IAEA Safeguards

Serving Nuclear Non-Proliferation

IAEA
International Atomic Energy Agency

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Foreword by the Director General of the IAEA Yukiya Amano

IAEA safeguards make a vital contribution to international peace and security. Through safeguards, the IAEA is able to provide credible assurances that States are honouring their international obligations to use nuclear material only for peaceful purposes. Its independent verification work allows the IAEA to play an indispensable role in deterring the spread of nuclear weapons. Through early detection of any diversion of nuclear material or misuse of technology, the IAEA can alert the world to potential proliferation. This serves to build international confidence in the non-proliferation regime.

The field of nuclear verification never stands still. The number of nuclear facilities coming under IAEA safeguards continues to grow steadily. So does the amount of nuclear material to be safeguarded. With new nuclear power reactors under construction and a steady growth in the use of nuclear science and technology in other peaceful applications, such as industry, medicine and agriculture, this trend looks set to continue.

In awarding the IAEA the Nobel Peace Prize in 2005, the Norwegian Nobel Committee said the IAEA's safeguards work was "*of incalculable importance*". For that to remain the case, safeguards must continue to evolve in line with emerging challenges. Over the past decade, safeguards have been strengthened in key areas. In the past five years alone, the number of States with additional protocols in force has risen by more than a quarter – to reach 125 States – which represents more than two-thirds of all States with safeguards agreements in force. The recent modernization of the IAEA safeguards analytical laboratories has significantly enhanced our independent verification capabilities.

With its in-field verification activities, the IAEA plays a unique role as the world's nuclear inspectorate.

However, funding for the IAEA has not kept pace with the growing demand for our services. So, in all areas of our work including safeguards, we must constantly find ways of increasing efficiencies without compromising effectiveness. The IAEA is committed to continuing to work closely with States to ensure the rigorous, transparent and non-discriminatory implementation of safeguards.

I trust that you will find this booklet helpful as an introduction to IAEA safeguards.

Introduction

Preventing the spread of nuclear weapons is a complex task. Seventy years 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 of States, multilateral treaties, other legally binding agreements in which States' non-proliferation commitments are embedded, and, critically, IAEA safeguards. The IAEA plays a crucial independent verification role, aimed at assuring the international community that nuclear material, facilities and other items subject to safeguards are used only for peaceful purposes.

The IAEA aims to assure the world that nuclear material, facilities and other items subject to safeguards are used only for peaceful purposes.

What are IAEA safeguards?

IAEA safeguards are a set of technical measures that allow the IAEA to independently verify a State's legal commitment not to divert nuclear material from peaceful nuclear activities to nuclear weapons or other nuclear explosive devices. Pursuant to the IAEA's Statute, which authorizes the IAEA to establish and administer safeguards, States accept the application of such measures through the conclusion of safeguards agreements with the IAEA (see box on page 9).

IAEA safeguards are embedded in legally binding agreements, providing the basis for the IAEA to implement effective verification.

The vast majority of safeguards agreements are those that have been concluded by the IAEA with non-nuclear-weapon States (NNWSs) party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) (see box on page 7). Under the NPT, these States have committed not to produce or otherwise

Key safeguards facts

- **182** States have safeguards agreements in force, 174 of them have comprehensive safeguards agreements, 5 States have voluntary offer agreements and 3 States have item-specific safeguards agreements
- **126** Additional Protocols are in force with 125 States and Euratom, and another 21 States have signed an Additional Protocol but have yet to bring it into force
- About **850** people from **95** different countries work in the Department of Safeguards
- More than **193,500** Significant Quantities* of nuclear material under safeguards
- Some **1,300** nuclear facilities and locations outside facilities (LOFs) under safeguards

during 2014

- More than **2,700** in-field inspections and design information verifications conducted worldwide, constituting about **13,000** calendar days in the field
- **78** complementary accesses conducted under additional protocols
- Almost **1,000,000** nuclear material accountancy entries in State reports received
- More than **23,000** seals applied and more than **2,600** attended and unattended monitoring and measuring systems in operation
- More than **900** nuclear material and environmental samples collected
- More than **400** satellite images analyzed
- Almost **3,000** safeguards statements and reports sent to States
- **131** million euros allocated regular budget (IAEA regular budget totals 341.6 million euros), and **31.8** million euros extra-budgetary contributions

** One Significant Quantity is the approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive device cannot be excluded.*

Treaty on Non-Proliferation of Nuclear Weapons (NPT)

The NPT is the centerpiece of global efforts to prevent the further spread of nuclear weapons and weapons technology, to foster the peaceful uses of nuclear energy, and to further the goal of nuclear disarmament. It entered into force in 1970. With some 190 Parties, it is the treaty most widely adhered to in the field of non-proliferation and disarmament.

While the IAEA is not a party to the Treaty, it is entrusted with key responsibilities. The IAEA has a specific verification role as the international safeguards inspectorate under Article III of the Treaty. The IAEA also serves as a multilateral channel for facilitating transfers of nuclear technology for peaceful applications to its Member States in accordance with its Statute.

The NPT represents a balance of rights and obligations for States, differentiating between **non-nuclear-weapon States (NNWSs)** and **nuclear-weapon States (NWSs)** – States that manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January 1967 (i.e. China, France, the Russian Federation, the United Kingdom and the United States of America).

