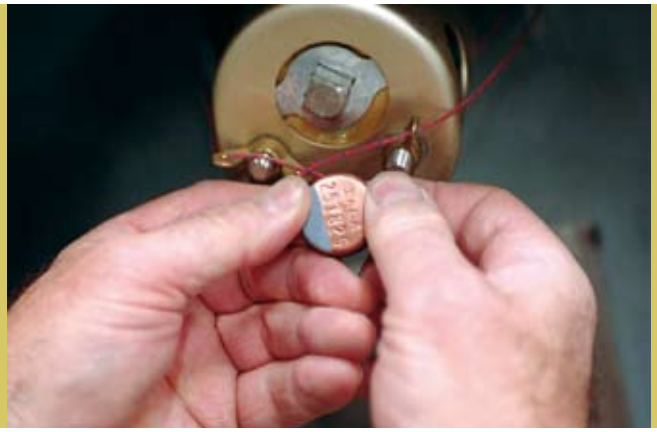
Today, the IAEA's broad spectrum of services and activities is based on the needs of more than 140 Member States. The IAEA's mission is guided by the interests and needs of Member States and the vision embodied in the IAEA Statute. Three main areas of work underpin the IAEA's mission: Safeguards and Verification; Safety and Security; and Science and Technology.

The IAEA works with all its Member States to ensure that cooperation is achieved within a safe, secure, and well-regulated nuclear infrastructure.

Promoting Safeguards and Verification

The IAEA is the world's nuclear inspectorate, with five decades of verification experience. Inspectors work to verify that safeguarded nuclear material and activities are not used for military purposes.

http://www.iaea.org/OurWork/SV/index.html



Promoting Safety and Security

The IAEA helps countries to upgrade nuclear safety and security, and to prepare for and respond to emergencies. Work is keyed to international conventions, standards and expert guidance. The main aim is to protect people and the environment from harmful radiation exposure.

http://www.iaea.org/OurWork/SS/index.html

Promoting Science and Technology

The IAEA is the world's focal point to mobilize peaceful applications of nuclear science and technology for critical needs in developing countries. The work contributes to fighting poverty, disease and pollution of the environment, and to other goals of sustainable development.

http://www.iaea.org/OurWork/ST/index.html

IAEA AT A GLANCE

- **143** Member States.
- **65** intergovernmental and non-governmental organizations worldwide having formal agreements with the Agency.
- Nearly **50** years of international service.
- **2312** professional and support staff.
- **$322** million regular budget for 2005, supplemented by extrabudgetary contributions received in 2005 amounting to **$39** million.
- **$77.5** million target in 2005 for voluntary contributions to the Agency's Technical Cooperation Fund, supporting projects involving **2784** expert and lecturer assignments, **3202** meeting and workshop participants, **1574** participants in training courses and **1436** fellows and visiting scientists.
- **2** liaison offices (in New York and Geneva) and **2** safeguards regional offices (in Tokyo and Toronto).
- **2** international laboratories and research centres.
- **140** active Coordinated Research Projects involving **1511** approved research contracts and agreements.
- **232** safeguards agreements in force in **156** States involving **2142** safeguards inspections performed in 2005. Safeguards expenditures in 2005 amounted to **$121.1** million in regular budget and **$14.5** million in extrabudgetary resources.
- **18** national safeguards support programmes and **1** multinational support programme (European Union).
- **15** million average monthly hits to the Agency's *IAEA.org* web site.
- **2.6** million records in the International Nuclear Information System (INIS), the Agency's largest database.
- **200** publications and newsletters issued (in print and electronic formats) in 2005.

ADDRESSING THE GLOBAL ENERGY IMBALANCE

Any discussion of 21st century energy trends must take into account the global energy imbalance. Roughly 1.6 billion people still lack access to modern energy services, and few aspects of development — whether related to living standards, health care or industrial productivity — can take place without the requisite energy supply. The growth in energy demand will be substantial, and 'connecting the unconnected' will be a key to progress.

Another challenge will be sustainability — meeting these growing energy needs without creating negative side effects that could compromise the living environment of future generations.

In recent years we have seen rising expectations regarding the role of nuclear power as a source of electricity. This rise is driven by a number of factors. The rapid growth in global energy demand is putting a premium on all energy sources. Climate change concerns have highlighted the advantages of nuclear power in terms of its minimal greenhouse gas emissions. And the sustained nuclear safety and productivity record over the past twenty years has made nuclear operating costs relatively low and stable.

Nuclear power is not a "fix-all", but it will certainly be part of this mix of solutions, and the expectations for the expanding use of nuclear power are rising.

