NNSA
National Nuclear Security Administration

OFFICE OF
NONPROLIFERATION AND
ARMS CONTROL (NPAC)

Introduction to International Safeguards

The Safeguards System of the International Atomic Energy Agency

The purpose of this booklet is to provide background information on how and why International Atomic Energy Agency (IAEA) safeguards play a central role in international efforts to prevent the spread of nuclear weapons.

Contents

Under Article III of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), each non-nuclear weapon State (NNWS) is required to conclude a safeguards agreement with the International Atomic Energy Agency (IAEA).[1] The IAEA, which was established in 1957, is an independent multilateral organization headquartered in Vienna, Austria. While the fundamental objective of the IAEA, as set out in its Statute, is to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world," it is also authorized to establish and administer safeguards. More than 180 countries have entered into safeguards agreements with the IAEA.

[1] *The NPT, which entered into force in 1970, defines nuclear-weapon States as those that "manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January 1967": the United States (1945); the Soviet Union, now Russia (1949); the United Kingdom (1952); France (1960); and China (1964). All other parties to the NPT are non-nuclear weapon States.*

IAEA safeguards provide assurance to the international community that nuclear material and facilities are not being used for the illicit manufacture of nuclear weapons.

With its collective technical experience and its legal authorities to access nuclear facilities around the world, the IAEA is uniquely positioned to verify that nuclear materials remain in peaceful uses and to provide such assurances to the international community. In a related manner, the IAEA Board of Governors is authorized to report non-compliance with a safeguards agreement—a judgment that alerts the international community to a possible undeclared nuclear weapons program—to the United Nations (UN) Security Council. Altogether, the IAEA's legal authorities are derived from the NPT, the IAEA Statute, and safeguards agreements.

What are International Safeguards?

International safeguards are the set of technical measures applied by the IAEA to independently and objectively verify that a State's nuclear material is accounted for and not diverted to nuclear weapons or other nuclear explosive devices. These technical measures include, for example, on-site inspections, nuclear material accountancy, physical measurements, facility design information verification, surveillance, environmental sampling, and the application of tamper-indicating seals.

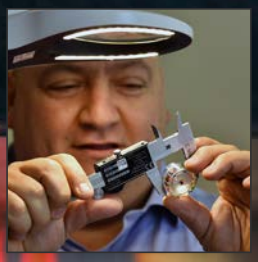
What are the Benefits of International Safeguards?

The peaceful uses of nuclear technology are so diverse that nearly every country in the world has some nuclear material or makes use of nuclear-derived technologies in some way, every day. They include such applications as electricity generation, seawater desalination, mapping of underground aquifers, improving crop varieties and yields, treatment of communicable and non-communicable diseases, treatment for cancer, and the control and eradication of disease-bearing insects. However, the nuclear material employed for some of these applications—and the facilities used to produce and process those materials—also can be used for the production of nuclear weapons.

By joining the NPT and bringing into force a safeguards agreement with the IAEA, a State may access a number of technical opportunities and partnerships designed to facilitate peaceful nuclear technology and applications.

The application of IAEA safeguards promotes international confidence that States are using nuclear materials and technology exclusively for peaceful purposes. Safeguards also deter and provide early warning of incipient nuclear weapon programs, and establish a basis for States to make judgments regarding compliance with the NPT. The system of international safeguards also contributes to the conditions that are necessary for and conducive to nuclear disarmament progress that is called for in Article VI of the NPT. Furthermore, international safeguards enable nuclear commerce and the spread of nuclear technology by demonstrating to exporters that their materials and technologies will not be misused.

For over 60 years, the confidence provided by the international safeguards system has allowed nuclear cooperation and commerce to thrive, thereby helping to address global energy, environment, and human health challenges.



The Impact of the NPT by the Numbers

- Fewer than **10 countries** have nuclear weapons
- At least **15** other countries seriously considered developing nuclear weapons but opted not to
- **3 countries** that "inherited" nuclear weapons chose to relinquish them
- **1 country** gave up its nuclear weapons

Historical Overview

In his "Atoms for Peace" speech, delivered in December 1953, U.S. President Eisenhower proposed to the United Nations General Assembly the establishment of an international atomic energy agency, in part to facilitate the application of nuclear material and technology "to serve the peaceful pursuits of mankind." The historic speech effectively brought the debate about the control of nuclear material and technology into the public sphere and led to the establishment of the IAEA.

In 1958, Ireland's delegation to the United National General Assembly put forward the first version of a resolution aimed at establishing a permanent ban on the "dissemination" of nuclear weapons. The United Nations General Assembly adopted the "Irish Resolution" in 1961, though negotiations did not begin in earnest until 1965. At that time, there were five nuclear powers—the United States, the Soviet Union, United Kingdom, France and China—and growing recognition that nuclear weapons technology had the potential to become widespread. In 1963, for example, President John F. Kennedy expressed concern that there would be 15-20 nuclear powers by 1975. The negotiations culminated in the establishment of the NPT.

The NPT is a landmark international treaty aimed at preventing the spread of nuclear weapons, promoting cooperation in the peaceful uses of nuclear energy, and furthering the goal of nuclear disarmament. The NPT entered into force in 1970 and was extended indefinitely in 1995. Today, it has near-universal global adherence, at least 190 States have joined the NPT, and the Treaty is considered a cornerstone of international peace and security.

The success of the NPT hinges on three mutually reinforcing pillars—nonproliferation, peaceful use, and disarmament.

1953 — President Eisenhower delivers the "Atoms for Peace" speech.

1957 — The IAEA is established.

1968 — The NPT is opened for signature; INFCIRC/66/Rev. 2 expands safeguards coverage to nuclear material in conversion and fuel fabrication plants.

1970 — NPT enters into force.

1972 — The IAEA Board of Governors approves INFCIRC/153 (Corr.) "The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons" and requests that the Director General use the document to serve as the basis for negotiating comprehensive Safeguard agreements (CSAs) between the Agency and non-nuclear weapon States party to the NPT.

1974 — The IAEA publishes standardized text for small quantities protocols (SQPs) concluded in conjunction with a CSA; India detonates a nuclear explosive device for the first time, said to be for "peaceful purposes."

1991 — IAEA uncovers Iraq's covert nuclear weapons program and reports Iraq's non-compliance to the UN Security Council; South Africa accedes to NPT after dismantling its nuclear weapons program.