Under the NPT, the NWSs committed, inter alia, not to transfer to any recipients nuclear weapons or other nuclear explosive devices and not in any way to assist, encourage, or induce any NNWSs to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices. Each NNWS is required to conclude a comprehensive safeguards agreement with the IAEA to enable the IAEA to verify the fulfilment of the State's obligation under the Treaty. Twelve NNWSs that are party to the NPT have yet to conclude a comprehensive safeguards agreement with the IAEA. Three States that are not party to the NPT have concluded item-specific agreements with the IAEA (see box on page 9).

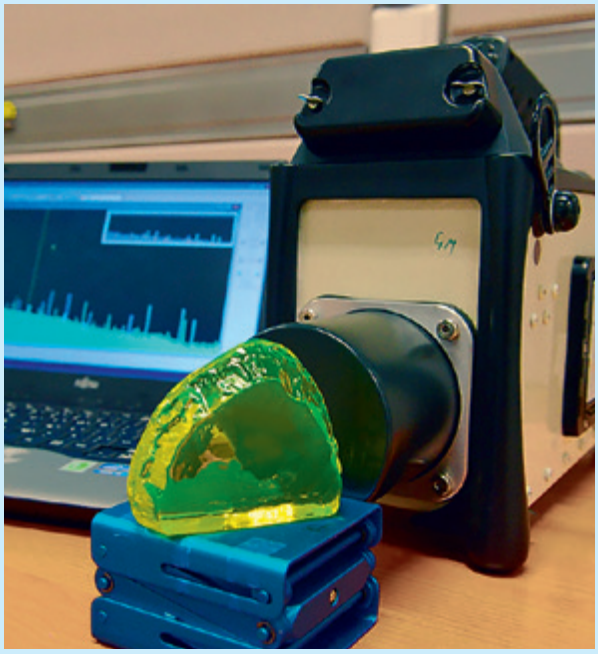
acquire nuclear weapons and to place all of their nuclear material and activities under IAEA safeguards and to allow the IAEA to verify their commitments.

Similar to the NPT, the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Treaty of Tlatelolco, 1967) requires its parties to conclude a comprehensive safeguards agreement (CSA) with the IAEA – as do the other regional nuclear-weapon-free zone treaties, including the South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga, 1985), the Southeast Asia Nuclear-Weapon-Free Zone Treaty (Treaty of Bangkok, 1995), the African Nuclear-Weapon-Free Zone Treaty (Treaty of Pelindaba, 1996) and the Central Asian Nuclear-Weapon-Free Zone Treaty (Treaty of Semipalatinsk, 2006).

In-field verification of a fibre-optic seal by checking its unique light pattern.

What nuclear material is subject to safeguards?

Nuclear material subject to safeguards includes special fissionable material from which nuclear weapons or other nuclear explosive devices could readily be made (e.g. plutonium-239; uranium-233; uranium enriched in the isotopes 235 or 233) and source material (e.g. natural uranium, depleted uranium or thorium), which cannot be directly used for nuclear weapons. All States are likely to have some nuclear material in their territory. For example, depleted uranium, in which the concentration of uranium-235 is lower than in natural uranium, is often used for non-nuclear purposes, such as shielding for radiation sources in hospitals, industry and agriculture. Radioactive sources that do not contain uranium, plutonium or thorium are not subject to safeguards and need not be reported to the IAEA under a safeguards agreement.



Mobile, high-resolution gamma detector for accurate measurement of the types and isotopic composition of nuclear material.

Why do IAEA safeguards matter?

Nuclear energy has the potential to contribute to health and prosperity throughout the world. However, it may also be used for the development of nuclear weapons. The implementation of IAEA safeguards, therefore, serves as an important confidence building measure, through which a State can demonstrate – and other States can be assured – that nuclear material is being used only for peaceful purposes. The IAEA and its safeguards were established nearly 60 years ago to help to reconcile the dual nature of the atom, so that nuclear energy could be placed only in the service of peace and the development of humankind while protecting against its misuse. There would be far less nuclear cooperation and transfer of nuclear technology if safeguards did not exist.

Practically all countries around the world use nuclear applications 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 nuclear weapons or other nuclear explosive devices (see box on page 8).

Safeguards help to reconcile the dual nature of the atom.

How have IAEA safeguards evolved?

IAEA safeguards have evolved over the past 60 years as a result of technological change, practical experience and the need of strengthening their effectiveness and improving their efficiency (for an overview of some key developments, see figure 1 on page 13). The events that have had the most profound impact on IAEA safeguards can be said to be: the introduction of comprehensive safeguards pursuant to the NPT and the Treaty of Tlatelolco in the early 1970s; the discovery of a clandestine nuclear weapons development effort in Iraq in 1991 (part of which had been concealed by Iraq within its declared nuclear programme); and the IAEA's experience in relation to the Democratic People's Republic of Korea (DPRK,

Three types of safeguards agreements, two protocols

- **Comprehensive safeguards agreements (CSAs):** all NNWSs party to the NPT, as well as States party to the regional nuclear-weapon-free zone treaties (NWFZ Treaties), are required to conclude CSAs with the IAEA. Such agreements are concluded on the basis of INFCIRC/153 (Corrected)). A State undertakes to accept IAEA safeguards on all nuclear material in all peaceful nuclear activities within its territory, under its jurisdiction or carried out under its control anywhere. Under these agreements, the IAEA has the right and obligation to ensure that safeguards are applied on all such nuclear material for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices.

