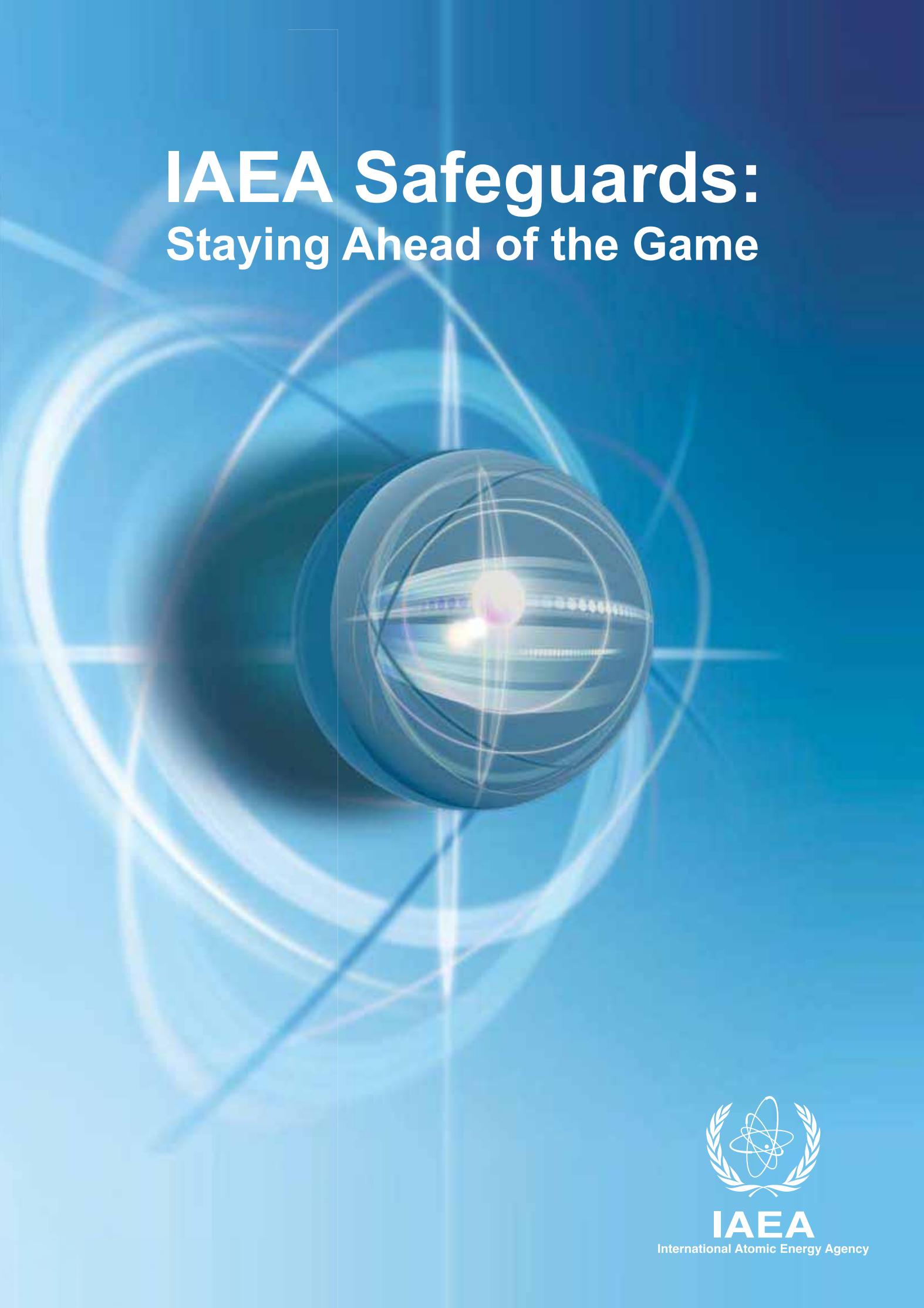
IAEA Safeguards:
Staying Ahead of the Game



IAEA
International Atomic Energy Agency

IAEA Safeguards:

Staying Ahead of the Game

IAEA

Atoms for Peace: The First Half Century

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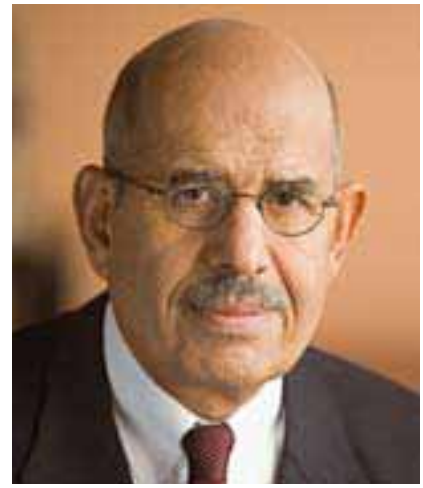

Foreword by the Director General of the IAEA Mohamed ElBaradei

Society faces many current challenges and threats. Of particular relevance to the nuclear verification mandate of the IAEA is the threat posed by the further proliferation of nuclear weapons. IAEA safeguards are important in this respect because, through the process of independent verification, they enable the IAEA to provide credible assurance that States are keeping to their nuclear non-proliferation commitments — or to 'sound the alarm' if they are not doing so. IAEA safeguards are a central element of the nuclear non-proliferation regime. This, in turn, is an essential component of the international security system.

Concerns have arisen in recent years because of the uncovering of undeclared nuclear programmes and of illicit networks trading in sensitive nuclear technology. Also relevant to the IAEA's verification mandate is the expected and unprecedented expansion of world energy demand over the next 50 or so years and, as a result, the renewed interest that many countries are showing in nuclear power. From the perspective of worldwide economic and social development, particularly in developing countries, we should welcome this expansion. From the IAEA perspective it is also clear that we can realize the vision in Article II of the IAEA Statute, *"to enlarge the contribution of atomic energy to peace, health and prosperity throughout the world"*, only by ensuring, *"so far as we are able"*, that peaceful nuclear energy is not used for military purposes.

In that respect, in late 2004, a high level United Nations panel described the safeguards system of the IAEA as *"an extraordinary bargain"*. More recently, in late 2005, the Nobel Peace Prize Committee expressed its conviction that: *"At a time when disarmament efforts appear deadlocked, when there is a danger that nuclear arms will spread both to States and to terrorist groups, when nuclear power again appears to be playing an increasingly significant role, the IAEA's work is of incalculable importance."*

The IAEA's verification work can continue to be *"of incalculable importance"* only if it moves with the times. In this regard, IAEA Member States are working with its Secretariat to ensure that the IAEA safeguards system is continuously appraised and updated as necessary.

The IAEA has come a long way in this respect since our experience in Iraq in the early 1990s, which provided the context and major impetus for us substantially to strengthen our safeguards system and to make it more efficient. A great deal has been achieved but much work remains.

Of particular importance is the continued strengthening of our ability to detect undeclared nuclear material and activities in contravention of safeguards agreements. Our ability to do this depends on the extent to which we have the necessary legal authority as well as the required information, up to date verification tools and adequate financial and human resources. Each of these requires ongoing effort: there is no cause for complacency.

This publication seeks to explain the fundamentals of the IAEA safeguards system, how and why it works, its role as a key element of international security, and its potential limitations. The IAEA's nuclear verification function has been under the spotlight in recent years: people know generally what it is and know that it can make a difference. We hope, in these pages, to show you why.

Deputy Director General for Safeguards, Olli Heinonen: "Effective IAEA safeguards remain a key component of the world's nuclear non-proliferation regime aimed at stemming the spread of nuclear weapons and moving towards nuclear disarmament".

Introduction

Preventing the spread of nuclear weapons is a complex task requiring international cooperation and confidence building at bilateral, regional and global levels. Today, more than half a century after the destructive power of nuclear weapons was first demonstrated, a number of international political and legal mechanisms are in place to help to achieve nuclear non-proliferation objectives. They include political commitments, treaties and other legally binding agreements in which non-proliferation commitments are anchored, export control and nuclear security measures and, also importantly, the safeguards system of the IAEA. In implementing its safeguards, the IAEA plays an instrumental verification role, demonstrating to and on behalf of States that nuclear non-proliferation commitments are being respected — or sounding the alarm to set other mechanisms in motion if the reverse seems to be the case.

What are IAEA safeguards?

IAEA safeguards are measures through which the IAEA seeks to verify that nuclear material is not diverted from peaceful uses. States accept the application of such measures through the conclusion of safeguards agreements with the IAEA. Although there are various types of safeguards agreements (see Box), the vast majority of States have undertaken not to produce or otherwise acquire nuclear weapons and to place *all* of their nuclear material and activities under safeguards to allow the IAEA to verify that undertaking.

The NPT is the centrepiece of global efforts to prevent the further spread of nuclear weapons. It entered into force in March 1970 after being ratified by 40 States including the three depositaries (the former Soviet Union, the United Kingdom (UK) and the United States of America (USA)). Today, with some 190 States party, it is the treaty most widely adhered to in the field of disarmament and non-proliferation. The NPT represents a balance of rights and obligations with regard to nuclear disarmament, non-proliferation and peaceful use, and its duration was extended indefinitely in a Conference of States party in 1995.

Although the IAEA is not party to the NPT, it has an essential verification role under that Treaty. Under Article III of the NPT, each non-nuclear-weapon State is required to conclude an agreement with the IAEA — in accordance with the IAEA's Statute and its safeguards system — to enable the IAEA to verify the fulfilment of its obligation not to develop, manufacture, or otherwise acquire nuclear weapons or other nuclear explosive devices.

Similarly to the NPT, the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (the Treaty of Tlatelolco, concluded in 1967, before the NPT) requires its parties to conclude CSAs with the IAEA. So do the other regional nuclear-weapon-free zone treaties, including the 1985 South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga), the 1995 Treaty of Bangkok (for Southeast Asia), the 1996 Treaty of Pelindaba (for Africa) and the 2006 Central Asian Nuclear-Weapon-Free Zone Treaty (which also requires States party to conclude additional protocols to safeguards agreements).

State undertakings with regard to IAEA verification

- **Comprehensive safeguards agreements (CSAs):** All non-nuclear-weapon States party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), as well as States party to the regional nuclear-weapon-free zone treaties, are required to conclude CSAs with the IAEA. The structure and content of CSAs concluded pursuant to the NPT are described in document INFCIRC/153 (Corr). In accordance with the terms of such agreements, a State undertakes to accept safeguards on all nuclear material in all peaceful nuclear activities, within its territory, under its jurisdiction or carried out under its control anywhere for the purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices. Under these agreements, the IAEA has the right and obligation to ensure that safeguards are applied on all such nuclear material.
- **Voluntary offer agreements (VOAs):** The five NPT nuclear-weapon States have concluded safeguards agreements covering some or all of their peaceful nuclear activities. Under the VOAs, facilities or nuclear material in facilities notified to the IAEA by the State concerned are offered for the application of safeguards. VOAs serve two purposes: to broaden the IAEA's safeguards experience by allowing for inspections at advanced facilities; and to demonstrate that nuclear-weapon States are not commercially advantaged by being exempt from safeguards on their peaceful nuclear activities.
- **Item specific safeguards agreements:** Agreements in this category cover only specified material, facilities and other items placed under safeguards, and are based on the safeguards procedures approved by the IAEA Board of Governors and published in INFCIRC/66/Rev.2 and its earlier versions. States parties to such agreements undertake not to use the material, facilities and/or other items under safeguards in such a way as to further any military purpose. The IAEA implements such agreements in the three States that are not party to the NPT.
- **Additional protocols:** These are designed for States having a safeguards agreement with the IAEA, in order to strengthen the effectiveness and improve the efficiency of the safeguards system as a contribution to global non-proliferation objectives. States with CSAs conclude additional protocols that include all provisions of the Model Protocol Additional to Agreement(s) between State(s) and the IAEA for the Application of Safeguards (published in INFCIRC/540 (Corr.)), which was approved by the Board of Governors in 1997. Other States may accept and implement those measures of the Model Additional Protocol that they choose with a view to contributing to non-proliferation aims or to the effectiveness and efficiency objectives of the Protocol.