Nuclear power remains the most prominent peaceful application of nuclear energy. The IAEA fosters the efficient and safe use of nuclear power by supporting interested Member States in:

- Preserving and disseminating information and knowledge;
- Developing indigenous capabilities around the world for national energy planning;
- Catalysing innovation in nuclear power and fuel cycle technologies;
- Improving the performance of nuclear power plants and the nuclear fuel cycle;
- Advancing science and industry through improved operation of research reactors; and
- Deploying new nuclear power plants.

Improving the performance of nuclear power plants and the nuclear fuel cycle

There are 435 nuclear power plants in 30 countries around the world providing 16 percent of the world's electricity. The percentage of time that nuclear power plants are available to generate electricity has risen from an average of 73 percent in 1990 to 83 percent in 2005. The increased availability is due to advances in technology and management that improve productivity and safety. IAEA activities target improvements in quality management, maintenance, on-line monitoring, instrumentation and control, modernization programmes, outage management, corrosion control, structural integrity, staff training and knowledge management. The IAEA also helps to cost-effectively schedule replacements, improvements, upgrades, licence renewals and decommissioning.

Efficient use of nuclear energy requires an efficient, cost-effective and environmentally acceptable fuel cycle. This includes all steps from uranium exploration and mining, through enrichment, fuel fabrication, spent fuel management storage and reprocessing, to disposal of the radioactive waste generated. The IAEA provides authoritative information on uranium resources and production and assists exploration activities in new countries. It also collects information and provides advice to Member States on spent fuel storage and reprocessing. A key component for the future success of nuclear energy is the proper management and disposal of the radioactive waste from the operation of the nuclear power plants. The IAEA fosters technology transfer, information exchange and cooperative research in this field and gives direct assistance in managing especially spent sources.

Support to infrastructure building for countries considering introduction of nuclear power

For Member States embarking on a nuclear power programme, the Agency provides assistance in planning and nuclear power infrastructure development. Nuclear infrastructure includes the institutional framework and legislation within which nuclear facilities

operate and the industrial, economic, social, technical and scientific capabilities to enable the secure and efficient development, management and operation of nuclear power facilities.

Planning the Future of Energy

The IAEA helps developing countries build their energy planning capabilities. The Agency develops and transfers planning models and data; it trains local experts; and it helps establish local expertise to chart national paths to sustainable development.

The IAEA helps keep the nuclear option open by being in the midst of international negotiations and studies that set the stage on which nuclear power competes, and through economic assessments of nuclear power and its environmental impacts.

It is the lead agency for two World Summit on Sustainable Development (WSSD) energy partnerships — on 'Indicators for Sustainable Energy Development' and 'Country Profiles on Sustainable Energy Development'.

Fostering Innovation in Nuclear Technologies

Future expansion of nuclear power will require continued innovation. The Agency serves as a catalyst. It helps Member States resolve scientific and technological issues related to nuclear power and to non-electric applications such as seawater desalination and hydrogen production. The Agency coordinates research and promotes information exchange for current reactor lines and for innovative nuclear energy systems. These include small and medium sized reactors that may be suitable for countries with small grids.

The Agency provides a unique forum for collaboration and helps to pool R&D resources towards common goals through Technical Working Groups for water cooled reactors, gas cooled reactors and fast reactors.

Technological and institutional innovations are necessary to secure the benefits of nuclear energy in the future. *INPRO (International Project on Innovative Nuclear Reactors and Fuel Cycles)* was set up in 2001 to help achieve this innovation by providing an open international forum bringing together both nuclear system supplier countries, and users of nuclear power for studying the problems associated with introducing innovative nuclear energy systems (INS).

After establishing a methodology usable by Member States (currently 28) in their evaluation and selection of INS, INPRO moved to Phase 2, which includes collaborative projects on technological issues that need to be addressed for improved economics, safety and proliferation-resistance.

Preserving Nuclear Information and Knowledge

Established in 1970 to foster the exchange of scientific and technical information on peaceful uses of atomic energy, the *International Nuclear Information System (INIS)* processes most of the world's scientific and technical literature on a wide range of subjects from nuclear engineering, safeguards and non-proliferation to applications in agriculture and health.

The maturing nuclear workforce is raising issues of *nuclear knowledge management (NKM)* underlying the safe and economic use of nuclear science and technology. In response, the IAEA has ensured that all its major programmes engage in activities to address the preservation and promotion of knowledge and maintain competence in nuclear science and technology. The focus is put on the development of guidance for NKM, on networking nuclear education and training, and on the preservation of nuclear knowledge.

The IAEA supports nuclear power programmes in numerous countries in a wide variety of ways: improving plant performance; sharing nuclear knowledge; fostering technological innovation; and planning the energy future.