- **Small quantities protocols (SQPs)**: as a means to minimize the burden of safeguards activities in CSA States with little or no nuclear activities, an SQP was introduced by the IAEA in the early 1970s. In 2005, the IAEA Board of Governors, as a safeguards strengthening measure, approved a modified text of the SQP.

- **Item-specific safeguards agreements**: agreements of this type cover only nuclear material, facilities and other items specified in the safeguards agreements. They are based on the safeguards procedures established in INFCIRC/66/Rev.2 and its earlier versions. States parties to such agreements undertake not to use nuclear material, facilities or other items subject to the agreement for the manufacture of any nuclear weapon or to further any military purpose. The IAEA implements safeguards pursuant to such agreements in three States that are not party to the NPT.

- **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 are notified to the IAEA by the State concerned and offered for the application of safeguards. The IAEA applies safeguards under VOAs to nuclear material in selected facilities.

- **Additional protocols (APs)**: these are designed for States having any type of safeguards agreement with the IAEA. States with CSAs which decide to conclude additional protocols must accept 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 (Corrected)), which was approved by the Board of Governors in 1997. States with item-specific or voluntary offer agreements may accept and implement those measures of the Model Additional Protocol that they choose.

see box on page 12). In particular the Iraq experience highlighted the shortcomings of the implementation of safeguards for States with CSAs – being primarily focused on declared nuclear material – and provided the catalyst for strengthening IAEA safeguards.

The discovery of clandestine nuclear weapons activities in Iraq in the early 1990s triggered an evolution to strengthen IAEA safeguards.

Formative years

The IAEA concluded its first safeguards agreement in 1959 with Canada, but it was not until 1961 that the Board of Governors of the IAEA approved a first safeguards document containing the principles and procedures for the application of safeguards (INFCIRC/26).

Throughout the 1960s, more and more countries began to request the IAEA to apply safeguards to nuclear material and facilities which they received under bilateral nuclear cooperation agreements. Those countries concluded with the IAEA item-specific

Next Generation Surveillance System (NGSS) Cameras installed at the Department of Safeguards' laboratories for testing prior to installation in nuclear facilities.

safeguards agreements (based on INFCIRC/26 and its subsequent revisions), also known as INFCIRC/66-type agreements, under which the IAEA applies safeguards to items subject to the agreements to verify that such items are used only for peaceful purposes.

It was not until 1971, following the entry into force of the NPT and the Treaty of Tlatelolco, that the IAEA started to conclude CSAs with States party to those treaties. Those agreements were concluded on the basis of another safeguards document (INFCIRC/153 (Corrected)) that laid the basis for negotiating CSAs and which was approved by the IAEA Board of Governors in 1971.

Changing expectations

The IAEA's experience in the Iraq and the DPRK demonstrated that, although IAEA safeguards had worked well with regard to verification activities on declared nuclear material and facilities, the IAEA was not well-equipped to detect undeclared nuclear material and activities in States with CSAs. This set the stage and provided the catalyst for far-reaching efforts to strengthen the safeguards system.

At the end of 1993, the IAEA embarked on a broad programme ('Programme 93+2') to further strengthen safeguards implementation under CSAs by enhancing the IAEA's ability to consider a State as a whole. As part of 'Programme 93+2', measures designed to improve the IAEA's ability to detect undeclared nuclear material and activities in States with CSAs were presented to the IAEA Board of Governors. Some of these measures – such as the early provision of design information, environmental sampling and the use of satellite imagery – could be implemented under the existing legal authority provided for in CSAs ('Part 1 measures'), while others – such as access to other buildings on the site of a facility, additional declarations from the State regarding nuclear-related research and development – required complementary legal authority in order to be implemented ('Part 2 measures'). In 1997, the IAEA Board of Governors approved the Model Additional Protocol designed to provide for additional measures to strengthen the IAEA's ability to detect undeclared nuclear activities in a State.

Additional Protocol

The Additional Protocol is very important for the effectiveness and efficiency of safeguards. An AP is not a free-standing legal instrument. It can only be

Strengthening measures under the Additional Protocol

APs concluded with CSA States equip the IAEA with important additional verification measures that provide for **broader access to information** about the State's nuclear programme, **increased physical access** by the IAEA and **improved administrative arrangements**.

These **additional measures** include: (i) State provision of information about, and IAEA access to, all parts of a State's nuclear fuel cycle, from uranium mines to nuclear waste and other locations where nuclear material intended for non-nuclear uses is present; (ii) State provision of information on, and IAEA short-notice access to, all buildings on a site; (iii) State provision of information about, and IAEA access to, a State's nuclear fuel cycle research and development activities not involving nuclear material; (iv) State provision of information on the manufacture and export of sensitive nuclear-related equipment and material, and IAEA access to manufacturing and import locations in the State; (v) IAEA collection of environmental samples beyond declared locations, when deemed necessary by the IAEA; and (vi) a simplified procedure for designation of IAEA inspectors, the issuance of multiple entry/exit visas and IAEA use of internationally established systems of communications.