Why are safeguards important and what do they seek to do?

Nuclear science and technology has the potential to contribute to health and prosperity. However, it is also the basis for the development of nuclear weapons. The acceptance and implementation of IAEA safeguards therefore serve as important confidence building measures, through which a State can demonstrate — and other States can be assured — that nuclear energy is being used only for peaceful purposes. The IAEA and its safeguards system were established some 50 years ago to help States to reconcile the dual nature of the atom, so that nuclear energy could be put squarely into the service of peace and development. There would be far less nuclear cooperation or trade if safeguards did not exist.

Practically all countries around the world use nuclear techniques for a variety of peaceful purposes, including food and water security, energy, industrial applications and human health. Only a few of these activities involve the type of nuclear material that could potentially be diverted to make nuclear weapons or other explosive devices (see Box on next page).

What material is subject to safeguards?

The safeguards system aims at detecting the diversion of nuclear material. Such material includes enriched uranium, plutonium and uranium-233, which could be used directly in nuclear weapons. It also includes natural uranium and depleted uranium, the latter of which is commonly used, for instance, as shielding for radiation sources in hospitals, industry and agriculture. Radioactive sources that do not contain nuclear material are not subject to safeguards and need not be reported to the IAEA under a safeguards agreement.

The expectations of the IAEA safeguards system have grown in the past 50 years in response to technological and geopolitical changes and to experience gained through responding to verification challenges (see Box). The events that have had the most profound impact on the safeguards system over the past 50 years are arguably the introduction of comprehensive safeguards pursuant to the NPT and the Tlatelolco Treaty in the early 1970s and the discovery, after the 1991 Gulf War, of a clandestine nuclear weapons development effort in Iraq, part of which had been concealed within Iraq's declared nuclear programme. The Iraq experience highlighted the shortcomings of the safeguards system and provided the catalyst for far-reaching changes.

Safeguards challenges

A number of safeguards challenges in recent years have led to increased expectations and highlighted the need to strengthen the effectiveness of the safeguards system. These challenges have also demonstrated that when international inspectors are given adequate authority and cooperation, and access to the relevant information, are backed by an effective compliance mechanism and are supported by international consensus, the safeguards system is able to provide soundly based, impartial information to decision makers that would not otherwise be available.

- Despite its existing CSA under the NPT, **Iraq**, until 1991, had been conducting a clandestine nuclear weapons programme that was centred around the same nuclear site where the IAEA conducted routine inspections of declared nuclear material. Many of the early strengthening measures and provisions in the Model Additional Protocol were designed to ensure that the safeguards system would be equipped to uncover any similar attempts in the future.
- In the early 1990s, the IAEA identified inconsistencies between nuclear activities declared under the NPT safeguards agreement of the **Democratic People's Republic of Korea** (DPRK) and information available to the IAEA through inspections and other sources. When bilateral efforts failed, the IAEA Board of Governors finally called for access to locations where these inconsistencies might have been reconciled. The DPRK denied such access and comprehensive IAEA safeguards have not been implemented in the DPRK since 1993. The DPRK case demonstrated the need for procedures that, with a minimum of intrusiveness, would give IAEA inspectors access to locations in order to verify the absence of undeclared nuclear activities.
- In 1991, **South Africa** acceded to the NPT, concluded a CSA and informed the IAEA that

IAEA inspectors go over plans during an overnight stay on an inspection, working by candlelight due to a power outage.

it had dismantled its nuclear devices prior to becoming party to the NPT. By meeting the challenges of observing the dismantlement of the rest of the nuclear weapons programme, and verifying the correctness and completeness of South Africa's declarations under the safeguards agreement, the IAEA gained important operational experience. This also served to demonstrate that with a high level of cooperation on the part of State authorities, the IAEA is able to reconstruct the history of undeclared nuclear activities — even a nuclear weapons programme — and make progress in its verification work.

- In 2003, information came to light regarding previously undeclared nuclear material and activities that the **Islamic Republic of Iran** (Iran) should have declared but had not declared to the IAEA. The IAEA has made progress in verifying the correctness of the declarations submitted by Iran in this regard, but has also identified some important outstanding issues that need to be resolved in order to enable the IAEA to verify the completeness of Iran's declarations. For the IAEA to be able to perform its verification role in a State with open issues regarding the history of its nuclear programme, it is sometimes necessary for the State to provide the IAEA with transparency and openness that go beyond the measures in an additional protocol.
- The **Libyan Arab Jamahiriya** (Libya) informed the IAEA in 2003 that it had previously engaged in small scale nuclear weapons related research and purchased related technology through a covert supply network. It asked the IAEA to verify that these activities had been discontinued. The Libyan case highlighted the importance, for effective safeguards, of monitoring and analyzing trade in sensitive nuclear technology, and research involving small quantities of nuclear material. In recent years, the IAEA has reported on such research of varying proliferation concern in several States with CSAs, including **Egypt** and the **Republic of Korea**. The latter cases also demonstrate the need for States to maintain an effective State system of accounting for and control of nuclear material (SSAC), which can report, as necessary, to the IAEA.

So how have safeguards changed?

The shift in the focus of safeguards implementation

There has been a major shift in the focus of safeguards implementation and in the way in which safeguards conclusions are drawn. In implementing safeguards for States with CSAs, the focus used to be on verifying the nuclear material actually declared by a State to the IAEA, with safeguards conclusions drawn at the level of individual nuclear facilities. This has changed dramatically.

In order to fully understand the magnitude of this change it is important to recall that the fundamental measures of the safeguards system consist of verification activities performed at nuclear facilities and at other locations where nuclear material is customarily used. Under a CSA, these activities (see Box) 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', which has a lot in common with a financial accounting system, is often complemented by containment and surveillance measures (e.g. applying seals, continuous observation by cameras), the basic aim being to detect any diversion of nuclear material to nuclear weapons or other nuclear explosive devices and any misuse of a declared facility to produce undeclared material.

Changing expectations

It is well known that the IAEA's experience in the early 1990s in Iraq and in the DPRK 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

In-field verification activities under a CSA

IAEA safeguards inspectors using specialised equipment, MMCA or Mini Multi-Channel Analyser, to verify fresh fuel at a nuclear power plant.

Under a CSA, the inspector has a variety of verification activities to perform at a facility. These encompass the verification of nuclear material accountancy and the verification of facility design.

Nuclear material accountancy verification is analogous to an audit at a bank; the inspector compares what is on the nuclear material accounting books of a facility with what has been reported by the State to the IAEA and, crucially, that the nuclear material is actually at the facility as declared. An inspector also verifies that the facility design is accurately described in the design information questionnaire that the State has submitted to the IAEA. When all of this information has been verified as correct and complete, it can be evaluated for the purpose of drawing safeguards conclusions.

Inspectors verify the inventory of nuclear material using a range of techniques. These include the inspector counting the items present and making measurements, using radiation detectors and/or taking samples for more detailed analysis at IAEA headquarters. Domestic and international transfers of nuclear material (e.g. spent fuel assemblies to a reprocessing plant) as well as other inventory changes are also verified. The inspector must also confirm that the facility has not been misused (e.g. that a research reactor has not been used to produce undeclared plutonium, or that an enrichment plant has not enriched any undeclared uranium). Facility design information provided by the State to the IAEA is examined and verified in accordance with established IAEA procedures.

An inspector performing item counting of cylinders containing uranium hexafluoride (UF_6) used for uranium fuel fabrication.

Containment and surveillance techniques (i.e. the application of seals and the use of cameras and detectors installed at the facility) may be used to provide continuity of knowledge over nuclear material and facilities between inspections by preventing undetected access to nuclear material or undeclared operation of the facility. Environmental samples may also be taken for analysis in order to verify that the facility has been used as declared (e.g. to confirm that there are no traces of separated plutonium or highly enriched uranium at a facility that has not been declared as handling such material).

CAPS or commonly called the Metallic Seal is extensively used for sealing material containers and IAEA safeguards equipment.

The inspector will be aware of a number of potential strategies that a State engaged in clandestine nuclear activities in contravention of a CSA might use to cover up a diversion of nuclear material or the misuse of a facility. For example, the inspector will check that there has been no tampering with the installed containment and surveillance

All in One Surveillance Unit or commonly called ALIS is a fully self-contained digital surveillance system. ALIS are normally mounted at high levels to give a clear activity view and provide a good recording of activity within the reactor hall.

equipment. Steps will be taken to confirm that the nuclear material verified at one facility has not been 'borrowed' from elsewhere in the State. This may be achieved by simultaneous inspections at all facilities from which material could be borrowed. Inspections performed at short notice may also be implemented to counter potential diversion strategies.

Inspections are also a means of following up potential discrepancies or other issues that have been uncovered by previous inspections. Additionally, the meetings associated with inspections provide a further important forum for communication between the State and the IAEA on operational issues.

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 — and reaffirmed in 1995 — that the scope of CSAs was not limited to nuclear material actually declared by a State but included any material that is required to be declared. In other words, the Board of Governors 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 declared 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 equip the safeguards system with important new tools to verify 'completeness'. Successive safeguards measures adopted since the early 1990s (see Box) must be seen in this light.

Some of the measures that have been developed can be implemented under the authority existing in CSAs. Others required additional legal authority and resulted in a new legal instrument, the Model Additional Protocol[1]. This was developed by a special committee of the Board of Governors (Committee 24) and approved in May 1997 as a contribution to global non-proliferation objectives.

The purpose of all of the 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 pro-

1. The 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.).

Measures to strengthen the safeguards system (1991-2005)*

Early strengthening measures (1991-1993):

State provision of design information on new facilities or on changes in existing facilities as soon as the State authorities decide to construct, authorize construction or modify a facility and the IAEA's continuing right to verify the design information over the life of a facility, including decommissioning.
Board of Governors endorsement of the voluntary reporting scheme (see under voluntary measures).

Measures implemented under the legal authority already existing in CSAs (1995-present):

Obtaining detailed information from States about SSACs and regional systems of accounting for and control of nuclear material (RSACs).
Obtaining information from States on facilities which had been closed down or decommissioned prior to entry into force of the safeguards agreement.
IAEA collection of environmental samples at any place where IAEA inspectors have access and subsequent sample analysis at the IAEA Safeguards Analytical Laboratory and/or at qualified laboratories in Member States.
IAEA use of unattended and remote monitoring of movements of declared nuclear material in facilities and the transmission of authenticated and encrypted safeguards relevant data to the IAEA.
IAEA use, to a greater extent than previously, of unannounced inspections within the routine inspection regime.
Provision of enhanced training for IAEA inspectors and safeguards staff and for Member State personnel responsible for safeguards implementation.
Closer cooperation between the IAEA and SSACs and RSACs in States.
Enhanced evaluation by the IAEA of information derived from States' declarations, IAEA verification activities and a wide range of open sources.

Measures implemented under additional protocols (1997-present):

State provision of information about, and IAEA inspector access to, all parts of a State's nuclear fuel cycle, from uranium mines to nuclear waste and any other location where nuclear material intended for non-nuclear use is present.
State provision of information on, and IAEA short notice access to, all buildings on a site.
State provision of information about, and IAEA inspector access to, a State's nuclear fuel cycle R&D activities not involving nuclear material.
State provision of information on the manufacture and export of sensitive nuclear related equipment and material, and IAEA inspector access to manufacturing and import locations in the State.
IAEA collection of environmental samples at locations beyond those provided under safeguards agreements.
State acceptance of streamlined procedures for IAEA inspector designation and requirement for multiple entry visas (valid for at least one year) for inspectors.

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IAEA's right to use internationally established communications systems, including satellite systems and other forms of telecommunication.
Wide area environmental sampling, after Board of Governors approval of such sampling and consultations with the State concerned.

Recent measures (2005):

Revised standardized text and modified eligibility criteria for a Small Quantities Protocol (SQP).