PUTTING SAFETY AND SECURITY FIRST

The IAEA helps countries to upgrade nuclear safety and security and to prepare for and respond to emergencies in order to protect people and the environment from harmful radiation exposure.

Ensuring the Safety of Nuclear Technology

Peaceful uses of nuclear technology are found throughout the fabric of modern life from food preservation to medical treatments. Some times, they evoke great passion, such as is the case with nuclear power plants. The one constant, however, is that no matter how nuclear technology is used, it must be done safely. This means that it must be used in a manner that does not jeopardize the health and safety of people, does not adversely impact the environment, and does not impose an unreasonable financial burden on an economy.

The Global Nuclear Safety Regime

The IAEA is dedicated to ensuring that all users of nuclear technology embrace the concept of a *Global Nuclear Safety Regime*. The cornerstones of the regime are the IAEA safety standards, the international safety conventions, national safety infrastructures and knowledge sharing. The IAEA safety standards define requirements and goals to protect people and the environment. They address how to ensure the safe design, construction and operation of nuclear installations used to generate electricity, and the wide variety of radiation sources used in applications such as medical diagnosis and treatment, sterilization and various industrial radiography uses. The effective implementation of the standards is then assessed through safety missions and reviews, carried out at the request of Member States.

Setting Safety Standards

The IAEA has established a vast body of safety standards covering nuclear installations, radiation protection, radioactive waste management and the transport of radioactive materials. They are updated regularly to reflect users' experience and to ensure state-of-the-art methods for achieving the highest levels of safety. They are also coordinated with the guidance associated with other industrial and technical organizations.

IAEA Safety Fundamentals

The IAEA has established ten principles to protect people and the environment from harmful effects of ionizing radiation. The safety fundamentals provide the basis for the IAEA's safety standards and its safety related programme. For details see: *www-ns.iaea.org/standards/default.htm*.

The objective of the ***Asian Nuclear Safety Network (ANSN)*** project is to pool and share existing and new technical knowledge and practical experience to further improve the safety of nuclear installations in Asia.

The ANSN computer network is operated in a coordinated yet decentralized manner with 8 ANSN National Centres in China, Indonesia, Japan, Korea, Malaysia, the Philippines, Thailand and Vietnam. The web site associated to each National Centre provides access to important nuclear safety knowledge and serves as a portal to other ANSN sites. Searching the ANSN is done either locally or through the IAEA web site.

Reviews for the Highest Level of Safety

To apply its safety standards, the IAEA conducts *safety reviews* and training for operators of research reactors and nuclear power plants, and regulatory bodies. These reviews and training events are conducted by experts from throughout the world, under

the coordination of the IAEA. This provides independent assessments whose results and recommendations are based upon the IAEA safety standards and globally accepted good practices. More importantly they provide a forum for knowledge sharing and mutual learning. Examples of these services, carried out at the request of Member States, include:

The *Integrated Regulatory Review Service (IRRS)* is a peer review service aimed at providing advice to Member States, upon request, to strengthen and enhance the effectiveness of the Member State regulatory infrastructure related to nuclear, radiation, waste and transport safety and security. The IRRS provides for sharing knowledge and mutual learning among senior regulators.

The *Operational Safety Review Team (OSART)*, established in 1982, assists Member States in enhancing the operational safety within all Member States by in-depth review of nuclear power plant operational safety performance and by the dissemination of good practices.

The *Integrated Safety Assessment of Research Reactors (INSARR)* provides for the integrated safety review of research reactor design and operational aspects. This includes assisting Member States in fulfilling relevant safety obligations.

The *Transport Safety Appraisal Service (TranSAS)* enhances the capabilities of Member States to ensure the safety and security of radioactive material transport. This service provides support for the implementation of international transport regulations and guidelines.

Fulfilling a Promise to Protect

Increased safety worldwide is achieved through the development and adoption of legally binding safety Conventions.

The *Convention on Nuclear Safety* was adopted in 1994. The Convention legally commits participating States operating land-based nuclear power plants to maintain a high level of safety by setting international benchmarks to which States subscribe. The obligations of the Parties cover siting, design, construction, operation, the availability of adequate financial and human resources, the assessment and verification of safety, quality assurance and emergency preparedness. All countries with operating nuclear power plants are now parties to the Convention.

The *Convention on Early Notification of a Nuclear Accident* strengthens international cooperation in order to provide relevant information about nuclear accidents as early as possible to minimize transboundary radiological consequences. In the event of a nuclear accident, States notify countries that may be affected as well as the IAEA, and provide relevant information about the accident. The IAEA in turn informs Member States, other States that may be physically affected and relevant international organizations of a notification received and provides other information on request.