1993 — The IAEA Board concludes the DPRK is in non-compliance with its safeguards agreement and reports matter to the UN Security Council; the IAEA initiates a two-year program ("Programme 93+2") to develop measures to strengthen safeguards.

1995 — The IAEA Board reaffirms that CSAs should be designed to verify both correctness and completeness of States' declarations; the NPT is extended indefinitely.

The IAEA has over 170 Member States and more than 180 countries have entered into safeguards agreements with the IAEA.

NPT ARTICLE III

Serves as the primary legal basis for the application of international safeguards in NNWSs party to the NPT. Under Article III, NNWSs agree to accept safeguards, as set forth in an agreement with the IAEA, on all nuclear material in all peaceful uses for the purpose of verification of the fulfillment of their NPT obligations "to prevent diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices."

NPT ARTICLE IV

Recognizes the "inalienable right" of States "to develop research, production and use of nuclear energy for peaceful purposes" and encourages the "fullest possible exchange of equipment, materials, and scientific and technological information."

NPT ARTICLE VI

Requires States to "pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control."

1997 — The IAEA Board approves the Model Additional Protocol, under which States voluntarily bring into force an obligation to provide the IAEA with more information and more access.

1998 — Pakistan detonates nuclear explosive device for the first time, following India's May 1998 tests.

2002 — A dissident organization exposes Iran's undeclared enrichment plant at Natanz, setting stage for the IAEA to investigate and reveal extensive undeclared activities and safeguards violations; IAEA Board takes note of the Conceptual Framework for Integrated Safeguards (GOV/2002/8).

2003 — DPRK withdraws from NPT and the IAEA Board reports matter to the UN Security Council; Libya agrees to disclose, and permit verified elimination of, its secret nuclear program.

2004 — President Bush announces the A.Q. Khan network sold centrifuge technology to Iran, Libya, and the DPRK.

2005 — IAEA Board approves the modified standard SQP text required for any new SQPs, and encourages States with original-text SQPs to modify (or to rescind) their protocols.

2006 — The IAEA Board reports Iran case to the UN Security Council; DPRK detonates nuclear explosive device for the first time.

2011 — The IAEA Board finds Syria in non-compliance with its safeguards agreement and reports matter to the UN Security Council; the IAEA Director General provides detailed report to the IAEA Board on "possible military dimensions" of Iran's nuclear program.

2014 — The IAEA Board takes notes of the Supplementary Document (GOV/2014/41) that explains and clarifies the conceptualization and development of safeguards implementation at the State level. The General Conference welcomes the SD and cites it as the "reference point" for safeguards implementation.

2015 — China, France, Germany, Russia, the United Kingdom, and the United States (P5+1) and Iran agree on a Joint Comprehensive Plan of Action (JCPOA) that limits Iran's nuclear program and enhances monitoring in exchange for relief from specified sanctions; the UN Security Council requests the IAEA Director General to undertake the verification and monitoring of Iran's nuclear-related commitments under the JCPOA*.

**The U.S. announced its decision to withdraw from the JCPOA in 2018. The U.S. re-engaged in multilateral discussions in April 2021.*

Structure of the IAEA

As established in its Statute, the IAEA functions through the operation of an administrative/operational arm (the Secretariat), as well as two policymaking bodies—the Board of Governors and the General Conference. In 2020, the IAEA's total Regular Budget amounted to 380.5 million euros (a little less than 420 million dollars).

IAEA SECRETARIAT

The **IAEA Secretariat** consists of some 2500 multidisciplinary professional and support staff from more than 100 countries. The Secretariat implements the Agency's mission through five operational departments: Safeguards, Nuclear Safety and Security, Nuclear Sciences and Applications, Nuclear Energy, and Technical Cooperation. It is headed by a Director General (DG), who is elected by the Board of Governors and serves a four-year term.

BOARD OF GOVERNORS

The **Board of Governors** comprises representatives of 35 Member States. The Board composition includes 13 Member States that are deemed to be the most advanced in nuclear technology and 22 members that are elected by the General Conference and represent eight geographical regions. The Board usually meets five times each year to decide or deliberate on a wide range of issues, including the IAEA budget, approving the applications for technical cooperation projects, applications for membership, implementation of and compliance with safeguards agreements, and recommendations from the General Conference. The Board of Governors also is responsible for electing the IAEA's DG, although the appointment is subject to the approval of the General Conference.

GENERAL CONFERENCE

The **General Conference** is composed of representatives of all Member States. The General Conference meets annually to consider issues brought before it by the Board of Governors, the DG, and Member States. These issues include approving the Agency's program and budget, considering recommendations by the Board of Governors on membership applications and election of members to the Board of Governors, and voting on amendments to the Statute. With regard to safeguards, the General Conference may adopt resolutions requesting reports from the Secretariat on the status of various safeguards implementation issues.

Director General of the International Atomic Energy Agency Rafael Mariano Grossi. IAEA photo by Dean Calma.

IAEA Contribution to Security, Safety, and Peaceful Uses

In addition to its role administering international safeguards, the IAEA strengthens the global nuclear safety and security framework. It identifies and promotes best practices and safety standards and implements programs to assist States in applying these standards. The IAEA is also a key player in the effort to prevent nuclear terrorism. It provides a variety of advisory and support services to help States strengthen nuclear security, including by enhancing the security of vulnerable nuclear and radiological materials, reducing the risk that such material could be acquired by terrorists. Moreover, the IAEA enhances national, regional, and international capacities to respond to, and minimize the impact of, nuclear and radiological incidents. In the event of an incident, the IAEA plays a leading role in providing timely and authoritative information to the international community. Finally, the IAEA also supports the NPT obligation of all Parties to share the benefits of peaceful uses of nuclear technology. Through its Technical Cooperation Programme, the IAEA transfers nuclear technology to Member States with the aim of addressing key development priorities.

The IAEA Department of Safeguards[2]

The IAEA Department of Safeguards comprises over 750 regular staff members—this includes approximately 270 safeguards inspectors. Altogether, it is the largest IAEA department and includes a number of offices and divisions (described below). The benefits afforded by the IAEA safeguards system are a bargain for the international community. In 2020, about 148 million euros (less than 165 million dollars), or roughly 39 percent of the total IAEA budget, will be used for nuclear verification activities around the world. By comparison, the annual budget for the New York City Police Department is more than 5 billion dollars.