Voluntary measures (1993 and 1999)**:

Voluntary reporting on imports and exports of nuclear material and exports of specified equipment and non-nuclear material, i.e. the voluntary reporting scheme (components of this scheme are incorporated in the Model Additional Protocol) (1993).
Voluntary reporting on holdings and exports of separated neptunium and americium and 'flow sheet monitoring' of facilities capable of neptunium separation (1999).

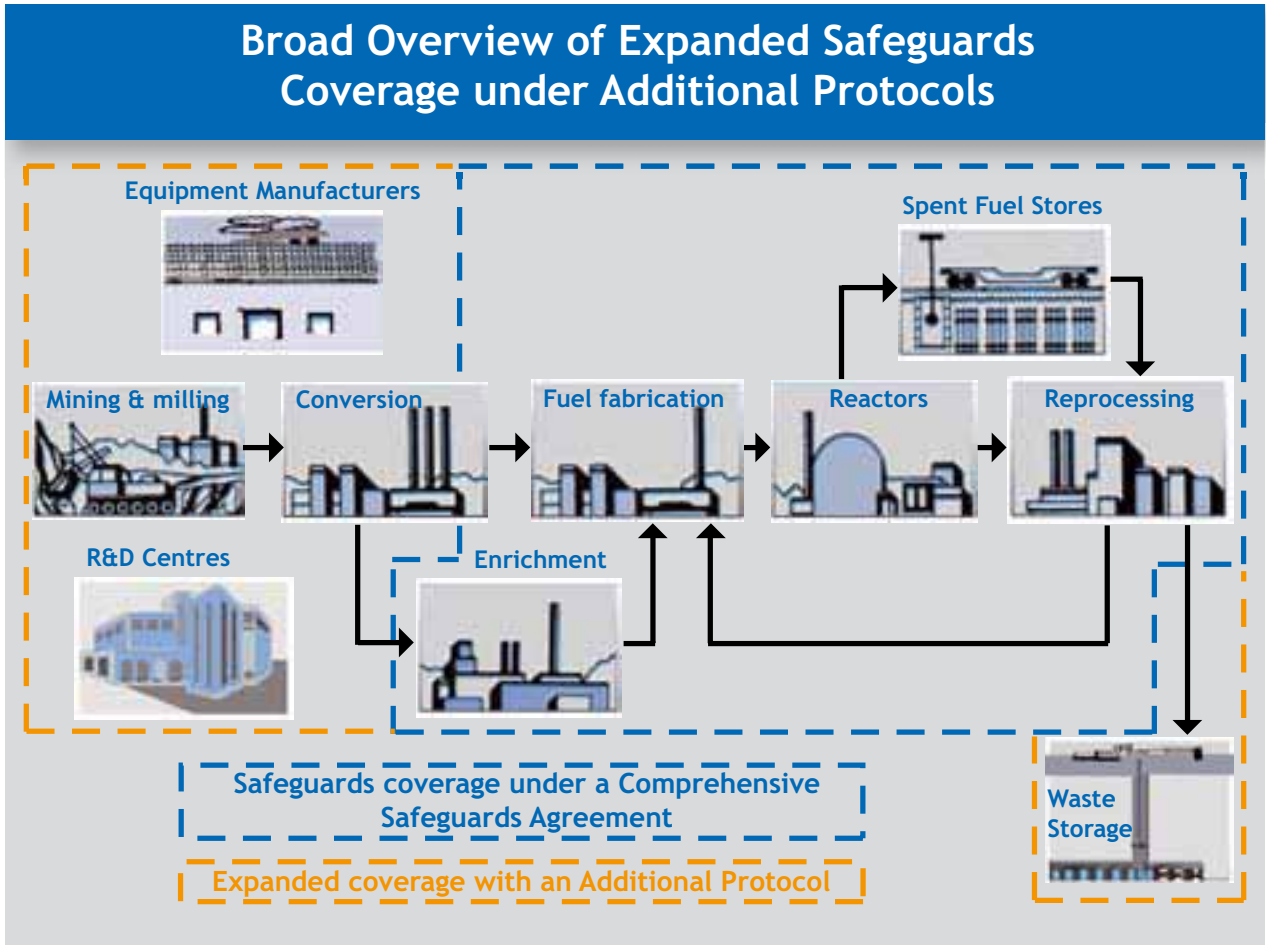
* This list globally summarizes safeguards strengthening measures. It is not necessarily exhaustive.
** Subscription to these measures is initially on a voluntary basis. However, once a State has undertaken to provide the information being requested it commits itself to do so at specified intervals.

vide credible assurance regarding the non-diversion of nuclear material from declared activities and 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 the 'timely detection of 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 is critically important in this regard. The additional information, access for IAEA inspectors (known under an additional protocol as 'complementary access') and other measures for which it provides are designed to 'fill the gaps' in the information reported under safeguards agreements. This enables the IAEA to obtain a much fuller picture of States' nuclear programmes, plans, nuclear material holdings and trade and to compare State declarations on such issues with information available to the IAEA from other sources. An additional protocol, as its name suggests, is not a free standing legal instrument and can be concluded and brought into force only with, or in addition to, a safeguards agreement. States with CSAs 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, or other legally binding agreements, containing those measures that they believe will contribute to safeguards' effectiveness and efficiency objectives.

When fully implemented in a State, the 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 ('completeness'). This is because, taken together, they provide for a set of 'indicators' that can be used for assessing the



correctness and completeness of a State's declarations and whether there is a possibility of undeclared nuclear material and activities.

Integrated safeguards

It is important to note that the successive measures adopted since the early 1990s were never intended to constitute an additional 'layer' of safeguards implementation. The aim was always to integrate, in an optimal way, a set of measures to enhance the IAEA's capability 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 seek to benefit from the synergy resulting from the combination of 'correctness' measures and 'completeness' measures to achieve greater overall effectiveness and cost efficiency.

A specific integrated safeguards approach is developed for each State with both a CSA and an additional protocol in force. It takes account, amongst other things, of differences between the nuclear fuel cycles and related activities of States and enables State specific features to be factored in. An integrated safeguards approach can be implemented when the IAEA Secretariat[2] has been able to draw the safeguards conclusion for a 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

2. The IAEA comprises the Member States of the organization (as represented by the Policy Making Organs, the IAEA General Conference and the IAEA Board of Governors) and its Secretariat. The latter is a team of over 2000 multidisciplinary professional and support staff from more than 90 countries. It is led by the IAEA Director General and by the Deputy Directors General who head the major IAEA Departments.

its entirety. Integrated safeguards are an important efficiency measure and are again discussed, in this context, in the section on efficiency. As of June 2007, integrated safeguards were being implemented for 17 States.

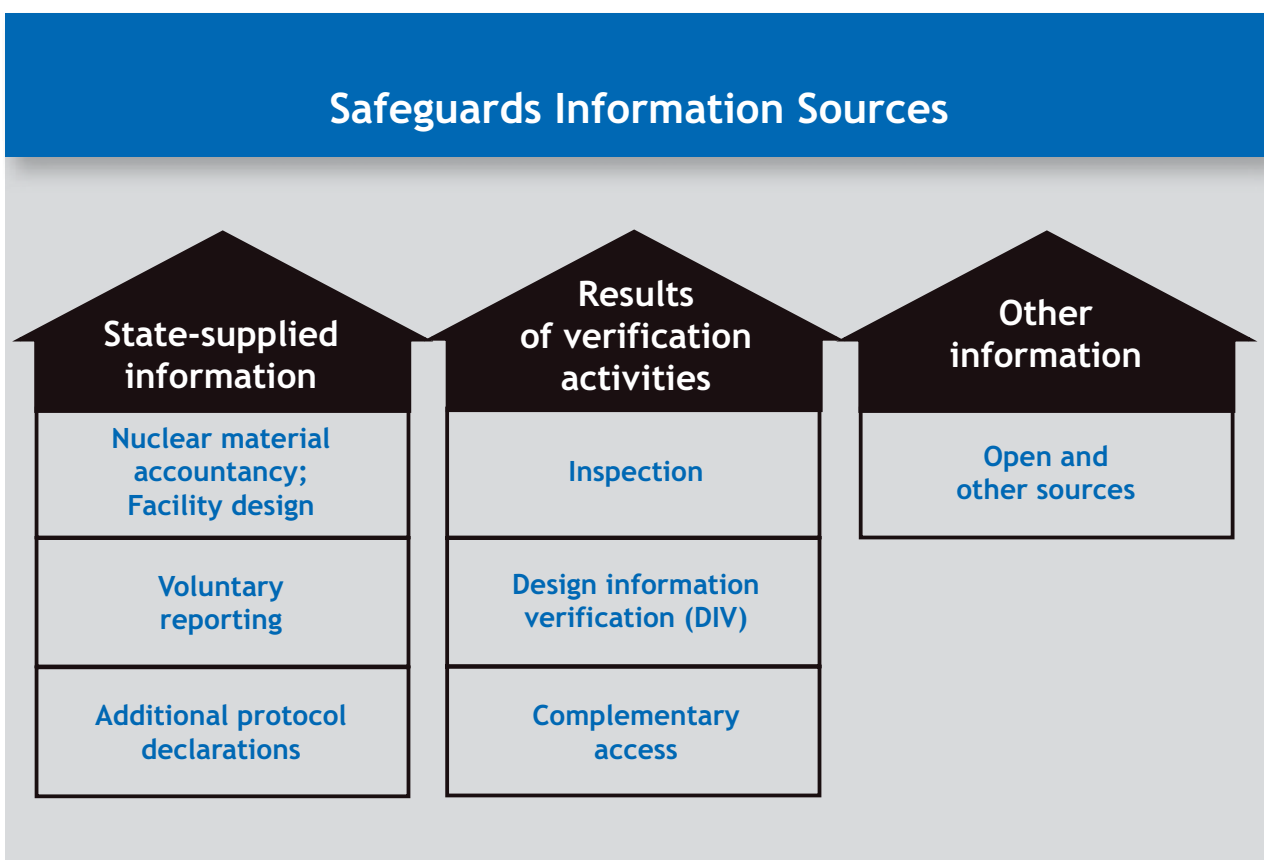
What are the practical consequences of the shift in the focus of safeguards implementation?

The shift in the focus of safeguards implementation, from verification of declared nuclear material at declared facilities to understanding and assessing the consistency of information on a State's nuclear programme, has resulted in a whole new way of working, new organizational arrangements, new responsibilities and new infrastructure. The changes are of such magnitude that they can rightly be characterized as a revolution, rather than an evolution, in the way in which safeguards activities are planned and implemented, the results are analysed, safeguards conclusions are drawn and follow-up activities are carried out.

The safeguards State evaluation process

The framework in which all of this planning, analysis, evaluation and assessment takes place is the safeguards State evaluation process, a continuous, iterative process for each State with a safeguards agreement. The process integrates and assesses all of the information available to the IAEA about that State's nuclear activities and plans. There are three main sources of safeguards relevant information: (i) provided by States under safeguards agreements, additional protocols or voluntarily; (ii) derived from IAEA in-field verification activities; and (iii) obtained from open and other sources of safeguards relevant information.

The underlying basis for State evaluations is that a State's nuclear programme, whether past, present or future, will generally have detectable indicators. A nuclear programme involves an interrelated set of nuclear and nuclear related activities that require or are indicated by the presence of certain equipment and specialized non-nuclear materials, a specific infrastructure, observable traces of nuclear activity in the environment and a predictable use of nuclear material. The picture that these features present



enable the IAEA to (i) assess whether the State's declarations to the IAEA are internally consistent; and (ii) carry out a point by point comparison between what the State has stated that it is doing – or plans to do – with regard to its nuclear programme and other relevant information available to the IAEA.