IAEA's Incident and Emergency Centre (IEC)

Incidents and emergencies sometimes occur — often involving lost, stolen, damaged or discovered sources. Relatively minor incidents occur at nuclear facilities that may raise undue anxieties among the public, and there remains the unlikely possibility of a severe emergency that could result in transnational impacts.

The ***IEC*** is the global focal point for nuclear and radiological emergency preparedness and response and, if necessary, the prompt, coordinated response to all such events.

The *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* represents a commitment by participating States to achieve and maintain a consistently high level of safety in the management of spent fuel and of radioactive waste as part of the global safety regime for ensuring the proper protection of people and the environment.

The obligations of the Contracting Parties with respect to the safety of spent fuel and radioactive waste management include the obligation to establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management. It also includes the obligation to ensure that individuals, society and the environment are adequately protected against radiological and other hazards, by appropriate siting, design and construction of facilities and by making provisions for ensuring the safety of facilities both during their operation and after their closure.

Ensuring the Safety of Research Reactors

The *Code of Conduct on the Safety of Research Reactors* was adopted by the IAEA in 2004, prompted by safety concerns as many of the world's research reactors approached the end of their originally planned life spans.

The Code is a non-binding international instrument, where States determine their own level of commitment to its guidance. The Code establishes best practice guidelines for the licensing, construction and operation of research reactors. The Code addresses research reactor operators, regulators and governments.

Managing the Safety and Security of Radioactive Sources

Although the vast majority of radioactive sources used around the world are managed safely and securely, accidents have occurred. Out of growing concern about radioactive sources in the 1990s, the *Code of Conduct on the Safety and Security of Radioactive Sources* was approved by the IAEA Board of Governors in 2000, and strengthened in 2003 to take account of international concerns following the events of 11 September 2001. In 2005 the IAEA published Guidance on Import and Export of Radioactive Sources.

The Code and the Guidance are non-binding international instruments that help national authorities to ensure that radioactive sources are used within an appropriate framework of radiation safety and security.

Typical iridium-192 shielding device.

Protecting Patients

Worldwide about 2000 million diagnostic X ray examinations and 32 million nuclear medicine procedures are carried out each year (UNSCEAR 2000). While new diagnostic equipment and techniques bring new benefits, some of the procedures involve the delivery of relatively high radiation doses to patients. The IAEA has established standards of safety to improve the radiological protection of patients in diagnostic and interventional radiology, nuclear medicine and radiotherapy.

NUCLEAR SECURITY: GUARDING AGAINST TERRORISM

Terrorist attacks in Kenya, the United States, Indonesia, Morocco, Spain, the UK, Turkey and other countries continue to shock the world. Governments across the globe recognize that concerted actions are required to protect against the possible malicious use of nuclear and other radioactive material and threats against nuclear facilities.

Terrorists could try to steal a nuclear weapon, or they could acquire the material needed for building a nuclear bomb. They could also use radioactive materials to make a so-called 'dirty bomb' or sabotage a nuclear power station, research reactor or other installation where these materials are used, stored or transported.

The IAEA helps Member States to strengthen their capabilities to prevent nuclear terrorism by: providing advisory services; carrying out capacity building activities such as training and supplying equipment; promoting international conventions; developing international guidelines and recommendations incorporating best practices; and supplying information services and technical support.

After the 11 September 2001, terrorist attacks on New York and Washington DC, the IAEA launched a plan for enhanced anti-terrorism activities known as the *IAEA Nuclear Security Plan of Activities*. A new *Nuclear Security Plan* for 2006–2009 builds upon the accomplishments of the first plan and on strengthened international instruments and agreements. It was approved by the Board of Governors in 2006.

The Plan is a comprehensive programme which focuses on four areas that build upon and expand a number of existing IAEA activities:

- Prevention activities to protect nuclear and other radioactive material and related facilities and transports from malicious acts. These include legislative and regulatory measures, physical protection and risk reduction activities;
- Detection and response activities to strengthen the capabilities of States to uncover illegal acts and unauthorized possession of nuclear and radioactive material, and to effectively respond to malicious acts or threats, such as a possible dispersal of radioactivity;
- Needs assessment, analysis and coordination activities, including evaluation missions, cooperation with bilateral and multilateral support programmes, and information collection and evaluation.
- Risk reduction activities that reduce inventories of high-risk materials such as high enriched uranium (HEU) and high activity sources. This is being achieved by converting research reactors from HEU to low enriched uranium (LEU), by decommissioning shut-down reactors and by repatriating stocks of fresh and spent HEU fuel to the country of origin. The IAEA is also providing extensive assistance to States for the reduction of high-risk and vulnerable radioactive sources.

Physical screening is an essential component of access control at nuclear power plants.