Office of the Deputy Director General The Deputy Director General and Head of the Department of Safeguards supervises the Department and oversees the implementation of IAEA safeguards.

Division of Concepts and Planning (SGCP)

SGCP "develops concepts, approaches and methods for safeguarding nuclear material, facilities and activities; prepares safeguards policy and guidance documentation; assists the Divisions of Operations with safeguards implementation issues; and supports advisory and policy-making bodies. It also conducts strategic planning for the Department and coordinates research and development activities, including the management of Member State Support Programmes. The Division also provides assistance to Member States through training, advisory missions and guidance documents."

Division of Technical Support (SGTS)

SGTS provides scientific and technical support to the Operations Divisions for the implementation of safeguards. Its responsibilities include "the design, development, testing, calibration, installation, and maintenance of safeguards equipment; performance and contamination monitoring of equipment; and inspection logistics."

Operations Divisions

There are three Operations Divisions (as well as the Office of Verification in Iran) that are responsible for safeguards implementation in different geographical areas. Each Division conducts an evaluation of the consistency of a State's declarations against the relevant verification activities, and performs a comprehensive State evaluation.

Division of Information Management (SGIM)

SGIM is responsible for data processing, and analyzing accounting data and additional protocol declarations. It "evaluates material balance as well as analytical results of nuclear material, non-nuclear material and environmental samples, and provides other statistical support." In addition, SGIM "processes and analyzes scientific, technical and political literature and geospatial information, and collects and develops and implements new information collection, processing and analysis techniques and methodologies."

Office of Safeguards Analytical Services (SGAS)

SGAS analyzes nuclear material samples and environmental swipe samples; provides associated sampling and quality control materials; coordinates sample shipment logistics; and coordinates work of the Network of Analytical Laboratories (NWAL). The office is also responsible for the management and operation of the Safeguards Analytical Laboratories.

Office of Information and Communications Services (SGIS)

SGIS has responsibility for the "specification, development and maintenance of information and communication technology systems and for the management of all associated infrastructure and services to support safeguards."

[2] *Most of the information in this section describing the Department of Safeguards comes directly from the IAEA's website as indicated by the quotation marks.*

IAEA Safeguards Agreements

Safeguards agreements reflect the rights and legally binding obligations of both the State and the IAEA with regard to the implementation of safeguards. There are currently three different types of IAEA safeguards agreements that are in force with Non-Nuclear Weapon States (NNWSs) and Nuclear Weapon States (NWSs) under the NPT, and States that never acceded to the NPT. Each type of safeguards agreement is described below.

Comprehensive Safeguards Agreements

The vast majority of safeguards agreements—175 as of early 2020—are comprehensive safeguards agreements (CSAs) with NNWSs. (Fewer than 10 NNWS parties to the NPT have yet to conclude CSAs with the IAEA.) The State's primary obligation under a CSA is "to accept safeguards on all source or special fissionable material in all peaceful nuclear activities...for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices." Under a CSA, the State is required to provide the IAEA with information on all imports, exports, inventories, and flows of nuclear material and on the design of nuclear facilities, and the IAEA is charged with not only verifying that nuclear material declarations made by the State are *correct* (i.e., confirming that they accurately describe the types, quantities, and locations of nuclear material in a State's declared nuclear inventory), but also that they are *complete* (i.e., determining that all nuclear material that is required to be under safeguards has actually been declared).

Voluntary Offer Agreements

Under a Voluntary Offer Agreement (VOA), an NPT NWS voluntarily offers nuclear material and/or facilities for the application of safeguards. By applying safeguards under a VOA, the IAEA can test new safeguards approaches or gain experience in using advanced equipment and technology. In some situations, the IAEA can enhance cost efficiency by applying safeguards in the exporting NWS, to nuclear material that will be shipped to States with CSAs in force.

INFCIRC/66-type Agreements

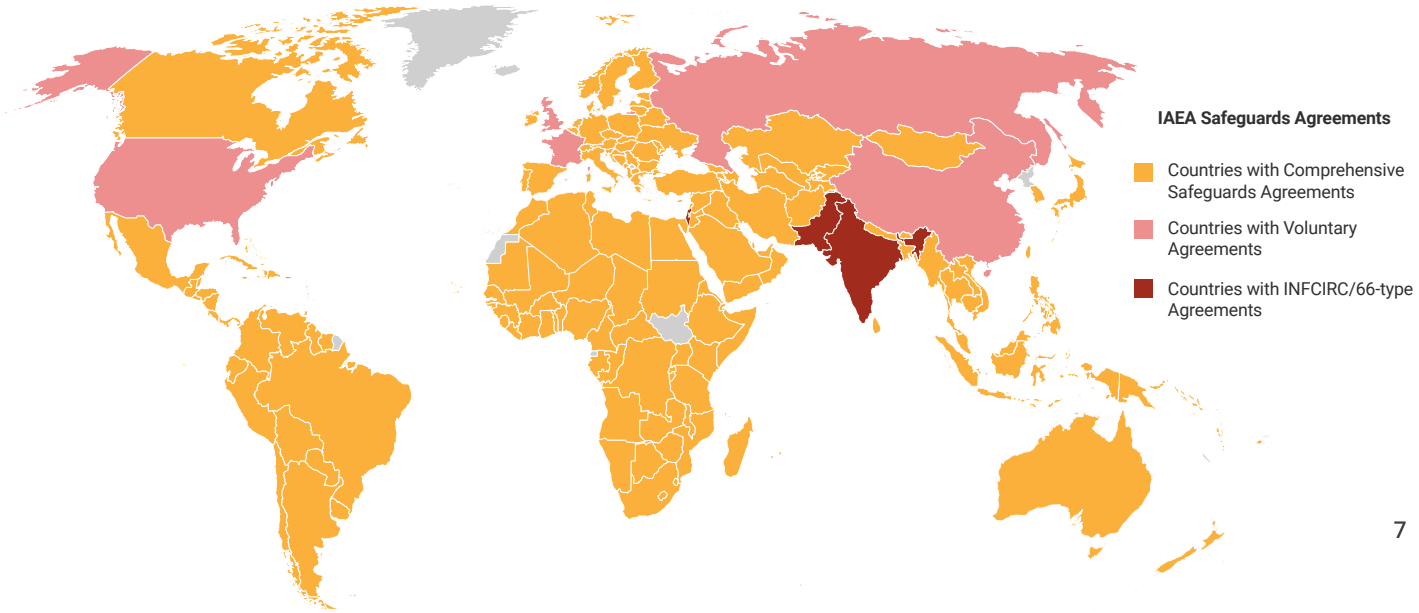
INFCIRC/66-type Agreements specify the nuclear material, non-nuclear material, facilities, and/or equipment to be placed under safeguards and prohibit the use of specified items from furthering any military purpose. The IAEA implements this type of agreement in India, Pakistan, and Israel—States that are not parties to the NPT.