Carrying out State evaluations

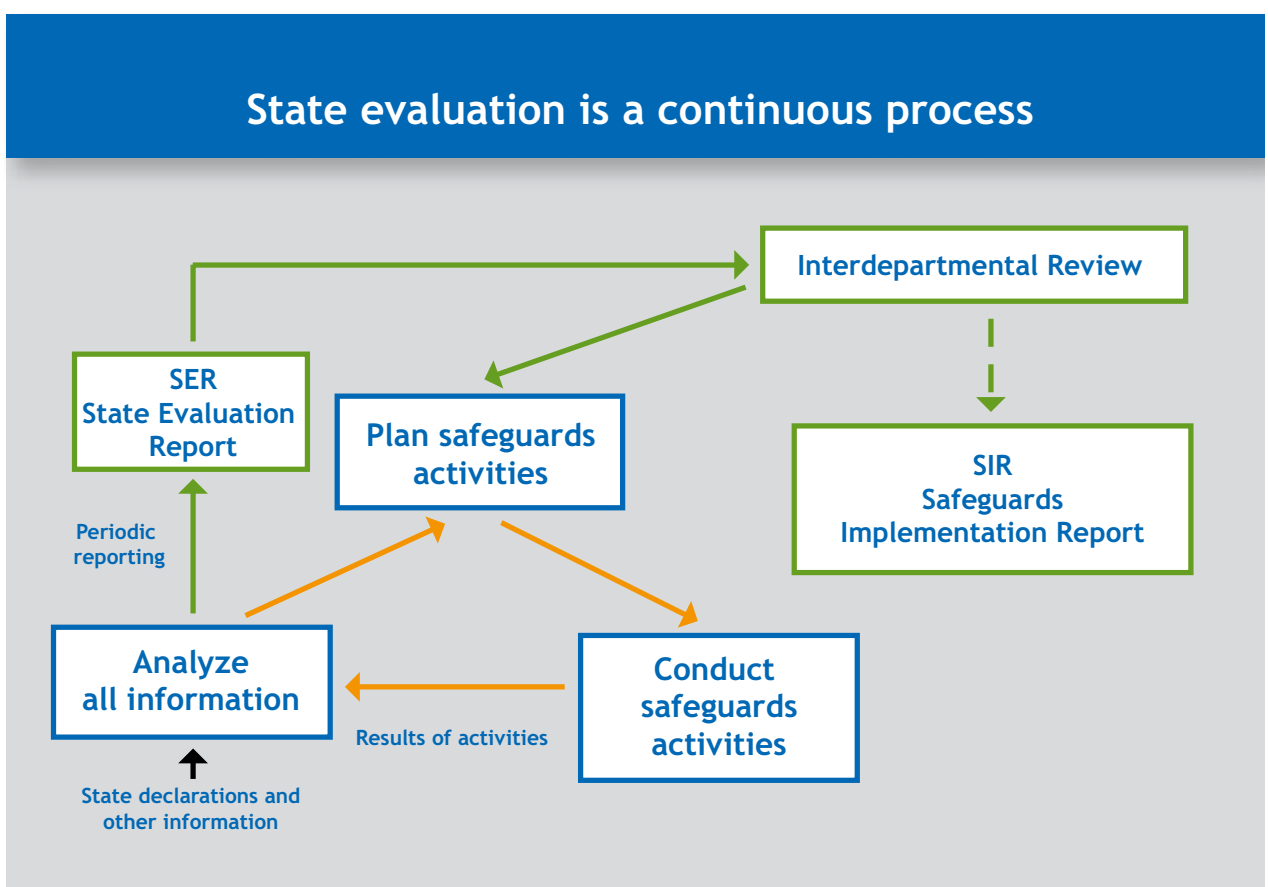
As evaluation is an on-going process, the safeguards system is truly 'information driven'. Periodically, the findings of the evaluations are recorded in an internal document known as a State Evaluation Report (SER). Each evaluation builds on the preceding one and takes into account the further safeguards relevant information that has become available to the IAEA since the previous evaluation. A dedicated, high level interdepartmental committee reviews the content of the SERs in detail, as well as the process that was followed during the evaluation. There are also mechanisms in place for reviewing evaluation methodology, guidelines, resources and information sources and for improving the evaluation and review system in the light of experience, technical advances and changing requirements. Safeguards State evaluation provides the basis on which the IAEA draws its safeguards conclusions and is also essential for planning and carrying out safeguards activities. The review committee makes the final decision regarding the conclusion for each State that will be reported in the annual Safeguards Implementation Report (SIR).

How does the IAEA draw its safeguards conclusions?

Drawing safeguards conclusions

The 'products' of safeguards implementation are the safeguards conclusions. A by-product is to highlight for IAEA Member States and the wider international community any particular issues or factors that may undermine, weaken or otherwise affect those conclusions.

Conclusions drawn from safeguards implementation can be, and frequently are, reported to the Board of Governors at their five regular meetings each year



and/or in response to special requests, mandates (e.g. from the United Nations Security Council) and other, ad hoc requirements. In any event, the IAEA Secretariat draws and reports its safeguards conclusions annually in its SIR, key portions of which are released for publication. These conclusions underpin the assurance that the international community can derive about States' compliance with their undertakings on the peaceful use of nuclear material and technology or, as appropriate, highlight cases of non-compliance. Conclusions are drawn for each State with a safeguards agreement in force and are reported collectively for specific categories of States, based on their respective safeguards obligations.

The safeguards conclusions that are drawn — and the nature and scope of the assurance that can be given — depend on the type of safeguards agreement that a State has brought into force and whether or not the State has also concluded an additional protocol. Optimum assurance is possible only for one category of States, i.e. States with both a CSA and an additional protocol. This is because it is only for this category of States that the IAEA has the authority to use the full range of verification tools that it has available.

Conclusions for States with CSAs

For each State with a CSA and an additional protocol, the Secretariat seeks to conclude that *'all nuclear material remained in peaceful activities'*. To draw such a conclusion, the Secretariat must first draw the two, interrelated conclusions that (i) there is no indication of diversion of declared nuclear material from peaceful activities (including no misuse of declared facilities or other locations to produce undeclared nuclear material) and (ii) no indication of undeclared nuclear material and activities for the State as a whole:

(i) To conclude that there is *no indication of diversion of declared nuclear material (including no misuse of facilities or locations outside facilities),* the Secretariat evaluates the quantitative results of its in-field safeguards verification activities to determine, amongst other things, that facility design, nuclear material inventories and flows and facility operations are as declared by the State. It also evaluates whether the safeguards activities that it has carried out during the calendar year have satisfied certain performance targets. The Secretariat then evaluates other, more qualitative information available about the declared facilities and about the relevant State as a whole, including the extent to which the State can be seen to be able to account for and control nuclear material and activities. Finally, the Secretariat evaluates the totality of its quantitative and qualitative information to determine if there is any indication of diversion of declared nuclear material or misuse of declared facilities. Where there is no such indication, the Secretariat draws the conclusion for the State in question and for a given year that *'declared nuclear material remained in peaceful activities'*.

(ii) To conclude that there is *no indication of undeclared nuclear material and activities for the State as a whole,* the Secretariat evaluates the results of its nuclear material verification activities under CSAs and the results of its broader, more qualitative, evaluation and verification activities under additional protocols. Certain conditions also need to be met to enable such a conclusion to be drawn:

- The State needs to have complied with the terms of its safeguards agreement and additional protocol (e.g. by submitting required information in a timely and appropriate manner, and by allowing IAEA inspectors to gain appropriate access for verification purposes).
- The IAEA needs to have conducted a comprehensive State evaluation based on all information available about the State's nuclear and nuclear related infrastructure and activities; implemented complementary access, as necessary, to locations relevant to the State's nuclear programme; and addressed any questions and/or inconsistencies that it has identified.

The comprehensive State evaluation includes determinations that:

- The State's declared present and planned nuclear programme is internally consistent.
- Nuclear activities and types of nuclear material are consistent with those the State has declared to the IAEA.
- Overall production, imports and inventories of nuclear material are consistent with the use inferred from the State's declared nuclear programme.

- Imports of specified equipment and non-nuclear materials, the status of closed down or decommissioned facilities (and locations outside facilities), nuclear fuel cycle R&D and nuclear related manufacturing are also consistent with what the State has declared.

When all of the activities necessary for these assessments have been completed and the Secretariat has found no indications that, in its judgement, would give rise to a proliferation concern, it is able to draw the conclusion that there is *'no indication of undeclared nuclear material and activities for the State as a whole'*.

The two conclusions (i.e. no indication of diversion of declared nuclear material and no indication of undeclared nuclear material and activities) are then combined to permit the broader conclusion, for the State and for the year in question, that *'all nuclear material remained in peaceful activities'*. To be able to maintain such a conclusion, the steps described above must be repeated annually, taking full account of new or updated information that becomes available throughout the year.

As previously explained, concluding that there is no indication of undeclared nuclear material and activities requires the information, access and technical measures provided for in the Model Additional Protocol. Consequently, the broader conclusion that all nuclear material remained in peaceful activities is drawn only for States with CSAs and additional protocols in force. For a State with a CSA but without an additional protocol, or where the evaluation referred to in (ii) above was still in progress in a given year, the Secretariat, based on (i) above, draws only a conclusion, for the State and for the year in question, with respect to whether *'declared nuclear material remained in peaceful activities'*. The types of safeguards conclusion that it can draw for other categories of States are described below (see Box).

What are key requirements of the safeguards system?

The requirements of the safeguards system are many and varied, tangible and intangible. They range from the safeguards relevant information and access already touched upon, to the hardware, software and infrastructure required for effective and efficient safeguards implementation, including information analysis, equipping IAEA staff with the specialist skills and training that they require in an increasingly complex international security environment and, also very importantly, cooperation and support on the part of States.

1. Support from stakeholders

At the most fundamental level, support from stakeholders is vital. The IAEA can work only with the authority and support of the international community – on whose behalf it works – as represented

Safeguards conclusions for other categories of States

Under item specific safeguards agreements, the IAEA applies safeguards in order to ensure that nuclear material, facilities and other items specified under the safeguards agreement are not used in such a way as to further any military purpose. Since 1975, such agreements also explicitly proscribe any use related to the manufacture of any other nuclear explosive device. For States with such item specific safeguards agreements, the Secretariat seeks to conclude that, for the year in question, the nuclear material, facilities and other items to which safeguards were applied remained in peaceful activities.

For States with voluntary offer safeguards agreements, the IAEA seeks to conclude that, for the year in question, nuclear material to which safeguards were applied in selected facilities was not withdrawn, except as provided for in the agreements, and remained in peaceful activities.

For States with no safeguards agreements in force, the Secretariat cannot draw any safeguards conclusions.

by its Member States. It is therefore vital that States support safeguards endeavours, including through the adequate provision of resources. One significant measure of support is the extent to which States act upon any legally binding obligations to conclude safeguards agreements (as in the case of States party to the NPT) and also bring additional protocols into force. Progress on the entry into force of additional protocols has been slower than anticipated but has picked up considerably in recent years because States have progressively recognized the need for a robust IAEA verification system.

2. Provision of resources

Following 15 years of a zero real growth budget, the IAEA General Conference agreed in September 2003 to increase the regular budget of the organization, including a 12.4% increase for safeguards. The General Conference also recommended further increases to be phased in until 2007. This welcome development is nevertheless tempered by the fact that, in a practical sense, IAEA safeguards are always operating on a shoestring budget. There are multiple demands on this budget which, at roughly $120 million a year, is about as much as it costs to run the police department of a medium-sized city. For example, the IAEA needs at all times to:

- Maintain an adequate information base, technological and other infrastructure;
- Respond to current challenges and anticipate future ones;
- Improve upon or develop new safeguards concepts and approaches; and
- Train its staff.

A high priority, ongoing need is to continue to enhance the IAEA's capability to detect undeclared nuclear material and activities that contravene safeguards agreements. This need has been further highlighted in the last 3-4 years by the uncovering of covert nuclear trade and procurement networks dealing in sensitive nuclear technology and nuclear activities that States were required to have reported — but did not report — to the IAEA. Significant resources are also required for technically sound and cost efficient safeguards measures in major new facilities and for other complex facilities that will come on-stream in the future. Also significant is that, despite the IAEA's considerable efforts to modify and extend the lifetime of safeguards equipment, its more extensive use of digital equipment (which is more expensive and has a shorter lifespan) will increase costs. Little wonder that the IAEA continues to attach great importance to using its resources as effectively and efficiently as possible, as required by safeguards agreements.