Under an AP, the IAEA may carry out **complementary access** to assure the absence of undeclared nuclear material and activities, to resolve a question or an inconsistency relating to correctness and completeness of the information provided by a State, and to confirm the decommissioned status of a facility or LOFs, such as in hospitals, where nuclear material was customarily used.

concluded to a safeguards agreement. The additional measures provided for in an AP include provision of information about, and inspector access to, all aspects of a State's nuclear fuel cycle – from uranium mines to nuclear waste and improved administrative arrangements (see box on page 11) – thus, 'filling the gaps' in the information reported under CSAs. By enabling the IAEA to obtain a much fuller picture of a CSA State's nuclear programme, plans, nuclear material holdings and trade, an AP helps to provide much greater assurance on the absence of undeclared nuclear material and activities in the State.

Today, 126 States have an AP in force, or approximately two-thirds of all States with safeguards agreements in force. Another 20 States have signed an AP but have not yet brought it into force.

The Additional Protocol provides the IAEA with important supplementary tools which significantly increase the IAEA's ability to verify the peaceful use of all nuclear material in a State with a comprehensive safeguards agreement.

Consideration of the State as a whole

The IAEA started to consider a 'State as a whole' in the implementation of safeguards for States with CSAs in the early 1990s. It started to better integrate and assess all of the information available to it about a State's nuclear activities and plans, and produced its first State evaluation report in 1995. The Additional Protocol in particular provided the IAEA with increased information about the State's nuclear and nuclear-related activities and capabilities, and added to the IAEA's ability to consider the State as a whole. In 1999 the IAEA drew its first so-called 'Broader Conclusion' for a State as a whole, namely that 'all nuclear material remained in peaceful activities'.

In 2001, the IAEA started developing and implementing State level safeguards approaches (SLAs) for States for which the IAEA had drawn a 'Broader Conclusion'. An SLA is a customized approach to implementing safeguards for an individual State. For such States, the IAEA began to implement 'integrated safeguards', integrating in an optimal way the safeguards measures available to the IAEA under a State's CSA and AP. In 2014, integrated safeguards were implemented for 53 States.

Current safeguards challenges

In the early 1990s, the IAEA identified inconsistencies between nuclear activities declared by the **DPRK** under its NPT Safeguards Agreement and information available to the IAEA through inspections and other sources. When bilateral efforts to resolve the identified inconsistencies failed, the IAEA Board of Governors decided that access to additional information and locations in the DPRK was essential and urgent in order to resolve these inconsistencies. Since 1994, the IAEA has not been able to conduct all necessary safeguards activities provided for in the DPRK's CSA. Since April 2009, when IAEA inspectors were requested by North Korean authorities to leave the DPRK, the IAEA has not implemented any measures under the ad hoc monitoring and verification arrangement agreed between the IAEA and the DPRK and foreseen in the Initial Actions agreed at the 'Six-Party Talks' between China, DPRK, Japan, the Republic of Korea, the Russian Federation and the United States of America. The DPRK case demonstrated the need for providing IAEA inspectors with access to locations in a State in order to verify the correctness and completeness of a State's declarations.

IAEA Director General Yukiya Amano and Dr. Ali Akbar Salehi, Vice President and Chairman of the Atomic Energy Organization of Iran, speak to the press in Tehran during a visit to Iran in August 2014.

In 2002, 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. At time of writing, while the IAEA continues to verify the non-diversion of declared nuclear material at the nuclear facilities and LOFs declared by Iran under its Safeguards Agreement, the IAEA is not in a position to provide credible assurance about the absence of undeclared nuclear material and activities in Iran, and therefore to conclude that all nuclear material in Iran is in peaceful activities. In November 2013, the IAEA and Iran agreed on a Framework for Cooperation, within which verification activities are being implemented by the IAEA to resolve all present and past issues. Also in November 2013, China, France, Germany, the Russian Federation, the United Kingdom and the United States and Iran agreed on a Joint Plan of Action (JPA). While not a party to the JPA, the IAEA is undertaking the necessary nuclear-related monitoring and verification activities in relation to the JPA, involving activities additional to those already being carried out pursuant to Iran's CSA and relevant provisions of United Nations Security Council resolutions.

In 2008, the Director General informed the Board of Governors that the IAEA had been provided with information alleging that an installation in the **Syrian Arab Republic** (Syria), destroyed by Israel in 2007, had been a nuclear reactor that was not yet operational. Syria has maintained that the destroyed building was a non-nuclear military installation. In 2011, the IAEA assessed that it was very likely that the destroyed building was a nuclear reactor which should have been declared to the IAEA.

Over recent years, the IAEA Secretariat has further developed the consideration of a State as a whole in the implementation of safeguards in the context of the State-level concept (SLC). This refers to the general notion of implementing safeguards in a manner

In view of the changing world, evolving safeguards implementation is essential to strengthen the effectiveness and improve the efficiency of IAEA safeguards.