Safeguards Implementation

The international community has entrusted the IAEA with the task of verifying that States are complying with their safeguards obligations. With regard to most States, the IAEA implements safeguards under comprehensive safeguards agreements (CSAs). It should be noted that concluding a CSA is an obligation under the NPT for all non-nuclear-weapon States party to this treaty. Each such agreement requires a State to accept IAEA safeguards on all source or special fissionable material in all of its peaceful nuclear activities. The two other basic types of safeguards agreement (i.e. those that are not comprehensive but 'item specific', and the voluntary offer safeguards agreements concluded by the five NPT nuclear-weapon States) are more limited in scope.

Strengthening Safeguards

The fundamental measures of the safeguards system consist of verification activities performed at nuclear facilities and at other locations where nuclear material is used. These activities focus on verifying a State's declarations to the IAEA on facility design and operation, and on nuclear material flows and inventories as reported by facility operators through State authorities. This nuclear material 'accountancy' is often complemented by containment and surveillance measures (e.g applying seals, continuous observation by camera), the basic aim being to be able to detect diversion of nuclear material to nuclear weapons or other nuclear explosive devices and misuse of a declared facility to produce undeclared material.

It is well known that the IAEA's experience in the early 1990s in Iraq, and in the People's Democratic Republic of Korea, highlighted the limitations of safeguards implementation concentrating on *declared* nuclear material and safeguards conclusions drawn at the level of facilities. It also dramatically changed the expectations of the safeguards system, showing that although IAEA safeguards had worked well with regard to declared nuclear material and facilities, it was not — but needed to be — equipped to detect *undeclared* nuclear material and activities in States which had made a legally binding commitment not to acquire or develop nuclear weapons. In that respect, the Board of Governors affirmed in February 1992 that the scope of CSAs is not limited to nuclear material actually declared by a State but includes any material that is required to be declared. In other words, the Board determined that under such agreements, the IAEA has the right and obligation not only to verify that State declarations of nuclear material subject to safeguards are *'correct'*, i.e. they accurately describe the type(s) and quantity(ies) of the State's nuclear material holdings, but that they are also *'complete'*, i.e. they include everything that should have been declared. This determination was a major catalyst for efforts to strengthen the safeguards system by providing it with important new tools to verify 'completeness'. Some of the measures developed for this purpose could be implemented under the authority existing in CSAs[1]. Others required additional, legal authority and led to the negotiation of a new legal instrument, the Model Additional Protocol[2] approved in May 1997 as a contribution to global non-proliferation objectives. The underlying aim of all of the strengthening measures is to increase 'transparency' (i.e. knowledge and understanding) about a State's nuclear material, activities and plans by:

(i) increasing the scope and depth of safeguards-relevant *information* available to the IAEA;
(ii) enhancing IAEA inspector *access* to safeguards-relevant locations in States beyond declared facilities; and
(iii) using 'state of the art' *technical verification measures*.

The overarching aim is to give the IAEA the authority and technical measures it needs to provide credible assurance of the non-diversion of nuclear material

[1] For example: the collection of environmental samples in facilities and locations where IAEA inspectors have access during inspections and design information visits; wider use of unannounced inspections within the routine inspection regime; enhanced evaluation of information obtained from States' declarations, IAEA verification activities and open sources.

[2] Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards is contained in document INFCIRC/540 (Corr.).

from declared activities and regarding the absence of undeclared nuclear material and activities for States with CSAs in force. Detecting undeclared nuclear material and activities requires very different tools from those needed for detecting diversion under CSAs alone, i.e. a broader range of information, more emphasis on information analysis, more access for IAEA inspectors to locations and a more investigative approach in implementing safeguards.

The Model Additional Protocol

There is no doubt that the Model Additional Protocol, which provides for all of this, is the principal achievement of strengthened safeguards. The additional information and access for IAEA inspectors (known, under an additional protocol, as 'complementary access') and other measures it provides for are designed to 'fill the gaps' in the information and access available under safeguards agreements. This enables the IAEA to obtain a much fuller picture of States' nuclear programmes including nuclear material holdings, plans and trade and to compare State declarations on such issues with information that it has available from other sources. An additional protocol, as its name suggests, is not a freestanding legal instrument and can be concluded and brought into force only with, or 'in addition' to a safeguards agreement. States with comprehensive safeguards agreements that also bring additional protocols into force are obliged to accept all of the measures in the Model Additional Protocol. Other States are encouraged to conclude additional protocols containing those measures that they believe will contribute to safeguards effectiveness and efficiency objectives.

When fully implemented in a State, the strengthening measures provided by a CSA and an additional protocol enable the IAEA to draw safeguards conclusions about non-diversion of declared nuclear material and about the absence of undeclared nuclear material and activities for the State as a whole.