3. Cooperation from and with State authorities

Even with the most sophisticated, state of the art safeguards measures, the IAEA must be able to count on a State to cooperate with safeguards implementation. The importance of such cooperation is reflected in CSAs, which require a State to establish and maintain an SSAC. In two cases, (the European Union and Argentina–Brazil) there is an RSAC.

SSACs can have a variety of functions and have many obligations with regard to IAEA safeguards (see Box). They are responsible for submitting design information to the IAEA, making sure that nuclear facility operators maintain the records that the IAEA requires and providing for IAEA inspectors to gain physical access to facilities and other locations. They must also make sure that nuclear plant operators are able to measure quantities and types of nuclear material precisely and accurately and that their equipment and measuring systems meet the highest international standards. SSACs can also help to resolve any problems that arise during in-field verification activities. For States with additional protocols in force, it is generally the SSAC that is entrusted with ensuring that the IAEA receives the additional information and access that this entails. For its part, the IAEA is required, in its verification activities, to take account of the technical effectiveness of the SSAC. The IAEA has initiated a comprehensive project to help States to establish and strengthen their SSACs. It has also established an SSAC advisory service which provides Member States with advice and recommendations regarding their SSACs. Most States with significant nuclear activities have SSACs that are capable of supporting the IAEA's basic verification activities effectively and the best SSACs have a high degree of technical expertise and experience.

Good cooperation between the IAEA and SSACs/RSACs is essential to effective and efficient safeguards. Moreover, for States with both CSAs and additional protocols in force, the implementation

of integrated safeguards offers the opportunity for enhanced cooperation, provided that the IAEA can have a high level of confidence in and good cooperation on the part of an SSAC/RSAC.

4. Information sources

A key, tangible requirement of the 'information driven' safeguards system is, of course, information itself. The three main types of information source available to the IAEA and used in the State evaluation process are those : (i) provided by States under safeguards agreements, additional protocols or voluntarily; (ii) derived from IAEA in-field verification activities or (iii) obtained from open and other sources of safeguards relevant information, all of which have already been mentioned. Additional information is given below.

(a) Open source information

One of the questions that the State evaluation process seeks to answer is whether a State's declarations about its nuclear programme and plans are consistent with information obtained from 'open' sources, that is, sources other than the findings of IAEA in-field verification activities or obtainable from other, internal IAEA databases. Open source information can shed light on a number of safeguards related matters such as research into sensitive technologies; details about nuclear material production; location specific information, which is particularly useful for complementary access under additional protocols and for satellite imagery acquisition; imports and exports of safeguards relevant technology, and general information relevant to a State's development of its nuclear fuel cycle. Open source information is very different from State declared and inspection related information in that it is amorphous, of varying quality and reliability, and has no strictly defined collection procedure. Finding and evaluating such information requires new hardware and software, new skills and analytical ability, and new procedures. All of this has been a major work in progress over the last decade and will continue to be a high priority.

One major task is to extract safeguards relevant knowledge from an ever increasing volume of information. When relevant material has been located, it

SSAC/RSAC

The SSAC is the organization within the State that typically has both a national objective to account for and control nuclear material in the State and an international objective to provide the basis for the application of IAEA safeguards. Under a CSA, the State is required to establish and maintain a SSAC. The SSAC must accurately account for all material subject to safeguards in the State and routinely report its findings to the IAEA.

Item specific safeguards agreements do not explicitly require States to have a SSAC, but the fact that INFCIRC/66 calls for agreement between the IAEA and the State on a "system of records" and a "system of reports" implies the need for an appropriate organizational arrangement at the State level.

Training courses conducted by the IAEA help Member States to establish and strengthen their SSACs.

In practice, the SSAC's role is greater than just accounting and reporting; it is also the chief point of contact between the State and the IAEA for operational issues (e.g. arrangements for installing safeguards equipment or for implementing unannounced inspections will require detailed discussions between the SSAC and the IAEA). Without close cooperation between the SSAC and the IAEA, efficient and effective safeguards would not be possible.

must be selected and processed, analysed, evaluated and cross-checked for credibility. All of this is an enormous undertaking and the IAEA's open source information system is continually being upgraded to incorporate new search and organizational capabilities. The introduction of new, analytical skills and tools is also essential.

(b) Commercial satellite imagery

A particularly valuable open source of information is commercial satellite imagery. This has become a key tool that is now used routinely to evaluate information provided by States on their nuclear activities and to plan inspections, visits to facilities to verify design information and complementary access.

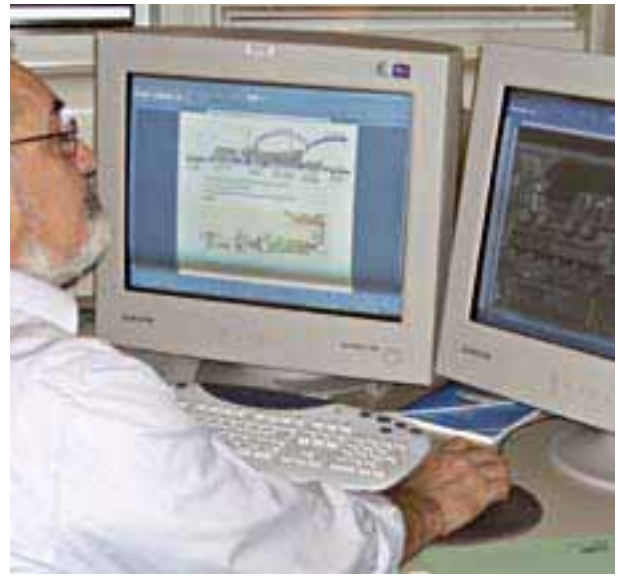
The use of satellite imagery often enables the IAEA to select the locations that need to be visited by safeguards inspectors on a more informed basis and can sometimes lead to efficiencies by decreasing the need for on-site verification. It therefore helps the IAEA to optimize the use of its human and financial resources. Satellite imagery also increases the possibility of detecting proscribed nuclear activities. A Satellite Imagery Analysis Unit has been established within the IAEA and provides in-house analytical capability.

(c) Further information from States

The Secretariat continually needs to be aware of any new vulnerabilities in the safeguards system that develop over time and to respond to them. The voluntary reporting scheme and the later monitoring scheme for separated neptunium and americium were designed to respond to the clear need for specific, supplementary information from States. More recently, events have demonstrated the usefulness of two further kinds of supplementary information, one sought from States on a voluntary basis and the other as a result of specific decisions by the Board of Governors.

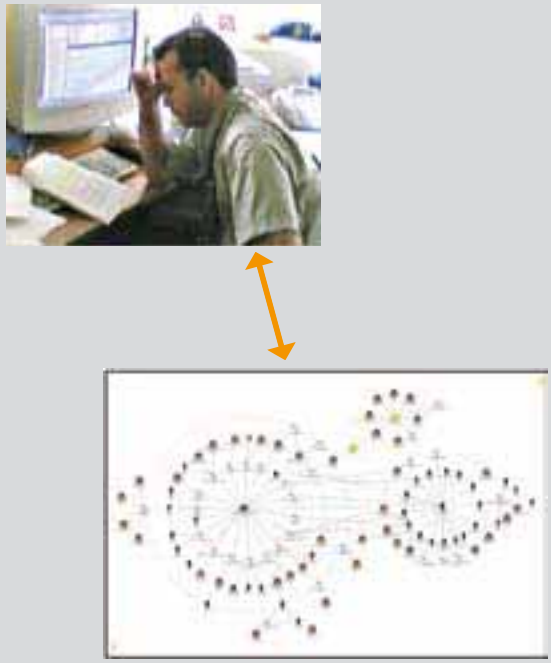
(i) Nuclear trade related information

Following revelations about extensive, covert networks related to the procurement and supply of sensitive nuclear technology, the IAEA undertook to strengthen its capabilities for obtaining and analysing information on such networks. With this aim, a unit for nuclear trade analysis was



The emergence of satellite imagery analysis has added a new dimension to the IAEA's verification toolset

Overlay of a site map provided under an additional protocol on a satellite image of the site



The nuclear trade analysis unit uses a customised Procurement Tracking System (PTS) which supports analysis, visualisation and reporting of unstructured nuclear trade related data

established in the IAEA in 2004. The unit seeks to identify elements of covert nuclear networks that could indicate the existence of undeclared nuclear material and activities. Some IAEA Member States have voluntarily been providing information to the unit on procurement enquiries, export denials and other nuclear trade-related information. This contributes to the IAEA's overall understanding of the issues and provides valuable input to the State evaluation process.

(ii) Information from States with SQPs

Further information is also now being sought under the provisions of the revised SQP to CSAs. SQPs were first introduced in the early 1970s as a means of minimizing safeguards implementation for States with little or no nuclear material and with no nuclear material in a facility. The practical effect of an SQP was to hold in abeyance the implementation of important safeguards measures related to the provision of information and access to nuclear locations that are implemented routinely in other States with CSAs.

In mid-2005, the Director General of the IAEA drew the Board of Governors' attention to the fact that SQPs were inconsistent with the main thrust of safeguards measures for States with CSAs, i.e. obtaining more information and access relevant to a State's nuclear material holdings and related activities in order better to understand and to be able to assess its nuclear programme. In September 2005, the Board of Governors decided that although SQPs would remain part of the safeguards system, the standard text of the SQP would be modified and the criteria for having an SQP would change. The practical effect of these changes is that the IAEA will have the authority to implement the same important safeguards measures in all States with CSAs.

5. State of the art equipment, techniques and technology

The IAEA has always applied technical measures and techniques to verify information provided by States pursuant to their safeguards agreements. New and/or improved equipment, techniques and technologies continue to provide an important basis for more effective and efficient safeguards.

(a) Equipment

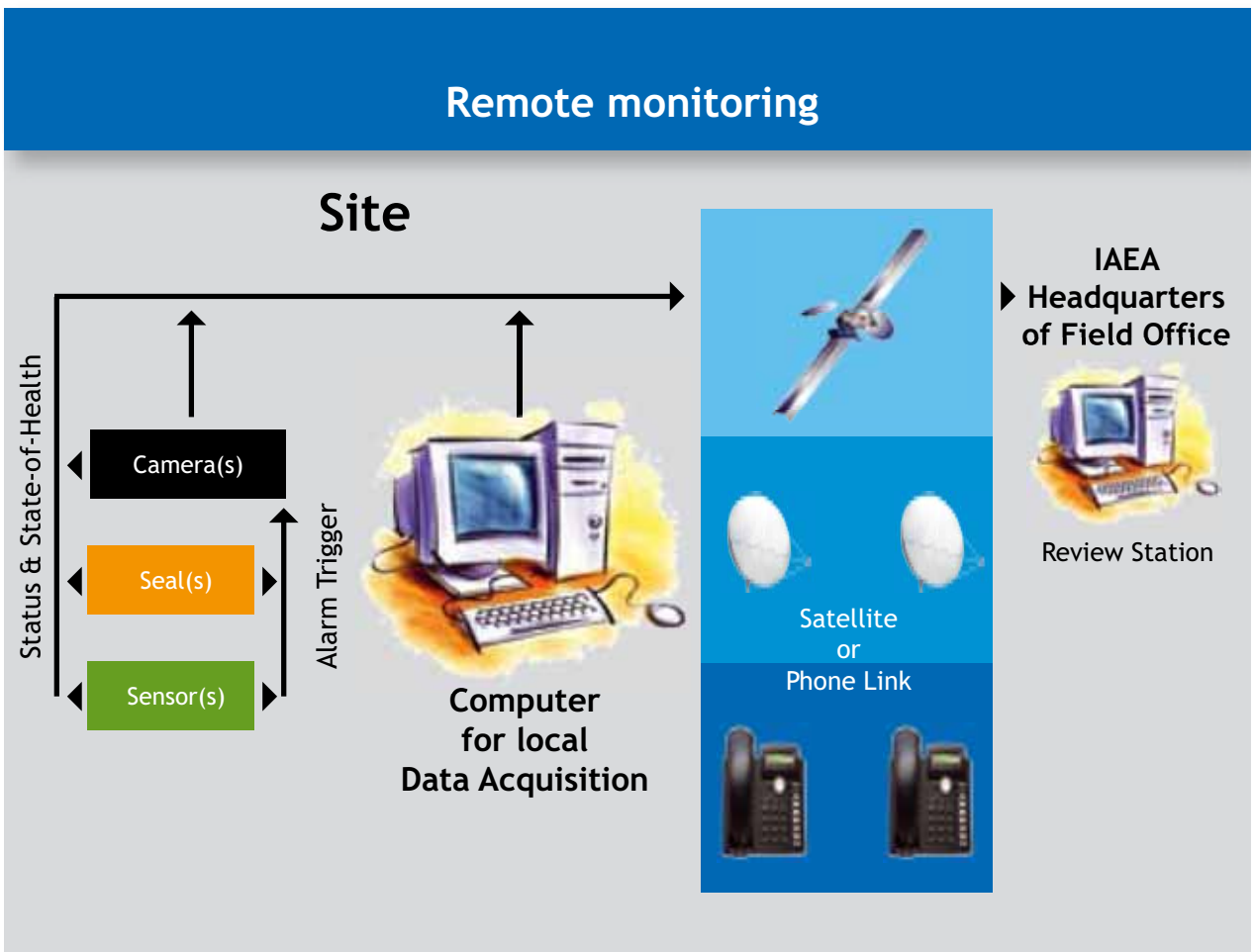
Safeguards implementation requires the availability of appropriately prepared, calibrated, tested and well-maintained equipment. The IAEA has accumulated considerable experience in the management of safeguards equipment and this is highlighted by its

An IAEA engineer performs final testing on a remote monitoring server (Server based Digital Image Surveillance, SDIS) prior to installation in a nuclear facility.