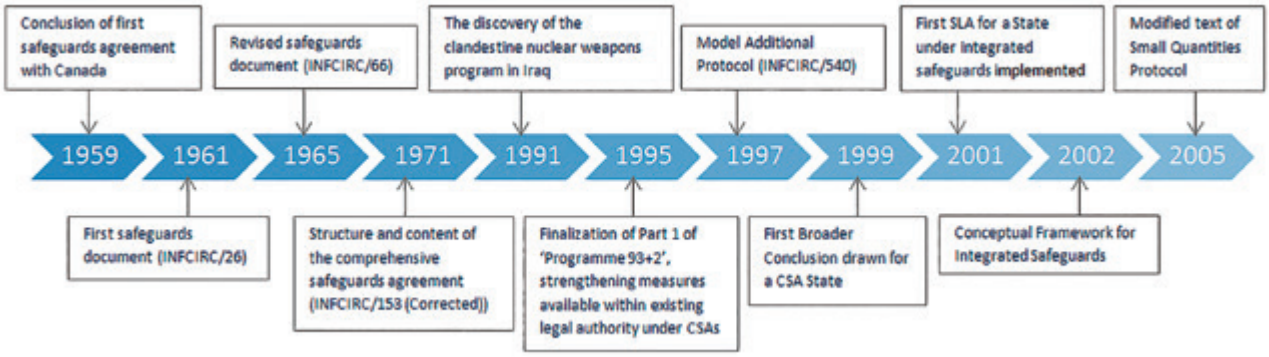


Figure 1. Some key developments in IAEA safeguards.

that considers a State's nuclear and nuclear-related activities and capabilities as a whole, within the scope of the State's safeguards agreement. The IAEA Secretariat is in the process of updating the current SLAs and plans for the progressive development of SLAs for other States in the future.

How are IAEA safeguards applied in practice?

The implementation of IAEA safeguards comprises four fundamental processes, namely (i) the collection and evaluation of information, (ii) the development of a safeguards approach for a State, (iii) the planning, conduct and evaluation of safeguards activities, including in-the-field and at Headquarters, and (iv) the drawing of safeguards conclusions. These processes are illustrated in figure 2. Throughout these processes, the IAEA performs a variety of safeguards activities, from the measurement of nuclear material items in facilities to the analysis of safeguards relevant information at Headquarters.

Safeguards processes

Collecting and evaluating information

The IAEA collects and processes safeguards relevant information about a State from three sources: information provided by the State itself (e.g. reports and declarations); safeguards activities conducted by the IAEA in the field and at Headquarters (e.g. in-field verification, evaluation of nuclear material accounting information); and other relevant information (e.g. from open sources and third parties). The IAEA conducts ongoing reviews of such information to assess internal consistency of State-declared information, and its consistency with the information generated and collected by the IAEA. Any anomalies, questions or inconsistencies are identified and addressed in a timely manner through consultations with the State and further action taken, as necessary.

Information provided by a State regarding its nuclear material and activities represents the great majority of information used by the IAEA for safeguards implementation. For States with CSAs and APs in force, information is provided to the IAEA in the form of nuclear material accounting reports,

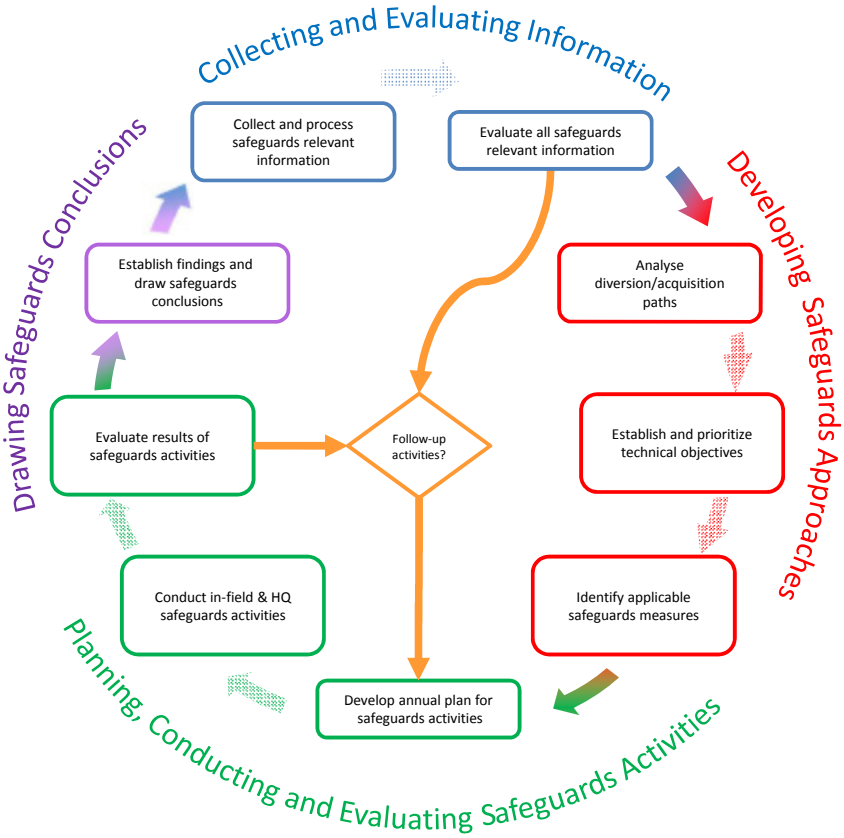


Figure 2. Main steps in safeguards implemetation processes.