State Evaluation

The assessments that form the basis for such conclusions are made in the framework of the Safeguards State evaluation process, an iterative, on-going process which integrates and assesses all of the safeguards relevant information available to the IAEA about individual States. The findings in each case are documented, periodically, in an internal document known as a State Evaluation Report and reflect the three main sources of safeguards-relevant information available to the IAEA:

(i) information provided by States under safeguards agreements, additional protocols or voluntarily,
(ii) information derived from IAEA in-field verification activities, and
(iii) information obtained from open sources (including commercial satellite imagery) and other sources of safeguards-relevant information.

The IAEA's safeguards conclusions are drawn annually and are published in its Safeguards Implementation Report. Soundly-based safeguards conclusions about 'completeness' are possible only if the IAEA is able to implement the whole range of safeguards measures that it has available i.e. for a State that has both a CSA and an additional protocol in force.

The downside is that the conclusion and bringing into force of an additional protocol is a voluntary measure on the part of a State and, apart from its ongoing efforts to encourage States to conclude additional protocols, there is nothing that the IAEA can do, unilaterally, to change that. Although about 80 States have now brought additional protocols into force, there are over 100 further States — some with significant nuclear activities — that have yet to do so.

Integrated Safeguards

The successive safeguards strengthening measures adopted since the early 1990s were never intended to constitute an additional 'layer' of safeguards implementation. The aim was always to integrate measures to enhance the IAEA's ability to verify 'correctness' — essentially through nuclear accountancy measures, complemented by containment and surveillance — with measures to verify 'completeness' — through the broader information and access provisions of additional protocols. 'Integrated safeguards' is the term used to describe the optimum combination of all safeguards measures available to the Agency under CSAs and additional protocols, which achieves maximum effectiveness and efficiency within available resources.

A specific integrated safeguards approach is developed for each State with a CSA and additional protocol in force and can be implemented when the IAEA Secretariat has been able to draw the safeguards conclusion for that State, and for a given year, that

'all nuclear material remained in peaceful activities'. To draw that conclusion, the Secretariat must first conclude that there is no indication of diversion of declared nuclear material from peaceful activities (including no misuse of facilities or locations outside facilities) and no indication of undeclared nuclear material and activities for the State 'as a whole', i.e. in its entirety. It takes account, amongst other things, of differences between the nuclear fuel cycles and related activities of States and enable State-specific features to be factored in. As of January 2007, integrated safeguards were being implemented in some 12 States.

New Infrastructure

The strengthened safeguards system needs extensive new infrastructure to support and improve implementation. Because safeguards are always aiming at 'moving targets' — or in other words are continually faced with fresh challenges[3], the safeguards system must also be able to adjust to changing needs. To date, a number of safeguards approaches have been revised and new ones developed as part of the strengthening process. Guidelines and procedures for implementing additional protocol measures have been developed for States and for the IAEA Secretariat. 'Information driven' safeguards also require an underpinning infrastructure of specialist software and hardware, related support mechanisms, a new mindset and culture, new skills, and updated training for safeguards inspectors.

Looking to the future

The political and non-proliferation landscape has changed drastically in recent years and will likely continue to do so. One significant factor is ever increasing globalization, characterized by rapid information exchange, interlinked financial systems and the constant movement of people, ideas and goods. Other, interrelated aspects which challenge the safeguards system are: the uncovering, in recent years, of further, clandestine nuclear programmes and illicit nuclear procurement networks; the threats that nuclear proliferation and nuclear terrorism pose to international security; the unprecedented expansion of energy demand that the world faces in the next 50 or so years; and the renewed interest that many countries are showing in nuclear power. Although the latter is welcome from the perspective of social and economic development, it will result in wider dissemination of nuclear technology — some of it highly sensitive. Consideration is therefore being given to possible arrangements to place sensitive nuclear operations under multinational control.

Adaptation to and managing change is not new to the IAEA, which has a lot of accumulated experience in these areas. However, the major shift in focus of recent years is of a different order of magnitude than anything faced before in the way in which safeguards conclusions are drawn, documented and acted upon. Much has been achieved, but much work remains and there is no room for complacency. If the safeguards system is to remain relevant, it must continually adapt to and overcome new challenges. Of immediate concern is further to strengthen the ability of the system to detect undeclared nuclear material and activities in contravention of safeguards agreements. Of paramount importance in this regard is support from stakeholders. The IAEA Secretariat has no independent existence and can only work with the authority and support of the international community, represented by its Member States. It is therefore vital that States support safeguards endeavours politically and through the provision of adequate resources.

[3] For example: developments in technology and/or in the proliferation and international security landscape.

IAEA inspectors responsible for safeguards implementation in the DPRK show broken IAEA safeguards seals salvaged from North Korea.