IAEA safeguards inspectors using the hand held HM-5 (fieldSPEC). The HM-5 is a modern hand-held digital gamma spectrometer combining various functions such as radiation dose rate measurement, nuclear material identification and isotope identification (e.g. U-235)

large equipment inventory (more than 25 000 items), the long list of equipment authorized for inspection use (some 140 types) and annual expenditure on equipment (an average of $14.5 million per year over the last 5 years).

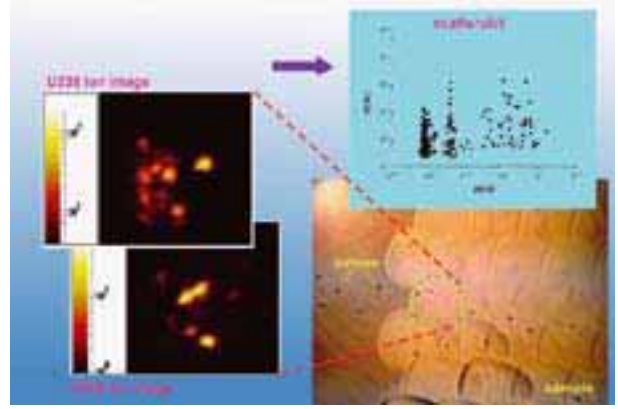
Safeguards equipment and instrumentation involves wide market assessment, extensive testing, documentation and training. It is developed to withstand the environmental conditions of nuclear facilities and in a rapidly changing technological environment. Given the high cost of developing and implementing equipment and the substantial current inventory, efficient adaptations are needed so that equipment can both satisfy the requirements of the



safeguards system and function effectively within budgetary limits.

(i) Unattended and remote monitoring systems

Unattended monitoring systems with a remote transmission capability are increasingly being used in facilities to reduce inspection effort. These systems have the ability to transmit authenticated 'state of health' data and verification data from the field in a cost effective manner. The development of these systems is predominately complete and the systems are now robust with reliable data transmission networks.



Particles from an environmental sample are analysed to determine their isotopic composition.

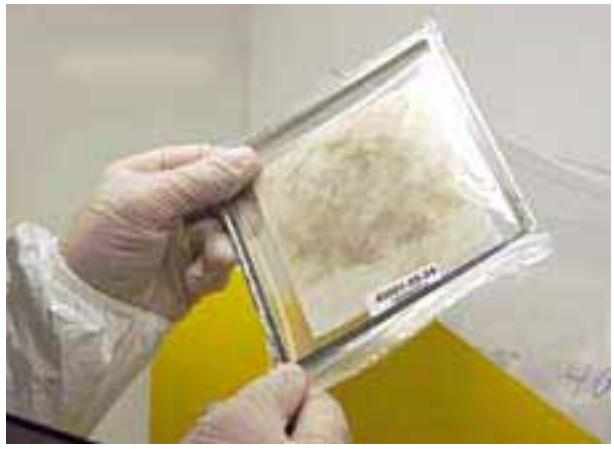
(b) Techniques and technology

(i) Environmental sampling

Environmental sampling (ES) was first introduced as a safeguards strengthening measure in 1996. It is now in routine use and is a powerful tool for detecting undeclared nuclear material and activities at declared facilities or at undeclared locations. ES involves collecting samples from the environment in order to analyse them for traces of materials that can reveal information about nuclear material handled or activities conducted. The majority of samples collected for safeguards are swipes of equipment surfaces and building structures. Thousands of such samples have been collected during routine inspection and design information visits and during complementary access under additional protocols.

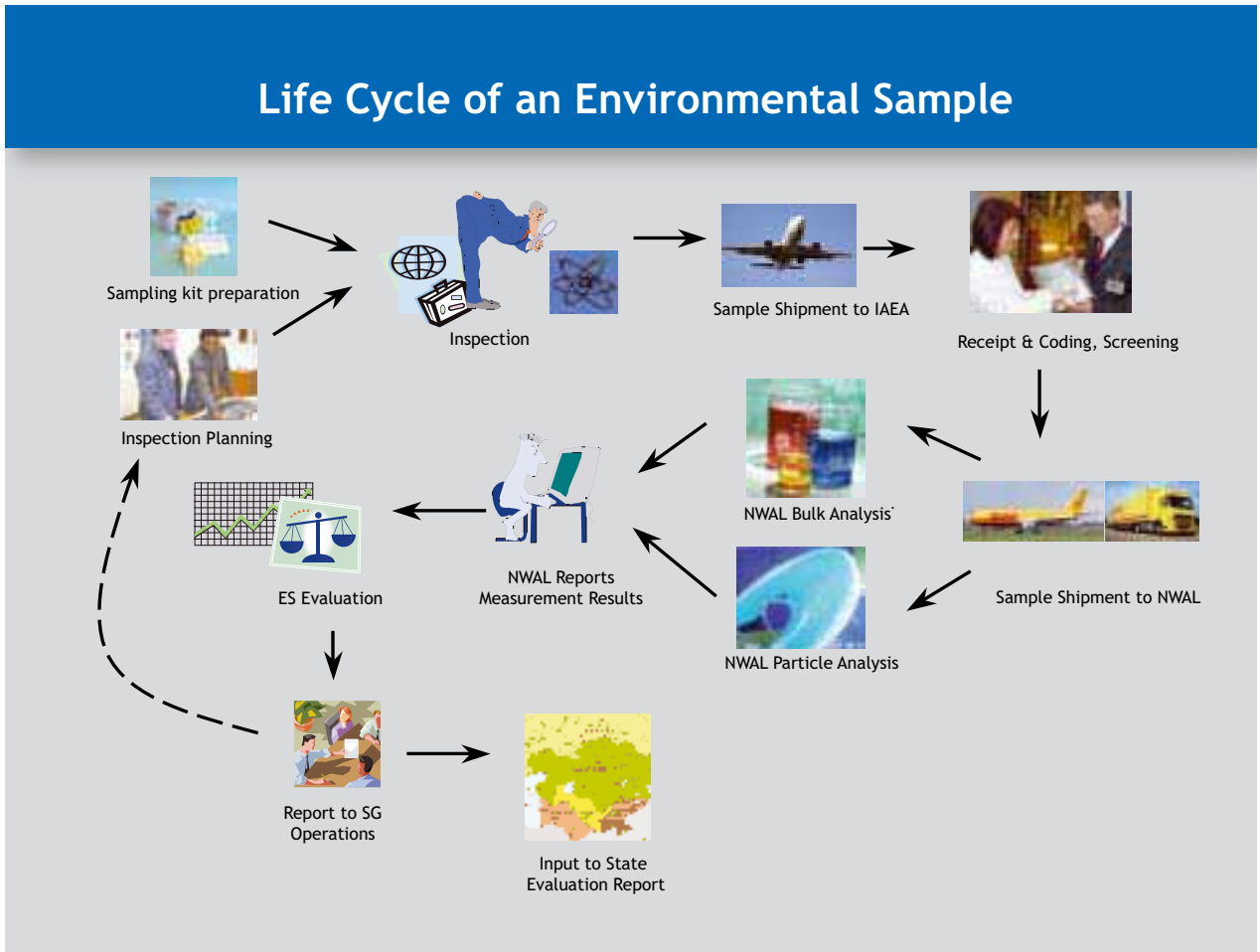
A whole new infrastructure has been designed, established and put into operation for ES. Sampling kits have been created and detailed instructions have been developed for sample collection and handling. Tools have also been devised to help with the evaluation of analytical results and a dedicated database records the collection, processing, analysis and evaluation of the samples taken.

The IAEA Safeguards Analytical Laboratory (SAL) in Seibersdorf, Austria, is an important support component of the ES programme and is responsible for processing, screening, distributing, analysing and archiving samples. The IAEA's Network of Analytical Laboratories (NWAL) supporting environmental sample analysis for safeguards, currently comprises 14 laboratories (including the SAL) in 8 Member States. However, a major, on-going challenge is how best to manage the total



A "swipe" sample collected on cotton cloth by inspectors.

A technician prepares a swipe sample for screening at the SAL using X-ray fluorescence spectrometry.



number of samples being taken. The capacity of the NWAL is not infinite and in recent years high priority samples from special verification activities have had a negative impact on the timely analysis and reporting of 'routine' samples. For all of these reasons, the IAEA wishes to upgrade the 30-year old infrastructure at the SAL as well as its analytical capacity and capability. It also wishes to expand the capacity and capability of the NWAL.

(ii) New technologies

Member State Support Programmes (MSSPs)

MSSPs provide extra-budgetary funding for research, development and implementation support for IAEA safeguards. The objective is to improve and strengthen international safeguards by transferring technology and expertise from Member States to the IAEA. The first MSSP was established in 1977. Today there are 20 such Support Programmes, i.e. those of: Argentina, Australia, Belgium, Brazil, Canada, the Czech Republic, the European Commission, Finland, France, Germany, Hungary, Japan, the Netherlands, the Republic of Korea, the Russian Federation, South Africa, Spain, Sweden, the UK and the USA, 19 of

An inspector uses the 3-Dimensional Laser Range Finder to verify the absence of undeclared changes in the facility design. This technology was developed initially for the IAEA under a Member State Support Programme, and continues to be augmented with more advanced features.

which were actively involved in specific MSSP tasks as at the end of 2006 (see diagram). The overall, annual contributions of MSSPs to safeguards exceed $20 million per year, addressing such needs as the development of safeguards concepts and information processing, verification technologies and training.

The IAEA communicates its research, development and safeguards implementation objectives to the MSSPs through its Research and Development Programme for Nuclear Verification (R&D programme). MSSP support is crucial to the IAEA because limited regular budget resources preclude it from implementing R&D tasks directly. In addition, the IAEA relies on the unique type of assistance that MSSPs can provide, such as national laboratories to develop equipment for safeguards verification; facilities for training inspectors; laboratories for conducting independent analyses; and open source information. MSSPs remain the principal vehicle through which the IAEA achieves its safeguards R&D objectives.