Cooperation with State and regional authorities responsible for safeguards implementation (SRAs)

In accordance with safeguards agreements, the IAEA and States are obliged to cooperate in the implementation of safeguards. The IAEA places great value on effective cooperation with States and devotes substantial resources to assist States in developing the relevant capabilities. Guidance documents, training offerings and reference materials are available at www.iaea.org/safeguards.

Each State with a CSA is required to establish and maintain a State system of accounting for control of nuclear material (SSAC). Some States have entered into a regional system of accounting for control of nuclear material (RSAC). An SSAC as a system is comprised of all of the elements necessary for a State to control and report its nuclear material inventory, including laws and regulations, nuclear material accounting systems at facilities, records, reports, information. The SRA is the authority established at the national (or regional) level to ensure and facilitate the implementation of safeguards. In addition to its safeguards functions, a State authority may have additional responsibilities associated with nuclear safety, security, radiation protection and export/import controls.

In practice, the SRA is also the 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 SRA and the IAEA). Communication between the SRA and the IAEA is an important component of effective cooperation.

advance notifications of transfers of nuclear material and facility design information, and information about the State's nuclear and nuclear-related activities.

One of the questions that the evaluation of safeguards activities seeks to answer is whether a State's declarations about its nuclear programme and plans are consistent with other safeguards relevant information available to the IAEA. Such information includes information from open sources (e.g. public government and operator publications, scientific and technical literature, etc.) as well as third party information (i.e. parties other than the State itself). The latter, which constitutes a very small part of information available to the IAEA, is made available to the IAEA by a State or an organization on a voluntary basis. This information, once validated, is thoroughly analyzed by the IAEA and corroborated with other safeguards relevant information available to it. During this process the IAEA engages with States and takes follow up actions to address the correctness and completeness of their declarations.

One example of a valuable open source of information is commercially available satellite imagery. Satellite imagery is used routinely to evaluate information provided by States on their nuclear activities and to plan inspections, visits to facilities to verify design information and to conduct complementary access under the AP.

The evaluation of all safeguards relevant information is important to obtain a comprehensive view of a State's nuclear and nuclear-related activities and capabilities as a whole.

IAEA staff analysing satellite imagery.

Developing Safeguards Approaches

The IAEA develops SLAs for States using a structured, technical method used to analyse the plausible paths by which nuclear material suitable for use in a nuclear weapon or other nuclear explosive device could be acquired. On this basis, technical objectives associated with the steps along a path are established and guide the planning, conduct and evaluation of safeguards activities for that State. To address the technical objectives, specific safeguards measures are identified in accordance within a State's safeguards agreement.

Planning, Conducting and evaluating safeguards activities

Based on an SLA, the IAEA prepares an annual implementation plan which specifies the safeguards activities, both in the field and at Headquarters in Vienna, which the IAEA plans to conduct in a given year for the State. Once an activity has been conducted, the IAEA evaluates the extent to which that activity has attained the technical objective(s) and identifies any questions, inconsistencies and anomalies necessitating further follow-up activities, which may then be incorporated into an updated plan.

Soundly based conclusions depend on the independent, impartial and rigorous technical implementation of safeguards.

In-field safeguards activities are complemented by activities at Headquarters. These include the processing, review and validation of information from States, resulting from in-field safeguards activities and generated from the equipment installed at nuclear facilities, and from open and other sources. Headquarters activities generate safeguards relevant information as a result of the review of data remotely transmitted from safeguards equipment and cameras installed at nuclear facilities around the world, verification of seals, evaluation of analytical results from safeguards samples collected in the field and material balance evaluation. Great effort is undertaken to ensure the consistency of the evaluation of all of the safeguards relevant information.

In the conduct of its safeguards activities in the field and at Headquarters, the IAEA utilizes instrumentation, technical measures and techniques to verify information provided by States. New and improved technologies continue to provide an important basis for more effective and efficient safeguards implementation.

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 large equipment inventory (more than 45,000 items), the long list of equipment authorized for inspection use (almost 140 types). For example, unattended monitoring systems may work with a remote transmission capability and are increasingly being used in nuclear facilities to reduce in-field inspection activities. These systems have the ability to transmit authenticated real time verification data from the field in a cost effective manner.

3D laser scanning allows for detection of design changes within a nuclear facility.

In-field safeguards activities

IAEA inspectors perform a variety of verification activities in the field.

Nuclear material accountancy is analogous to an audit of a bank: the inspector compares what is on the nuclear material accounting records, books and reports of a facility with what has been reported by the State to the IAEA and, crucially, that the nuclear material is actually present at the facility as declared.

During the **design information verification**, inspectors compare the design information that the State has submitted to the IAEA with in-field observations to confirm that the information provided by the state is correct and complete, and the facility has not been misused.