The IAEA and the Democratic People's Republic of Korea

The ***Democratic People's Republic of Korea (DPRK)*** became a party to the NPT in 1985, and its NPT safeguards agreement entered into force in 1992.

Shortly after routine inspections began, inconsistencies emerged between the DPRK's initial declaration and the IAEA's findings, suggesting that undeclared plutonium existed in the DPRK. To clarify the inconsistencies, the IAEA requested access to additional information and to two sites related to the storage of nuclear waste. The DPRK, however, refused access to the sites.

The IAEA Board of Governors concluded in April 1993 that the DPRK was in non-compliance with its safeguards agreement and referred this non-compliance to the UN Security Council. In parallel, the DPRK announced its decision to withdraw from the NPT, but suspended that notice in June 1993 before it came into effect. In June 1994, however, the DPRK withdrew from its membership in the Agency.

The mid-1994 crisis was defused by an Agreed Framework drafted between the US and the DPRK in October 1994. The Agreed Framework stipulated that the IAEA would be allowed to monitor the freeze, and at the request of the Security Council, the IAEA maintained a presence in Nyongbyong to verify the freeze.

In October 2002, the US announced that the DPRK had acknowledged that it had a "programme to enrich uranium for nuclear weapons". The US, together with Japan and the Republic of Korea, concluded that the DPRK's programme was a violation of the Agreed Framework, the NPT and the DPRK-IAEA safeguards agreement.

The DPRK started to cut seals and disable surveillance cameras on 22 December 2002, and on 27 December it ordered the IAEA inspectors to leave the country. The DPRK announced its withdrawal from the NPT effective as of 11 January 2003.

The IAEA referred the matter to the UN Security Council. Since the end of December 2002, when IAEA verification activities were terminated by the DPRK, the Agency has been unable to conduct any verification activities there.

In October 2006, the DPRK foreign minister announced that his country was planning to conduct a nuclear test "in the future", although it did not state when. This test was reported to have occurred on 9 October 2006.

In March 2007, the IAEA Director General visited the DPRK at the invitation of the government.

The IAEA stands ready to work with the DPRK — and with all others — towards a solution that makes use of the Agency's verification capability with a view to assure the international community that all nuclear activities in the DPRK will become exclusively used for peaceful purposes.

WORKING FOR SUSTAINABLE DEVELOPMENT

Over a billion people in the developing world lack safe drinking water and sufficient food. The world's population is projected to increase by another 2 billion people in the next 25 years — most of them in the poorest countries of the world. The poor lack the tools and know-how that would allow them to be more healthy and productive. But by applying science to these development problems, new technologies can emerge that offer effective and sustainable solutions. The IAEA's technical cooperation programme promotes research, adaptation and the transfer of nuclear science for meeting basic human needs.

For five decades, the IAEA has been fulfilling its mandate to "accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world". Since its launch, the IAEA's technical cooperation programme has benefited from a framework which incorporates research, adaptation and transfer of nuclear science and technology for development.

Partners in Development

Putting advanced science to work is a multifaceted and complex process. It requires a concerted campaign of *capacity building* to prepare national scientists and institutions in the practical utilization of science. It requires focused resources and special expertise to test, adapt, and refine nuclear applications. Finally, it requires complementary mechanisms and institutions that can ensure that successful nuclear applications gain widespread recognition and implementation in the most opportunistic sectors, and across all regions. Working together with bilateral, multilateral and non-governmental aid partners, the IAEA is

A cocoa farmer in central Ghana harvesting a cocoa pod from one of the trees that is her family's livelihood. Ghana has employed mutation breeding techniques to identify cocoa strains that are resistant to a plant virus that has killed over 200 million trees in the past 50 years.

contributing to the social and economic development of its Member States and delivering substantial human benefits.

This goal is conveyed by the term Partners in Development — the idea being that the Agency is a partner with each Member State, cooperating in the process of achieving sustainable development. The TC programme disburses more than $70 million worth of equipment, services and training per year in approximately 100 countries and territories which are grouped into four geographic regions:

- *Africa*
- *Asia and the Pacific*
- *Europe*
- *Latin America*

A Global Challenge

With more than 190 staff members, the TC staff work in full partnership with technical officers and project counterparts in the recipient Member States. In addition, the Secretariat collaborates with the World Bank and other organizations to plan and execute projects in harmony with Member States' needs.

Through training courses, expert missions, fellowships, scientific visits and equipment disbursement, the technical cooperation programme provides the necessary skills and equipment to establish sustainable technology in the counterpart country or region. With more than 800 on-going projects, the programme strives to have an impact on Member State problems that can be solved with nuclear technology.