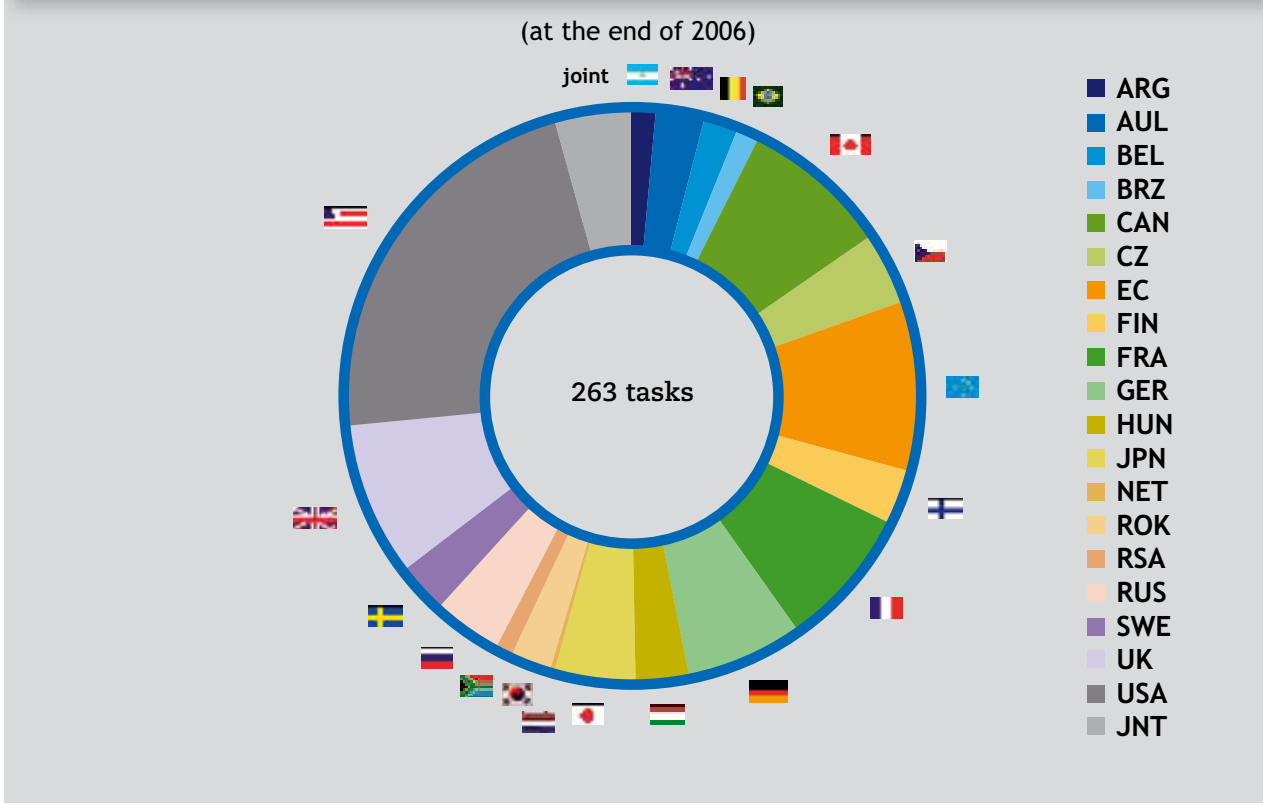
6. Infrastructure

The safeguards system needs extensive infrastructure to support and improve implementation. It must also be capable of adjusting to changing needs. Some of this infrastructure has been mentioned already but there are many other examples. The process of developing appropriate new infrastructure and putting it in place will continue. As advances are made in some areas, priorities and resources must shift to other needs.

(a) Safeguards concepts and approaches

A number of safeguards approaches have been revised and new ones developed since the early 1990s, e.g. the guidelines for planning, carrying out and reporting on design information examination and verification activities have been revised and now cover such activities throughout a facility's lifetime. Also, much effort has been devoted to developing a more cost–efficient approach to safeguarding transfers of spent (irradiated) nuclear

Member State Support Programme Tasks by Country



fuel. Work also continues on further developing and/or refining elements of integrated safeguards and on integrated safeguards approaches to be implemented in specific States and at specific types of facility.

(b) Guidance for implementing additional protocols

Although the Model Additional Protocol describes techniques and technical measures that can be used for safeguards activities, it was never intended to specify in detail how those measures are to be implemented. Consequently, an urgent requirement immediately following the Board of Governors' approval of the Model Additional Protocol was to put in place the means needed by States to implement it. Towards this end, the Secretariat developed guidelines in August 1997 (since updated and reissued) to help States to complete, format and submit their additional protocol declarations and to achieve consistency. It later developed and distributed the Protocol Reporter software to help States with the submission of the declarations required from them under additional protocols.

The infrastructure for the safeguards system has grown and continues to mature. Guidance continues to be required for States and for the IAEA Secretariat. The successive safeguards measures adopted in recent years, especially those in additional protocols, have resulted in a wide range of new or revised procedures and documentation whether for internal use by the IAEA Secretariat or designed for States.

(c) Information technology

Any information system, especially one as large and complex as the one required for the IAEA's verification activities, requires an underpinning infrastructure of specialist software and hardware. Therefore, one of the IAEA's objectives is to provide an adequate information technology (IT) infrastructure and support mechanisms for the reliable and secure network, telecommunications and database services that verification activities require. Some aspects of this have already been mentioned, for example in the context of open source information. Of primary importance are the major efforts being made to re-engineer the IAEA Safeguards Information System (ISIS).

(i) ISIS re-engineering

The overall aim of the ISIS re-engineering project is to increase the effectiveness and efficiency of information processing within the Department of Safeguards by replacing the current computer system with a modern platform. Specific aims are to provide immediate and secure online access to the information which safeguards inspectors need, whether at headquarters or in the field, to provide appropriate capability to enable the IAEA Secretariat to analyse all of the safeguards relevant information available to it and to provide a flexible and adaptable infrastructure that can respond to future needs and challenges.

The re-engineering is essential because of the obsolescence of the software and computer languages used to maintain the IAEA's data. Current IT applications are inflexible and unable to be networked to meet current needs, especially in the light of the major changes to working methods and practices implemented since the early 1990s.

7. Developing a new mindset and culture

The major changes in safeguards implementation since the early 1990s have brought about the need for new ways of thinking, new behaviour and a new culture. This is where training and recruitment play key roles.

Specialist training is available to safeguards inspectors at all stages of their careers and the safeguards training programme constantly needs to be adapted to meet changing requirements at basic

The IAEA organises about 50 training exercises each year, for up to 12 inspectors at a time.

and advanced levels. Basic training has been updated progressively since 1997 to reflect developments in safeguards measures and changes in technology. The State evaluation process requires new skills in multidisciplinary evaluation teams. These need to be developed through training as well as through targetted recruitment.

Much has been done to equip safeguards staff (both safeguards inspectors and support staff) with the knowledge and skills they now need. Training has been developed to cover such issues as the principles and practices of complementary access, proliferation indicators of different types of nuclear fuel cycle facility and practical exercises in performing State evaluations. Complementary access requires inspectors to have specific implementation skills that are currently covered in courses on enhanced observational and communications skills. The training programme also provides for specialized courses on such topics as ES and satellite imagery. This list is by no means exhaustive and can be expected to grow in response to other requirements.

This also applies to the assistance provided to IAEA Member States through training activities. Particularly important is training in establishing and developing the expertise required by effective SSACs. Whether focused internally on IAEA safeguards staff or externally on Member State personnel, training makes a valuable contribution to effectiveness and efficiency, to capacity building for the future, to succession planning and to effective knowledge management and enhancement.

8. Efficiency measures

The resources available for IAEA verification activities are finite and there are many demands made upon them. Thus, although much effort in recent years has focused on increasing the effectiveness of safeguards implementation, considerations of efficiency have also been pursued. The efficiency measures taken to date can be grouped into three 'clusters': (i) measures in connection with verification activities in the field; (ii) measures with regard to equipment and technology; and (iii) measures related to improved organization, management and procedures.

By way of example, measures have been taken to reduce inspection effort in nuclear facilities by introducing unattended monitoring systems with remote transmission capability where studies have demonstrated that it would be cost beneficial to do so. Of particular note is that, as expected, the implementation of integrated safeguards has resulted in savings of approximately 10% of in-field inspection effort in the relevant States. The extent of the savings differs from State to State because of different fuel cycle facilities and the integrated safeguards approaches used. In coming years, further savings are anticipated as a result of implementing integrated safeguards, especially in Canada, the European Union and Japan, which have traditionally accounted for a very large share of inspection effort. Savings to date have been used to cover other needs, such as additional activities in connection with State evaluation work at IAEA headquarters and in-field verification activities at new facilities coming under safeguards.

In the area of IT, new tools have been introduced for access to information and for reporting verification activities while, at the same time, reducing communication costs between nuclear facilities and IAEA headquarters. On the management side, the IAEA Department of Safeguards has moved to medium term planning, reflected in its Strategic Objectives, and, since the introduction of project management in 2000, has made progress in a number of areas involving defined projects and nominated project leaders, specific work programmes, measurable milestones and 'deliverables'. Cost–benefit analyses have been introduced to evaluate the effectiveness and efficiency of planned expenditures. Particularly important for the future will be the full implementation of a quality management system based on international standards. The quality management system for safeguards was initiated in a substantive way in 2004. It aims to improve further the effectiveness and efficiency of the IAEA's verification work by streamlining and continually improving work processes.

How much do safeguards cost and where do the resources come from?

1. Financial resources

There are multiple demands on the IAEA safeguards budget which, as explained, is roughly $120

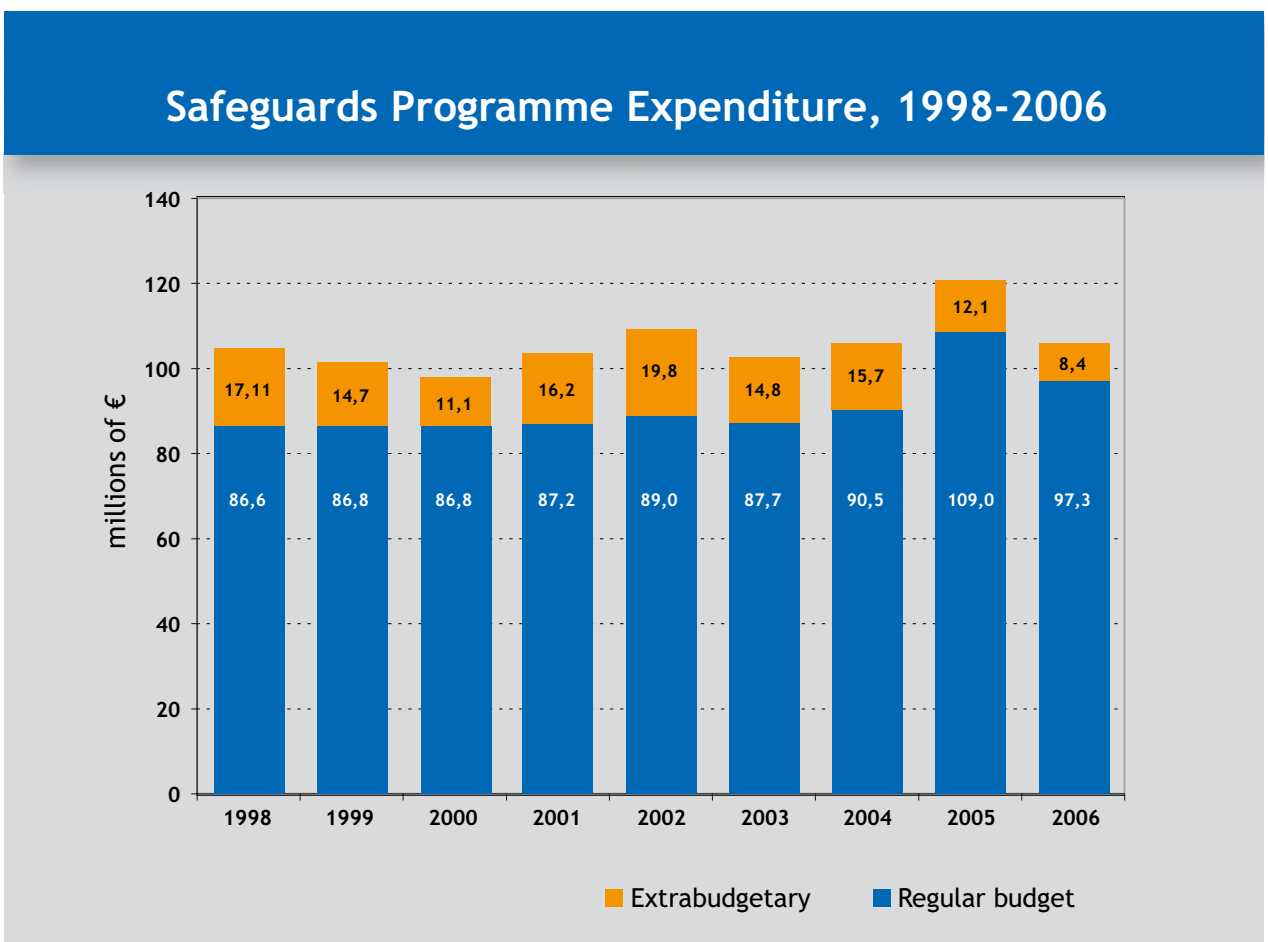
million a year. Safeguards expenditure includes projects that are directly related to verification, namely: inspection and complementary access, information processing, equipment management, sample logistics and analysis, effectiveness evaluation and State evaluation. It also includes the important projects that support verification activities, e.g. those related to the development of safeguards concepts and approaches, to process design, to the development of instrumentation and communications infrastructure.