Then IAEA Director General Yukiya Amano and HE Mr David Hall, Resident Representative of the United Kingdom to the IAEA, sign the Safeguards Voluntary-Offer Agreement at the IAEA headquarters in Vienna, Austria. 7 June 2018. IAEA photo by Dean Calma.

Timeliness Goals for CSA States

The goal of safeguards under CSAs is to provide "timely detection" of diversion of "significant quantities" of nuclear material from peaceful nuclear activities and the deterrence of such diversion by the risk of early detection. The required "timeliness" of diversion detection is dependent on material "attractiveness." The more directly a material could be applied to nuclear explosives, the shorter the time window for detecting diversion. Direct-usability is influenced by enrichment levels for uranium and by isotopic purity levels in the case of plutonium. A significant quantity (SQ) is the approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive device cannot be excluded.

Nuclear Material	Significant Quantities in kg	Timeliness
Plutonium (<80% Pu238)	8 kg total Pu	Irradiated = 3 months Unirradiated = 1 month
Highly Enriched Uranium (≥20% U235)	25 kg U-235	Irradiated = 3 months Unirradiated = 1 month
Low Enriched Uranium (<20% U235) – including natural uranium (NU) and depleted uranium (DU)	75 kg U-235 (or 10 t NU or 20 t DU)	12 months



Implementation:
Safeguards Tools and Methods

To implement safeguards agreements, States need to establish a state system of accounting for and control of nuclear material. Among other things, States are required under CSAs to provide information to the IAEA on their nuclear activities including an initial nuclear material inventory report, information on facility design, and inventory changes. States must also provide access to the IAEA for different types of inspections, depending on the terms of their respective safeguards agreements. [For States with CSAs, these include ad hoc, routine, and special inspections; for States with an AP in force, the IAEA has the right to conduct complementary access as well (see page 12 for details).]

As part of the process of determining the rules that govern inspections, a State needs to negotiate so-called Subsidiary Arrangements with the IAEA to establish an agreement on, inter alia, the scope, access, frequency and intensity of inspections.

Safeguards implementation involves the use of advanced technologies and equipment in ways that are cost effective and efficient for both the IAEA and the State. Common tools and methods employed for the implementation of safeguards, include:

Nuclear Material Accountancy methods to establish the quantities of nuclear material present within defined areas of a facility and the changes in those quantities within defined periods. The IAEA applies nuclear material accountancy to independently verify the correctness of the accounting information provided by the State, so as to detect and deter the diversion of nuclear material and provide assurance that nuclear material is present in the declared locations.

Containment and Surveillance (C/S) methods are designed to help detect diversion of nuclear materials. Tools such as cameras, seals, and other sensors provide "continuity of knowledge between inspections by preventing undetected access to, movement of, or interference with nuclear or other materials."[3]

> ***Seals** also help to "ensure continuity of knowledge of the identity and integrity of the material" in facilities, containers, and equipment by making "access to their contents without opening the seal difficult."*[4]

[3] *Safeguards Glossary: http://www-pub.iaea.org/MTCD/publications/PDF/nvs-3-cd/PDF/NVS3_prn.pdf, section 8.1*

[4] *Safeguards Glossary: http://www-pub.iaea.org/MTCD/publications/PDF/nvs-3-cd/PDF/NVS3_prn.pdf, section 12.20*

Environmental Sampling refers to the collection and analysis of samples from inside the facility or the local environment in order to detect traces of materials that can reveal information about nuclear processes conducted in the vicinity. Analysis of environmental samples helps the IAEA to assess the correctness and completeness of the information provided by the State and provide increased assurance of the absence of undeclared nuclear activities.

Nondestructive Assay (NDA) refers to the process of measuring the nuclear material content or the elemental or isotopic concentration of an item without producing significant physical or chemical changes in the item.

Destructive Analysis (DA) refers to the process of measuring the nuclear material content or the elemental or isotopic concentration of a sample through methods that alter the physical or chemical form of the sample. Analysis of nuclear material samples from declared nuclear facilities yields data essential to evaluating the correctness of a State's declaration in the operation of its nuclear facilities and nuclear material storage areas.

Unattended Monitoring refers to non-destructive assay and/or C/S measures that operate for extended periods in facilities without inspector presence. The data collected by unattended monitoring systems may be transmitted off-site via secure communication networks (i.e., remote data transmission) for review and evaluation by the IAEA. Unattended monitoring systems can also store data on-site.

United States Support Program (USSP) to the IAEA Department of Safeguards

Since 1977, the USSP has provided the IAEA with extra-budgetary assistance for targeted projects to resolve specific technical safeguards issues. In recent years, the USSP has sponsored projects to assist the IAEA across a broad spectrum of activities, including nondestructive analysis of nuclear material, containment/surveillance capabilities, environmental sampling and analysis techniques, remote data transmission, information collection, processing and analysis, training, and development of expertise. Assistance is provided to the USSP by a number of U.S. participants, including private sector businesses, Department of Energy national laboratories, individual consultants on short-term assignments, and cost-free experts and junior professional officers who live in Vienna and work at IAEA headquarters. The USSP is primarily funded by the Department of State through the U.S. Program of Technical Assistance to IAEA Safeguards (POTAS). Representatives from the Department of State, the Department of Energy, the Nuclear Regulatory Commission, and the Department of Defense provide program coordination and oversight of the USSP.