Some examples of the IAEA's worldwide efforts:

- In *Bangladesh*, isotopes are used to better manage the flow of groundwater and reduce the human impacts of arsenic contamination. Up to 60 million people are threatened with unsafe drinking water.
- In *Thailand*, nuclear methods help food companies fortify basic foodstuffs and eliminate malnutrition in mothers and children.

Nearly a billion people worldwide lack access to safe drinking water. The IAEA promotes isotope hydrology techniques that help developing countries better plan to use of this precious natural resource.

- In *Ethiopia, Brazil* and *Sri Lanka*, women are being successfully treated for deadly breast and cervical cancer using radiotherapy equipment and training supplied by the IAEA.
- In *the Philippines*, the dangers posed to seafood consumers by toxic algae are being reduced through nuclear techniques provided by the IAEA.
- In *Argentina*, ten years of technical support provided by the Agency and FAO to implement nuclear-based techniques as part of an area-wide integrated pest management approach has culminated in the complete eradication of fruit flies from the Patagonia region.

EMPLOYING NUCLEAR SCIENCES AND APPLICATIONS

The IAEA works to foster the role of nuclear science and technology in sustainable development. This involves both advancing and employing knowledge to tackle pressing worldwide challenges — hunger, disease, natural resources management, environmental pollution, energy production and climate change.

The Major Programme on Nuclear Techniques for Development and Environmental Protection is driven by key areas identified by the World Summit on Sustainable Development in Johannesburg in 2002.

Nuclear Techniques in Food and Agriculture

Forty years ago the Food and Agriculture Organization of the United Nations (FAO) and the IAEA created the *Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture*. The Joint Division combines the talents and resources of both organizations to assist their Member States in applying nuclear techniques for providing people with better and safer food and other agricultural products while sustaining the natural resources base.

The Joint Division operates an Agricultural and Biotechnology Laboratory at Seibersdorf, Austria, with the twin goals of developing and testing agricultural techniques involving isotopes and radiation to suit local requirements and environmental conditions, and to provide the necessary training and analytical services for Member States.

Improving Human Health

A general improvement in public health care in Member States has, as a result of improved economic conditions, been followed by the development of medical services for the prevention of malnutrition, detection of health effects of pollution, and diagnosis and management of cancer, nutritional, infective and genetic disorders. Many of these significant health needs are effectively addressed using nuclear techniques, for which the Agency has unique competence among United Nations organizations. The Agency plays an important role in all human health issues involving the diagnostic and therapeutic administration of radiation for medical purposes, as well as in the assessment of health effects resulting from accidental irradiation.

Managing Water Resources

Isotope and related nuclear techniques are effective and unique tools for obtaining hydrologic information for a broad range of water resource management issues. The IAEA is the lead UN agency in this area and provides the basic means of using these techniques in the form of global reference data and isotope reference materials. A wider use of isotope hydrology in the developing Member States for water resources development and management requires the development of technology and human resources as well as financial assistance. The water resources programme of the Agency aims to fulfil these needs. As isotope techniques are more effective when used as an integral part of hydrologic practices, the programme coordinates its activities with other national and international organizations active in the water sector.

Protecting Marine and Terrestrial Environments

The Agency has over the years, under its mandate of encouraging and assisting research and practical applications of nuclear techniques for development and environmental protection, demonstrated that these play an important role in the protection of the environment from radioactive and non-radioactive pollutants. The transfer and behaviour of radionuclides and non-radioactive pollutants in the marine and terrestrial environment are investigated to develop and improve transfer models. These are used for impact assessments and to elaborate appropriate remediation strategies. The work also involves the use of radioecology for the protection of the environment and for making contributions to studies concerned with climate change.

Physical and Chemical Applications

Applications of radioisotopes and ionizing radiation in many spheres of science and technology are contributing significantly towards sustainable development and improving the quality of life. The Agency is contributing in radiopharmaceutical, radioanalytical and industrial spheres of activity. Radiopharmaceuticals and radiation sources are extensively used in the health sector for the diagnosis of a variety of ailments and for the treatment of cancer. Nuclear methods of analysis contribute to environmental pollution studies and help in certifying contamination levels for international trade of agricultural products.

The entire spectrum of nuclear science and technology is deeply rooted in atomic and nuclear physics data, with the Agency being the main source of up-to-date information in this area. The Agency provides data users in Member States with cost free access to the most important basic numerical data needed in a wide range of energy and non-energy applications.

New instruments continue to enter the marketplace, making older instruments obsolete and unserviceable in a relatively short time. Member States and their technical work force need to keep abreast of these changes. To support them, interactive distance learning modules and training tools for nuclear instrument maintenance were developed and made available through regional courses.

Applications of nuclear technology are being employed to address some of the developing world's most pressing problems — from undernutrition and burgeoning cancer to managing the marine environment.

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