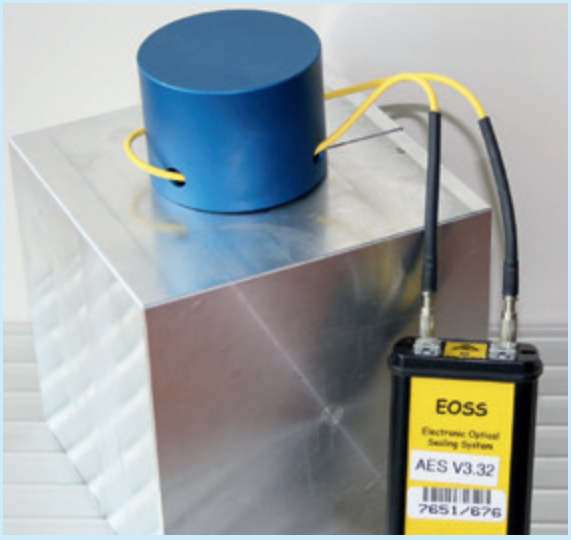
Nuclear inspector verifying design information in a facility.

In-field verification of an electronic seal.

Environmental samples may be taken for analysis in order to verify that the facility is used as declared. These samples allow an analysis of traces of materials that can reveal information about nuclear material or activities (e.g. separated plutonium or highly enriched uranium at a facility) that have not been declared to the IAEA.

Inspectors verify the inventory of nuclear material using a range of **measurement techniques**. These techniques include item counting, weighing, non-destructive assay with radiation detectors and sample taking for detailed, destructive analysis at IAEA laboratories. **Non-destructive assay** can be used to determine the presence of nuclear material in an item, or the amount of nuclear material in an item without physically changing the item. **Destructive analysis** produces a very accurate determination of the concentration of nuclear material in a small sample of material taken from a facility. The sample material is destroyed in the measurement process.

Containment and surveillance techniques, such as 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. In addition, almost 300 **unattended systems**, some of them with remote transmission of data to Headquarters, further support effective and efficient continuity of knowledge.

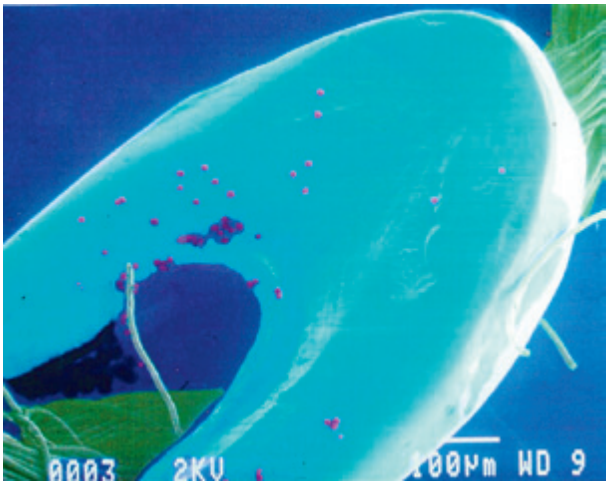


Electronic optical seal.

Data transmitted to IAEA headquarters from remote surveillance monitoring systems at nuclear facilities.

A very powerful verification technique used by the IAEA is environmental sampling. Environmental sampling is effective in detecting undeclared nuclear material and activities. It involves collecting swipe samples in order to analyze them for traces of materials that can reveal information about nuclear material handled or activities conducted.

The nuclear material and environmental samples taken by IAEA inspectors during in-field verification activities are analyzed in the IAEA Safeguards Analytical Laboratory (SAL) in Seibersdorf, Austria. SAL provides the IAEA with a set of independent verification capabilities in areas such as the analysis of uranium and plutonium. The work of the laboratory is critical for the evaluation of safeguards verification activities. It is responsible for processing, screening, distributing, analyzing and archiving samples. The analytical capabilities of SAL are further augmented by the IAEA's Network of Analytical Laboratories (NWAL) which comprises SAL and 20 qualified laboratories in nine IAEA Member States and the European Commission.



Example of environmental sample analysis: isolation and measurement of micron-sized particles of nuclear materials to determine their isotopic composition.

Equipment, techniques and technologies are critical components of IAEA safeguards.

Drawing safeguards conclusions

The products of IAEA safeguards implementation activities are annual safeguards conclusions drawn and reported by the IAEA's Secretariat each year to the Board of Governors in the Safeguards Implementation Report (SIR). In order to draw a safeguards conclusion for each State with a safeguards agreement in force, the IAEA needs to have conducted a sufficient level of safeguards activities and performed a comprehensive evaluation of all safeguards relevant information available to it about a State. It also needs to have

Type of safeguards conclusions per legal agreement

For States with a CSA and an Additional Protocol in force, if the IAEA's Secretariat has completed all evaluations and found no indication of the diversion of declared nuclear material from peaceful activities and no indication of undeclared nuclear material or activities for the State as a whole, the Secretariat concludes that all nuclear material remained in peaceful nuclear activities.

For States with a CSA but without an Additional Protocol in force, if the IAEA's Secretariat found no indication of the diversion of declared nuclear material from peaceful activities the Secretariat concludes that declared nuclear material remained in peaceful nuclear activities.

Under item specific safeguards agreements, if the IAEA's Secretariat found no indication of the diversion of nuclear material or of misuse of the facilities or other items to which safeguards had been applied, the Secretariat concludes that nuclear material facilities and other items to which safeguards had been applied remained in peaceful activities.

For States with voluntary offer safeguards agreements, if the IAEA's Secretariat found no indication of the diversion of nuclear material to which safeguards had been applied, the Secretariat concludes that nuclear material to which safeguards had been applied in selected facilities was not withdrawn from safeguards, except as provided for in the agreements, and remained in peaceful activities.