Strengthening Safeguards

The Model Additional Protocol

Background

Until the 1990s, safeguards activities focused almost exclusively on verifying declared nuclear material inventories. The safeguards measures applied at each type of nuclear fuel cycle facility, and the frequency and intensity of safeguards activities, were based on the 'Safeguards Criteria.'[5]

Between 1991 and 1993, the IAEA was confronted with unique safeguards challenges in Iraq and Democratic People's Republic of Korea (DPRK). Following the 1991 Gulf War, the UN Security Council empowered the IAEA to conduct intrusive inspections, including short-notice access to locations suspected of harboring undeclared nuclear material and activities that resulted in the revelation of an extensive undeclared nuclear weapons program in Iraq. In 1992, discrepancies between DPRK's initial nuclear material declarations and the IAEA's inspection findings led to a conclusion that the DPRK was concealing an unknown quantity of undeclared plutonium in violation of its safeguards agreement. As a result of these undeclared activities, the Board of Governors found Iraq and the DPRK to be in noncompliance with their respective safeguards agreements. These circumstances demonstrated the need for new safeguards tools and methods, increased access, and expanded information in order for the IAEA to fulfill its verification responsibilities more effectively, in particular with respect to detecting and deterring undeclared nuclear activities.

In 1993, the IAEA and Member States began an intensive effort to identify and evaluate measures to strengthen the IAEA safeguards system. The target date for finishing this work was the 1995 NPT Review and Extension Conference, which led to the name "Programme 93+2." When the results and recommendations of Programme 93+2 were reported to the Board of Governors, several Member States expressed concern that the proposed measures went beyond the requirements of a CSA and would require complementary legal authority. In response, the Secretariat presented a revised version of its proposals, calling for "Part I" measures that could be implemented under existing authority and "Part II" measures that would require new authority. The Board took note of the DG's intention to begin implementing Part I measures (e.g., improved analysis of information, environmental sampling, use of commercial satellite imagery analysis, remote data transmission and unannounced inspections) in cooperation with States.

State Evaluation Process

Among these Part I measures to strengthen safeguards, was the shift from drawing conclusions at the facility-level to drawing conclusions at the State-level, by looking at the State as a whole—**looking at the entire nuclear fuel cycle of the State instead of just individual facilities and taking all available safeguards-relevant information into account.** In 1995, the Board recognized the need for this rigorous method when it reaffirmed that CSAs are designed to verify that States' declarations are both correct and complete (i.e., not only declared material, but all material that the State is required to report under the terms of its safeguards agreement). Applying (and effectively codifying) this more comprehensive approach to assessing States' nuclear programs led to the first State Evaluation Report (SER) in 1995. The institutionalization of the State evaluation process allows the IAEA to develop and maintain an extensive picture of the State's nuclear programs and related activities and assess the consistency of all safeguards relevant information in a structured way. This ongoing process, which increases the IAEA's knowledge of a State's nuclear material inventory, activities, and plans, provides the basis for applying safeguards at the State-level.

International Standard for IAEA Safeguards Agreements

The combination of a CSA and an AP has become the de facto standard for achieving NPT safeguards goals and assuring that NPT safeguards obligations are met.

[5] *The Safeguards Criteria were established for each facility type and location outside facilities (LOF), and specify the scope, the frequency and the extent of the verification activities required to meet the quantity and the timeliness goals. The Criteria specify verification activities to be carried out across a State and were used both for planning the implementation of verification activities and for evaluating the results.*

A Multi-Component Inspector Kit (MCIK) for conducting Complementary Access (CA) Inspections under the Model Additional Protocol (AP). IAEA Photo by Dean Calma

To capture the expanded focus on information, the IAEA has established a more collaborative State evaluation process—in which State Evaluation Groups with individuals with different types of expertise, collect, synthesize, and analyze all available information, including, State declarations, inspectors' observations, information from open sources, commercial satellite imagery, and third-party information. The variety of information sources are listed in the table below.

Information Provided by the State
Nuclear Material Accounting Data
Imports/Exports
Facility Design Information
Additional Protocol Declarations
Voluntarily Provided Information

Information from IAEA SG Activities
Inspections
Design Information Verification
Complementary Access
Headquarters Evaluation Activities

Other Relevant Information
IAEA Non-Safeguards Databases
Scientific and Technical Literature
Trade and Procurement Data
News Sources
Commercial Satellite Imagery
Third-Party Information

Part II Measures: The Model Additional Protocol

To achieve the new legal authorities needed to implement Part II measures and provide more credible assurance of the absence of undeclared nuclear material and activities anywhere in a State, the Secretariat drafted a new protocol additional to States' existing safeguards agreements. The Model Additional Protocol (AP), published as INFCIRC/540 (Corr.), was adopted by the Board of Governors in 1997.

The Model AP includes two important elements to strengthen the IAEA's authorities. First, it provides for additional information through an expanded State declaration. The expanded declaration includes information on, for example, nuclear fuel cycle R&D activities not involving nuclear material; the use and contents of buildings on a site surrounding nuclear facilities; certain nuclear fuel cycle-related manufacturing and assembly activities; uranium mining and ore concentration activities; and exports of certain nuclear-related equipment. Second, the Model AP provides the IAEA with "complementary access" (in addition to inspections under a safeguards agreement) in order to provide, among other things, assurances of the absence of undeclared nuclear material or activities, including the resolution of questions and inconsistencies about the completeness or correctness of a State's declarations. The Model AP identifies activities that the IAEA may conduct during such complementary access (e.g., expanded use of environmental sampling), and the basis upon which the State can manage that access.

PART I

- Implemented under existing authority at the time
- Shifts from facility-level evaluation to State-level evaluation
- Encompasses the entire fuel cycle

PART II

- Required new legal authority
- Provides for additional information through an expanded State declaration
- Provides complementary access to the IAEA

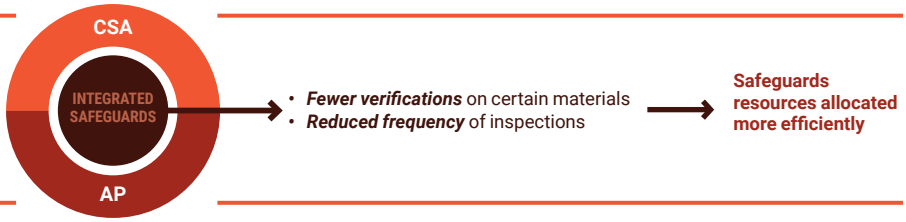
Integrated Safeguards

In addition to strengthening safeguards through the adoption of the Model AP, in the late 1990s and 2000s, the IAEA developed methods to improve the *efficiency* and *effectiveness* of safeguards implementation in States with both CSAs and APs in force.