Annual safeguards expenditure between 1998 (the year in which the IAEA began significant implementation activities related to additional protocols) and 2002 was roughly the same, and excessively reliant on extrabudgetary funds, i.e. funds provided by IAEA Member States outside the regular budget framework. As stated previously, in 2004 the regular budget was increased to address this situation. The chart below shows the reduction in the amount of extrabudgetary expenditure since 2004.

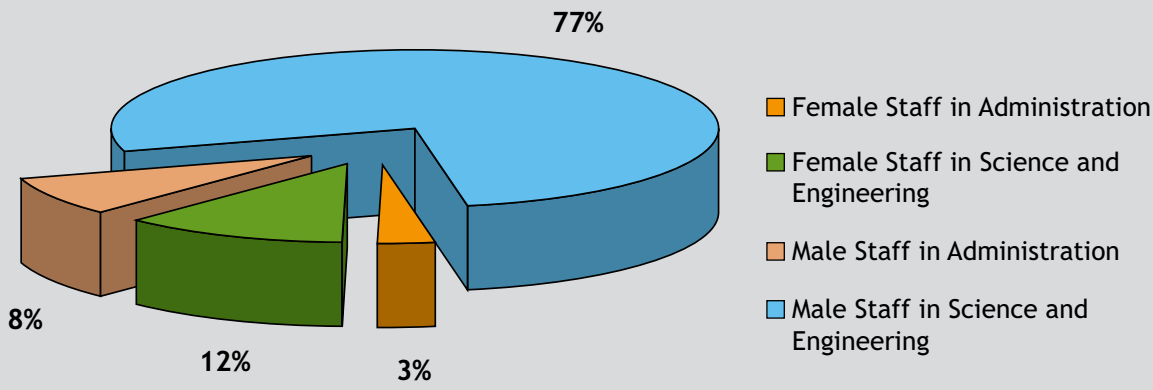
Staff of the IAEA Department of Safeguards

2. Human resources

The human resources necessary to fulfil the IAEA's statutory safeguards obligations include a wide variety of specialists, mainly nuclear engineers and nuclear physicists. Other scientific and technical groups comprise chemists, mathematicians, and information

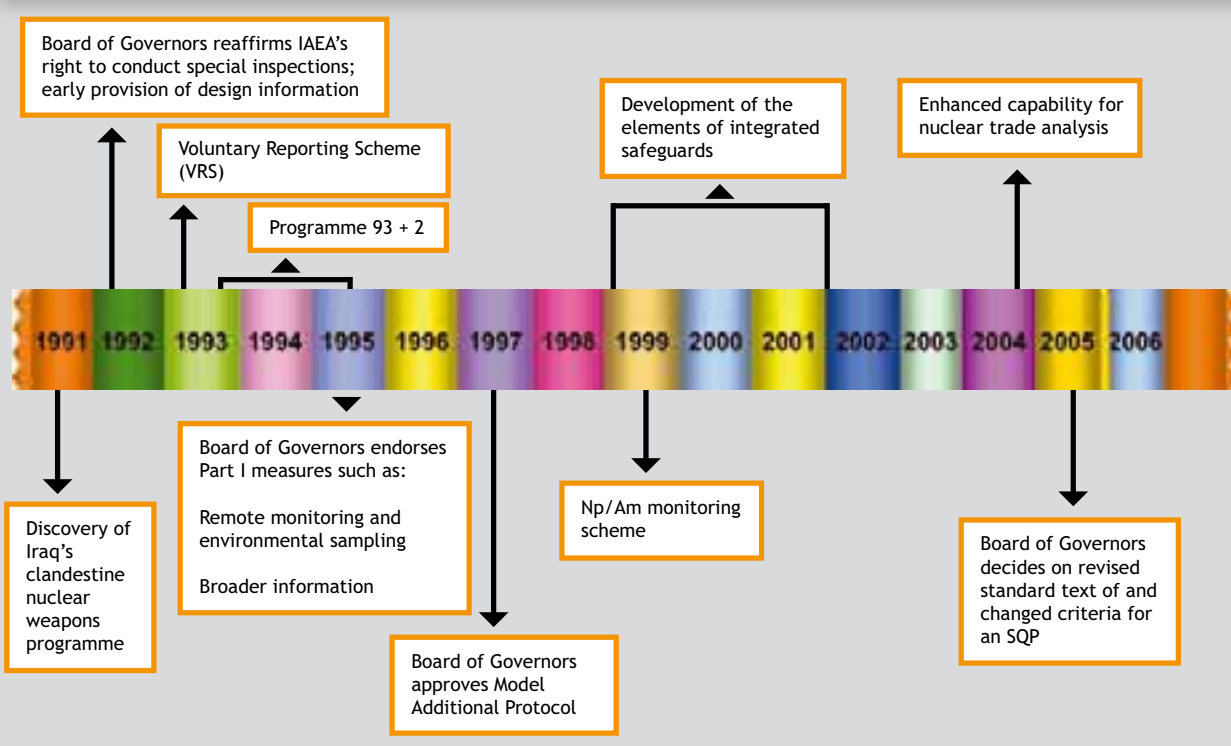


Professional Safeguards Staff
Professional staff by gender and job category



management and IT specialists. The Department of Safeguards has over 500 staff members and the number of full-time safeguards inspectors has increased by 18% over the last 10 years, from 209 in 1996 to 255 in March 2007. The accompanying diagram gives further details regarding safeguards staff.

Development of the Safeguards System Since 1991



Major achievements to date

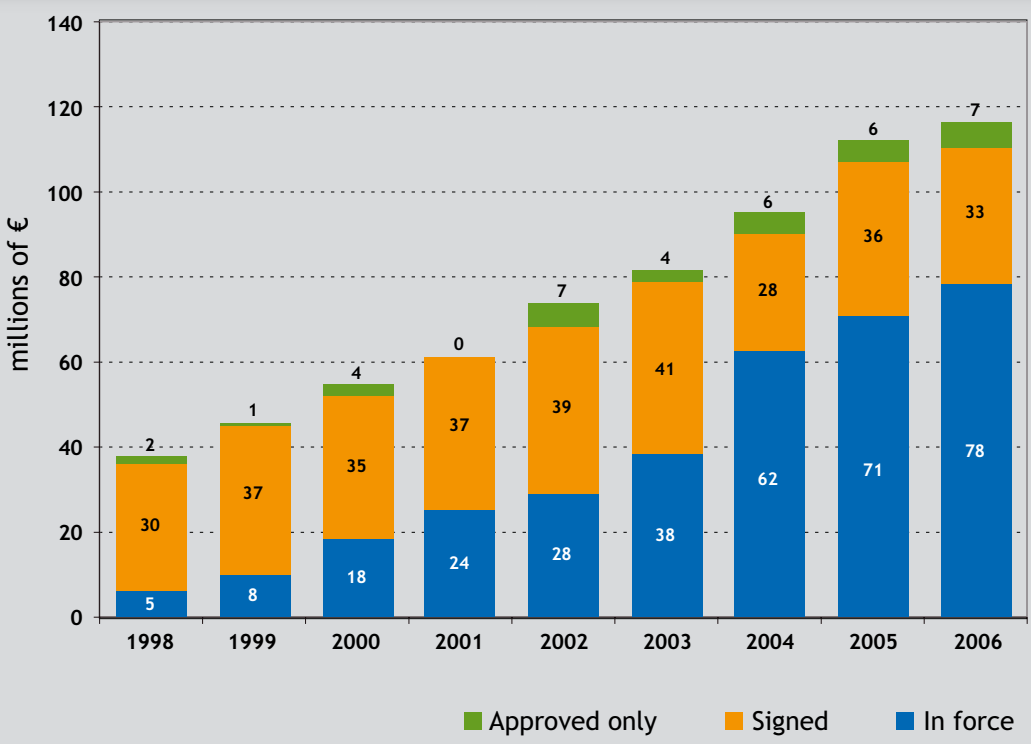
The evolution of safeguards since the approval of the IAEA Statute in 1956 has clearly needed to take account of and respond to changing political, legal and technical considerations. Particularly important landmarks in this evolution have been the development of comprehensive safeguards in the early 1970s (through the adoption of INFCIRC/153) to meet the safeguards requirements of the Treaty of Tlatelolco and the NPT; and the safeguards strengthening measures of the 1990s. In the latter context, the figure on p.30 summarizes the major milestones to date.

Current challenges

The additional protocol to safeguards agreements provides the IAEA with supplementary tools that are essential in enabling it to provide assurances regarding the absence of undeclared nuclear activities. However, the extent of IAEA authority remains uneven from country to country. Although safeguards agreements are now in force in the vast majority of States party to the NPT, and many States have brought additional protocols into force, a number of States have still not fulfilled their legal obligation to conclude CSAs; and over 100 States have yet to bring an additional protocol into force.

This variation in IAEA authority from country to country is the focus of the IAEA Secretariat's *Plan of Action to Promote the Conclusion of Safeguards Agreements and Additional Protocols,* through which States that have not yet done so are informed about, and encouraged to adhere to, the key legal instruments of the safeguards system. Regional and interregional outreach events are organized in Vienna and elsewhere to enable State representatives to be briefed about the policy, legal and technical aspects of safeguards, and to receive hands-on training in safeguards reporting.

Conclusion of Additional Protocols, 1998-2006 (cumulative)



Further enhancement of the IAEA's capability to analyse trade in nuclear fuel cycle related technology would also strengthen the information base on which the IAEA draws its safeguards conclusions. Although safeguards have traditionally focused on nuclear material, experience in recent years has shown that, in order to identify undeclared acquisition efforts, the IAEA needs more information on nuclear trade and procurement. In the future, as in the past, experience might point to the value of other types of supplementary information that further increase nuclear transparency.

The Department of safeguards conducts many training and development courses throughout the year. Here, new inspectors are being trained in the use of specialised equipment that they will use in the field.

Looking to the Future

The non-proliferation landscape has changed drastically in recent years and will likely continue to do so. One significant factor is ever increasing globalization. Other interrelated aspects which challenge the safeguards system are the uncovering, in recent years, of further, undeclared nuclear programmes and covert nuclear trade networks and the threats that nuclear proliferation and nuclear terrorism pose to international security. Further challenges are the unprecedented expansion in energy demand that the world faces over the next 50 or so years and the consequential, 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 use of nuclear technology — some of it highly sensitive. Consideration is therefore being given to possible arrangements to place sensitive nuclear operations under multinational control.

Managing change is not new to the IAEA, which has a great deal of accumulated experience in these areas. With the support of the international community, the IAEA will continue to address such challenges and to maintain and strengthen its role as an indispensable part of the multilateral nuclear non-proliferation regime and global security system.

Under the media glare, IAEA Director General Mohamed ElBaradei appears before the international press.

IAEA

Atoms for Peace: The First Half Century

1957–2007