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

addressed anomalies, questions or inconsistencies identified in the course of its safeguards activities, and assessed whether there are any indications that, in its judgement, would constitute a safeguards concern. The type of conclusion varies according to the type of safeguards agreement in force (see box on page 18).

What are the current trends in IAEA safeguards?

The global nuclear landscape is changing rapidly and will likely continue to do so. Every day – across the world – more nuclear facilities and material come under IAEA safeguards. Nuclear power is expanding – in countries already using it, as well as in States introducing it. Over the past five years alone, the number of nuclear facilities under safeguards has risen by 12 per cent and the quantity of nuclear material under safeguards by some 14 per cent. Facilities undergoing decommissioning may also involve a large safeguards effort to verify nuclear material packaging, movement and disposition. In addition, the number of safeguards agreements and additional protocols entering into force is increasing. These global trends look set to continue.

Demands on IAEA safeguards are rapidly growing and becoming more complex.

International nuclear cooperation between States is intensifying with an expansion of trade and services in nuclear related equipment, items and materials. Technologies are also changing. Many older nuclear plants are being modernized and new facilities are becoming more technologically sophisticated. The geographical focus of these expanding programs also continues to change. These trends are not only a macro-level phenomenon; they are an everyday reality for the IAEA. In short, demands on IAEA safeguards are growing and becoming more complex.

For the foreseeable future, the IAEA's regular budget is not likely to grow to meet these increasing demands. Indeed, it has been nearly static for some time already. The IAEA depends on the financial contributions of its Member States, many of which

Optimizing safeguards

IAEA safeguards comprise a fundamental component of nuclear non-proliferation. They promote greater confidence among the international community by providing assurance that States are complying with their obligations under relevant safeguards agreements. IAEA safeguards also contribute to strengthening collective security and help to create an environment conducive to nuclear cooperation.

Even though the nuclear world constantly changes, the IAEA's obligations and those of States under their existing safeguards agreements remain unchanged. In this context, it is essential that the Department of Safeguards improve its productivity by striving for greater efficiency without compromising the credibility and quality of its safeguards conclusions. There are three main ways in which this can be done: firstly, doing things more smartly and efficiently in-house and in the field can bring improvements in effectiveness as well as cost savings; secondly, by making better use of modern technology to identify ways of implementing safeguards most cost-effectively; and thirdly, by Member States themselves improving their performance in safeguards implementation.

Tero Varjoranta, Deputy Director General and Head of the Safeguards Department

"My vision is one where States and industry see us as value added – important partners, not adversaries – and issues of safeguards concern continue to be properly addressed."

In seeking to optimise safeguards implementation for a State, the relationship between the IAEA and the national or regional authority responsible for safeguards implementation can be a critical factor. Building cooperative and trusting relationships often brings tangible mutual benefits: for example, it may result in lower in-field inspection effort. We are making a conscious effort at the IAEA to foster more cooperative partnerships with national and regional authorities. Real progress is being made, but there is further to go.

Central to our efforts for optimization is the further evolution – not revolution – of safeguards implementation, particularly in those States with the Broader Conclusion.

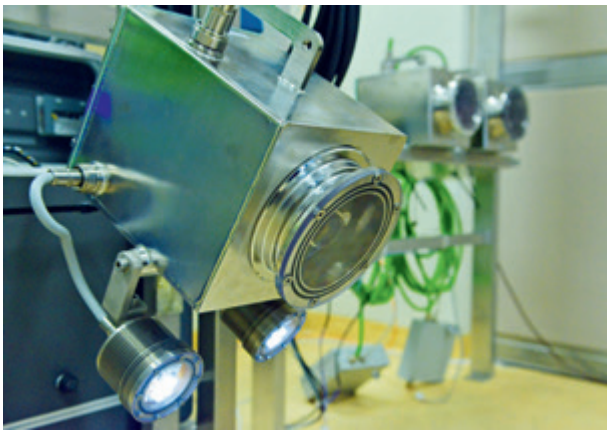
This evolution takes place in a structured, objective and coordinated manner, consistent with well-established principles.

My vision for safeguards in the future is one in which States and nuclear industry see us as value added – important partners, rather than adversaries; in which we continue to draw independent and soundly-based safeguards conclusions and issues of safeguards concern continue to be properly addressed.

are under pressure to reduce public expenditures.

At the same time, the IAEA's and States' obligations under safeguards agreements remain the same. Their implementation cannot be relaxed – whether to save money or for any other reason.

As long as the nuclear world continues to change, IAEA safeguards will need to adapt and change with it. Managing change is not new to the IAEA. Without further improvements and optimization, it will be increasingly difficult to guarantee an effective, reliable



Under water surveillance cameras installed at IAEA laboratories for testing prior to installation in nuclear ponds.

and credible safeguards system. In this context, it is essential that the IAEA continue to improve its productivity by striving for greater efficiency without compromising the effectiveness of our work and our ability to continue drawing soundly-based conclusions.

The cooperation between the IAEA and States remains critical for the implementation of safeguards.

With the support of its Member States, the IAEA will continue to live up to the expectation of the international community by verifying the peaceful use of nuclear energy thereby contributing to the non-proliferation of nuclear weapons.

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