During the IAEA Board's deliberations on the Model AP, some States (particularly those with significant nuclear fuel cycle activities) expressed concerns that the expanded State declarations and complementary access measures would increase their respective safeguards burdens. In response, the Secretariat launched an initiative in 1998 to develop Integrated Safeguards (IS). IS refers to an **optimized combination of all safeguards measures available to the IAEA under a CSA and an AP to maximize effectiveness and efficiency.** This effort culminated in 2002 when the IAEA Board of Governors took note of the "Conceptual Framework for Integrated Safeguards."

The framework was based on the premise that for States with both a CSA and an AP in force the IAEA was equipped to provide credible assurance of the absence of undeclared nuclear material and activities in those States. This conclusion, in turn, created the potential for reductions in the IAEA's verification effort on declared nuclear material that would need further processing to produce nuclear-weapons-usable material, e.g., irradiated fuel and depleted, natural, or low enriched uranium. For example, if the IAEA has confidence that a country does not have any undeclared reprocessing plants, then it can reduce the frequency of inspections at spent fuel storage facilities and, consequently, allocate its limited safeguards resources more efficiently.

Integrated Safeguards: The optimum combination of all safeguards measures available to the IAEA under a CSA and an AP to achieve **maximum effectiveness and efficiency**.



The framework identified a number of basic principles that governed the development of IS, including:

- nondiscrimination between States;
- comprehensive review and evaluation of all relevant information available to the Agency about a State's nuclear program;
- coverage of acquisition paths (i.e., steps needed to acquire nuclear material suitable for use in a nuclear weapon);
- nuclear fuel cycle "features and characteristics" (now referred to as "factors") specific to an individual State; and
- nuclear material accountancy (NMA) as the basis for verifying the non-diversion of declared nuclear material.

Finally, it is important to note that IS are implemented through customized State level approaches, based on features and characteristics of the State and its nuclear fuel cycle, and only in States for which the IAEA has drawn the so-called "broader conclusion" that all nuclear material in a State remained in peaceful activities. In 2018, the IAEA implemented integrated safeguards for 67 States.

Broader Conclusion

In the late1990s, the IAEA began issuing the "broader conclusion" for States, with both a CSA and AP in force, where it had **confidence that all nuclear material remained in peaceful activities**. The IAEA was able to draw the broader conclusion for 69 States in 2019.

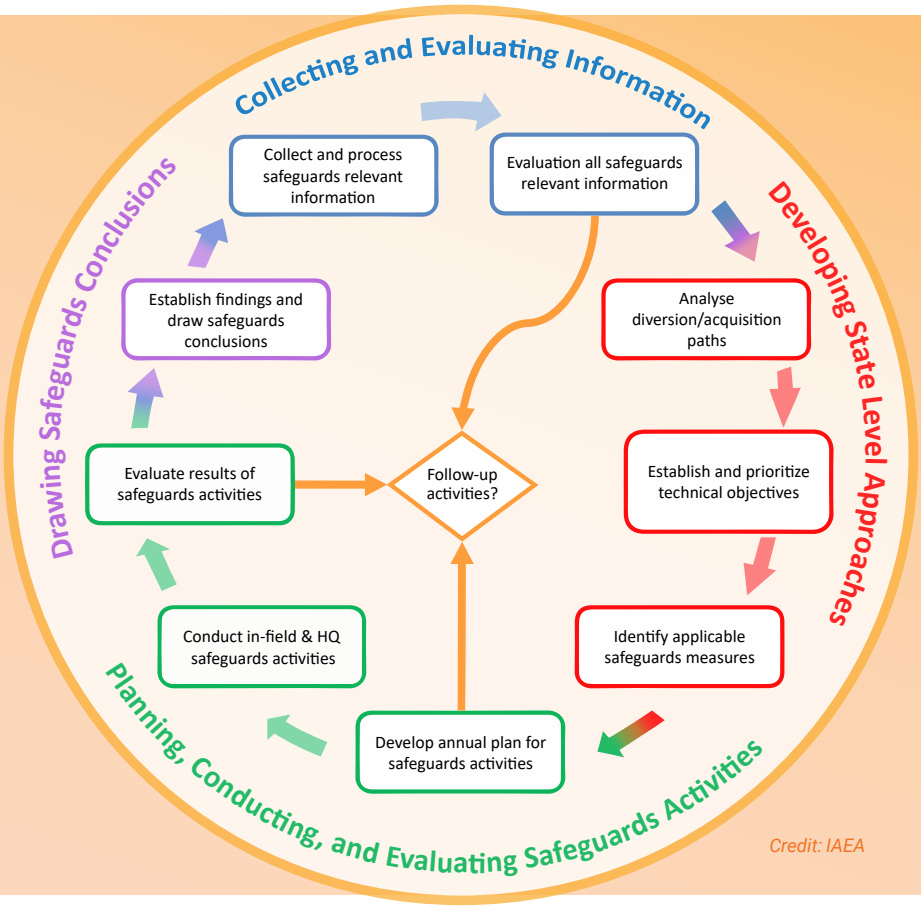
For the decade following the 2002 introduction of the Conceptual Framework, in-field activities at declared facilities for States under integrated safeguards, were still largely based on the Safeguards Criteria, but with timeliness goals relaxed to reflect the increased assurance of the absence of undeclared activities for States under the broader conclusion.

The State-Level Concept

The IAEA's most recent effort to strengthen safeguards is commonly referred to as the State-level Concept (SLC). Fundamentally, the SLC, *which builds on and further develops integrated safeguards*, is intended to help the IAEA to continue to draw soundly based safeguards conclusions and to increase confidence that countries are adhering to their respective safeguards obligations. Following several noncompliance cases in the early 2000s, one of the main drivers in developing and implementing the SLC was the need to enhance existing efforts to strengthen safeguards effectiveness in detecting and deterring diversion, misuse of declared facilities, and undeclared nuclear material and activities in the State as a whole. Other drivers included the need to collect and analyze the growing amount of safeguards relevant information available, and address the IAEA's expanding safeguards responsibilities without a commensurate increase in its financial resources.

The IAEA describes the SLC as a holistic approach to safeguards implementation, enabling the Agency to be more focused on the attainment of technical objectives rather than "mechanistically" carrying out activities according to a rigid checklist of criteria for specific types of nuclear facilities. It is also intended to improve efficiency by helping the IAEA avoid conducting more activities than needed. Implementation of the SLC aims to be responsive to relevant new developments, to ensure that the IAEA can adjust the focus and level of verification effort, accordingly.

Under the SLC framework, by moving away from prescriptive criteria at the facility level, integrating headquarters information analysis with in-field verification, linking safeguards activities to the achievement of objectives, and providing the flexibility to shift resources within a State, the IAEA can implement safeguards agreements more strategically.



Credit: IAEA

The above diagram illustrates the IAEA Department of Safeguards' improved work practices and processes that support the implementation of safeguards under the State Level Concept.

State-Level Approaches

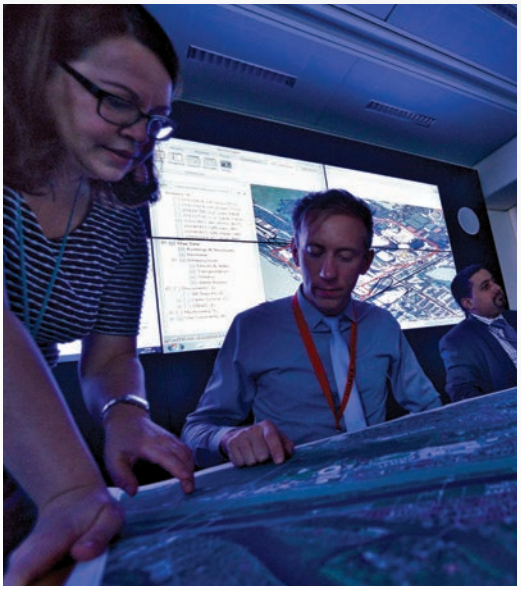
Under the SLC, the IAEA plans to develop customized State-level approaches (SLAs) for all States with safeguards agreements, including CSA States without an AP in force. Such SLAs have implications for how the IAEA plans, conducts, and evaluates safeguards activities, and ultimately how the Agency draws and presents conclusions about a State's compliance with its safeguards agreement.

The SLC seeks to improve existing safeguards practices by conducting technical analysis more collaboratively, systematically and rigorously; and standardizing documentation, processes, procedures, guidance and methodologies. The development of SLAs tailored to individual States helps the IAEA optimize safeguards implementation. The analysis performed by "State Evaluation Groups" (SEGs) includes identifying relevant factors specific to States, assessing a State's nuclear activities and capabilities—and related industrial capabilities—and estimating the time it would take a State to complete the steps along the nuclear fuel cycle to acquire a sufficient amount of nuclear material (i.e., a Significant Quantity) to manufacture a nuclear weapon. The findings flowing from this "acquisition path" analysis facilitate the establishment of prioritized technical objectives and identification of safeguards measures to achieve those objectives, which in turn guides the frequency and intensity of verification effort conducted by inspectors in the field and information analysts at IAEA headquarters. Verification goals are used to describe the extent to which safeguards activities succeeded in attaining technical objectives and assess the coverage of the plausible acquisition paths for the State as a whole.

In recent years, the IAEA has focused on updating and improving more than 50 existing SLAs for States under integrated safeguards and for 131 States with a CSA in force. Those 131 States hold 97% of all nuclear material (by significant quantity) under IAEA safeguards in States with CSAs. In 2018, the IAEA reported that the implementation of revised SLAs in such States has contributed to:

- the development of uniform processes and well-defined procedures resulting in greater consistency and objectivity in safeguards implementation;
- better focus of verification effort and resources to achieve higher priority technical objectives;
- more standardized and better documented SLAs;
- more structured and systematic use of acquisition path analysis and State specific factors; and
- improved knowledge management and long-term preservation of institutional knowledge.

The IAEA is currently working to extend these benefits to all States with safeguards agreements in force.



Above: IAEA Member States were given a comprehensive overview of safeguards activities and process as they toured and learned various technical and scientific services at the Agency headquarters in Vienna, Austria.

Left: Satellite Imagery facilities at the IAEA Department of Safeguards. IAEA Photos by Dean Calma

Noncompliance

Brief History of IAEA Board and UNSC Resolutions on Noncompliance (1991–2011)

To maintain the credibility and effectiveness of the international safeguards system, the world must be confident that States with safeguards agreements in force are meeting their legal obligations. If a State fails to meet its obligations, the State can be found in noncompliance with its safeguards agreement. To reach such a finding, the IAEA Secretariat, through the Director General, reports any case of noncompliance to the IAEA Board of Governors.

The Board is empowered to report any noncompliance it finds to have occurred to Member States, the UN General Assembly, and the UN Security Council. Under Chapter VII of the United Nations Charter, the UN Security Council has the authority to impose punitive economic and political sanctions on States that are violating their safeguards agreements with the IAEA as part of the Council's responsibility to maintain international peace and security.

The IAEA Board has determined noncompliance to have occurred in a number of cases and has reported that noncompliance to the UN Security Council. For example:

1991 The Board found Iraq in noncompliance for its extensive undeclared nuclear program and its misuse of declared nuclear material and facilities.

1993 After the DPRK refused to address anomalies in its initial declaration of nuclear material, the Board found the DPRK to be in noncompliance with its safeguards agreement. Ten years later, after the DPRK unilaterally removed IAEA seals and surveillance equipment and expelled inspectors, the IAEA determined that it was still not in a position to verify the non-diversion of nuclear material and the Board found the DPRK to be in "further noncompliance" before reporting the matter to the UN Security Council. In 2003, the DPRK announced that it was withdrawing from the NPT, and in 2009 kicked out IAEA inspectors.

2004 The Board found Libya in noncompliance based on its past pursuit of an extensive undeclared nuclear program that it recently had disclosed and had agreed to verifiably eliminate. Libya's noncompliance was reported to the UN Security Council for information purposes.

2005 The Board found Iran to be in noncompliance based on its past concealed nuclear program, as the DG had reported to it in 2003. The Board delayed reporting its noncompliance finding to the UN Security Council until 2006. Between 2006 and 2010, the UNSC passed six resolutions imposing punitive sanctions on Iran for its failure to comply with the terms of its safeguards agreement.

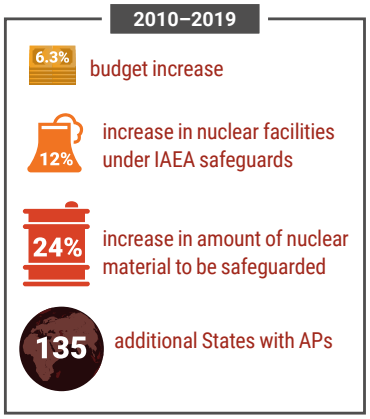
2011 In a report on Syria presenting the Secretariat's conclusions concerning an alleged nuclear reactor destroyed in a 2007 Israeli air strike, the DG stated that *'the [IAEA] concludes that the destroyed building was very likely a nuclear reactor and should have been declared by Syria pursuant to...its Safeguards Agreement and...Subsidiary Arrangements'*. The Board subsequently determined that Syria was in noncompliance with its safeguards agreement and reported the matter to the UN Security Council.

Challenges

In recent years, a convergence of factors has challenged the IAEA's ability to carry out its safeguards mission effectively. Some of these factors include:

- a relatively static budget;
- increasing verification responsibilities;
- emerging technologies that may impact the safeguards system;
- a high rate of attrition and turnover amongst safeguards professionals;
- late and inaccurate safeguards reports; and
- a number of ongoing safeguards compliance issues.

Static Budget and Increasing Verification Responsibilities



The IAEA's safeguards responsibilities continue to increase faster than its financial resources. For example, between 2010 and 2019, the IAEA's safeguards budget increased by only 6.3 percent in real terms. In contrast, during the same period, the number of nuclear facilities coming under IAEA safeguards grew by 12 percent and the amount of nuclear material to be safeguarded rose by approximately 24 percent. Furthermore, the number of States with APs in force has increased to more than 135, thereby increasing the number and scope of State declarations to the IAEA. Without a systematic, concerted effort to address these challenges, the disparity between resources and responsibilities will continue to increase and will risk the effectiveness of IAEA safeguards.

Emerging Technologies

Emerging technology can help or hurt the implementation of safeguards, depending on its applications. Learning to harness and deal with those technologies takes time, money, and effort. As is often the case with applying new technologies, the learning curve can be steep and there can be significant "growing pains."

Challenges associated with new software tools, for example, can include compatibility (does it work well with existing systems), sustainability (will it become obsolete in a few years), and understandability (can the algorithms be understood and explained so that there are no serious concerns about bias or a lack of transparency).

The IAEA is now seeking opportunities to incorporate artificial intelligence (AI) and machine learning (ML) advances into nuclear material surveillance and associated analysis. One example of how AI and ML could help make safeguards implementation more efficient involves reviewing 24/7 footage from surveillance cameras. Numerous IAEA cameras are installed at nuclear facilities and these cameras capture images every few seconds to minutes, depending on their locations. These images are then reviewed by IAEA inspectors. Scrolling through large numbers of images is time-consuming and tedious, and it is possible that an inspector could become fatigued and miss an important detail in the images. AI and ML are being tested to mitigate this problem.

Another technology that could strengthen safeguards is robotics, particularly with respect to verifying spent fuel declarations in cooling ponds so that inspectors can minimize their exposure to radiation.

Attrition, Turnover and Other Staffing Issues

With a total of approximately 55 staff members retiring or separating from the Safeguards Department in 2017 and 2018, the IAEA has needed to enhance its "knowledge management" efforts to support supervisors in identifying the critical job-related knowledge that must be retained. Another issue that has emerged in the human resources area is the need to enhance efforts to recruit, train, and retain inspectors (including the extension of long-term contracts to preserve the substantial investment in highly performing, experienced inspectors). In addition, the number of certain types of training programs for the Safeguards Department staff have declined in recent years.

State Systems of Accounting (SSACs): Late and Inaccurate Reporting

Another challenge is the effectiveness of State systems of accounting for and control of nuclear material. Late and inaccurate (or imprecise) reporting by States to the IAEA is one of the recurring performance issues that make it more difficult for the IAEA to fulfill its safeguards mission and draw sound conclusions. These performance issues have undermined the IAEA's implementation of safeguards and also lead to additional costs for State authorities and facility operators. According to the IAEA, not all State authorities "have the necessary legal authority, independence from nuclear facility…operators, resources or technical capabilities to implement the requirements of safeguards agreements and additional protocols."[6] Additional implementation issues include: lack of timely inspector access to locations, material, facility records and other relevant documents; problems acquiring customs clearance of IAEA safeguards equipment needed to conduct verification activities; and delays in shipping samples to the IAEA that has prevented timely analysis.

Noncompliance Issues: Ongoing Investigations

If a State violates its safeguards agreement and continuously flouts the IAEA with impunity, then it weakens confidence in the overall effectiveness and integrity of the international safeguards system, sets a dangerous precedent for other potential proliferators, and leads to contentious, divisive political debates among the IAEA's Board of Governors. In addition, from a practical standpoint, addressing noncompliance cases can divert and strain resources (staff, time and funding) that could have otherwise been used to support other important safeguards activities.

The IAEA Secretariat continues to report concerns to the Board of Governors about compliance issues involving Iran, North Korea, and Syria. It remains critical that the IAEA has sufficient resources in support of its essential role in monitoring Iran's nuclear program. In regards to North Korea, the IAEA established and maintains a group of safeguards experts that could promptly undertake verification activities in North Korea if a political agreement is reached and the IAEA is asked to play such a role (and the IAEA Board approves). In the meantime, the IAEA relies on satellite imagery and open source information to monitor the North Korea's nuclear program. Syria's failure to cooperate with the IAEA over the last decade, ignoring the DG's and Board's calls to address outstanding safeguards questions, presents an ongoing challenge.

IAEA Safeguards: An Important, Evolving, Cooperative System

As the information outlined above suggests, international safeguards are a cooperative undertaking of States and the IAEA. Everyone involved in this global system has an important role to play. Safeguards rely on rigorously structured, analytical processes to design effective safeguards approaches; well-trained staff and reliable equipment; and proactive and dedicated State authorities with good systems of control and accounting over their nuclear material inventories. The United States views such international cooperation to be of paramount importance because it highly values the Agency's many programs and activities designed to strengthen the international safeguards regime and prevent the proliferation of nuclear weapons.

[6] *IAEA, Safeguards Statement for 2019 [1,2], paragraph 45. https://www.iaea.org/sites/default/files/20/06/statement-sir-2019.pdf [iaea.org]*

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