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The Future of IAEA Safeguards:

Rebuilding the Vienna Spirit through Russian-U.S. Expert Dialogue

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We would also like to acknowledge Gennady Pshakin, longtime friend and colleague to many of us, who passed away in December 2019. Gennady contributed to our work until the end, consistent with his longtime commitment to international engagement and education on nuclear safeguards, non-proliferation, and export controls. He will be dearly missed.

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The IAEA must remain a professional, technical mechanism for verifying compliance with safeguards commitments and play the key role in international cooperation in peaceful uses of nuclear energy. We are certain that the system of IAEA safeguards must remain unbiased and depoliticised. It must rely on international law and the related agreements.”

Sergey Lavrov

Foreign Minister of the Russian Federation
The 2019 Moscow Nonproliferation Conference, November 8, 2019



For nearly 50 years, the Nuclear Non-Proliferation Treaty has prevented the spread of nuclear weapons. The IAEA, by promoting the responsible use of nuclear energy and ensuring [that] its use remains peaceful, has been critical to this success.”

Rick Perry

Former U.S. Secretary of Energy
IAEA 63rd General Conference, September 16, 2019

The Future of IAEA Safeguards: Challenges and Responses

Project Overview and Statement from the Co-Chairs

Corey Hinderstein, NTI and Anton Khlopkov, CENESS

The Center for Energy and Security Studies (CENESS) and the Nuclear Threat Initiative (NTI) launched a two-year joint project in early 2019 to build mutual understanding of current political and technical challenges to fully implementing International Atomic Energy Agency (IAEA) safeguards and to build support for more productive cooperation and collaboration between the Russian Federation and the United States in this area. NTI and CENESS were motivated to address this topic in light of concerns that current relations between the two countries inhibit effective intergovernmental cooperation on the IAEA safeguards and verification issues. In particular, a growing divergence between the United States and Russia has contributed to the erosion of the long-standing “Vienna spirit,” which has previously enabled the IAEA to carry out its work successfully as an independent technical authority, charged by its member states with verifying that states comply with their obligations undertaken in safeguards agreements with the IAEA—in particular, providing credible assurance regarding the non-nuclear weapons States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) that all nuclear material in those states remains in peaceful nuclear activities. This publication is the result of our work.

Project Overview

THE THREE MAJOR OBJECTIVES OF THE PROJECT WERE:

- 1** To bridge the gap between the Russian and U.S. experts’ visions of the future of IAEA safeguards.
- 2** To develop joint proposals by U.S. and Russian experts for strengthening the IAEA safeguards system.
- 3** To create a backup channel for Russian-U.S. dialogue on the future of IAEA safeguards.



Corey Hinderstein, NTI



Anton Khlopkov, CENESS

To launch the project, CENESS and NTI convened a group of experts with deep experience in diplomatic and technical aspects of IAEA safeguards policy and implementation (see participant list on page 43). Participants represented neither their governments nor previous employers, but brought their personal perspective and analysis to the project. Drawing on their rich knowledge base, they explored fundamental issues related to IAEA safeguards, including:

- The IAEA's mandate and authorities
- The evolution of safeguards implementation, including the development of the state-level concept (SLC)
- Methodology and procedures for drawing safeguards conclusions
- The use of open-source and other third-party information by the IAEA
- Addressing weaponization-related cases
- IAEA staffing and organizational issues and
- Reviewing of case studies of several past and present proliferation crises.

The group met in Russia and Austria in 2019, and then virtually in lieu of in-person meetings after the beginning of the COVID-19 pandemic. Subsequently, four separate groups of participants prepared papers:

- Grigory Berdennikov, John Carlson, Thomas Countryman, and Anton Khlopkov, "Principles and Recommendations for Implementation of the IAEA Safeguards System"
- Mark Hibbs, Vladimir Kuchinov, Laura Rockwood, and Alexander Tuzov, "IAEA Safeguards: Reaching Safeguards Conclusions"
- Valery Bytchkov and Jill N. Cooley, "IAEA Safeguards System: Implementing the State-Level Concept"
- Shirley Johnson, Nikolai Khlebnikov, Vladimir Kuchinov, and Thomas Shea, "IAEA Safeguards: Preparing for the Future"

NTI and CENESS have published these documents in English and Russian to provide the safeguards community, diplomats, and the public at large with their important findings and recommendations. The papers represent the views of their authors, but not necessarily all other project participants, CENESS, or NTI.

Co-Chairs' Observations

The NTI and CENESS co-chairs were struck by the wide areas of consensus observed during project meetings and in the process of drafting these papers. Given the recent political backdrop of increased tensions and divergent perspectives on safeguards issues, the co-chairs expected to see these differences reflected in a discussion even among non-governmental experts. However, there was a remarkable degree of overlap in the participants' perspectives. Moreover, when there were disagreements or differing approaches, they were not necessarily along national lines. Instead, Russian and U.S. participants with experience working in the IAEA often shared a perspective that may have run counter to a view expressed by a former national government official. The participants were also frank in noting areas where the IAEA could have better managed issues related to the SLC, including communications with member states.

The co-chairs have summarized below several main themes that emerged from the dialogue. These themes provide important insights into areas where U.S., Russian, and IAEA officials, as well as those from other IAEA member states, could find common ground in strengthening cooperation and bolstering IAEA safeguards.

MAIN THEMES

- ✓ **Establishing and Maintaining Regular Russian-U.S. Channels and Developing a Common Set of Principles for Safeguards Implementation**
- ✓ **Strengthening the State Evaluation Process**
- ✓ **Increasing Transparency and Communication**
- ✓ **Drawing Conclusions Based on IAEA Safeguards Activities**
- ✓ **Planning for and Investing in the IAEA's Future**

Establishing and Maintaining Regular Russian-U.S. Channels and Developing a Common Set of Principles for Safeguards Implementation

Participants broadly supported the idea that Russia and the United States should reaffirm their commitment to a shared set of principles or considerations related to IAEA safeguards implementation. These principles, grounded in the existing legal framework of the IAEA, could serve as guideposts for the two countries to work together in specific implementation cases and when addressing questions related to safeguards policy formulation. While the aforementioned confirmation by the two countries would not have any binding effect on the IAEA, the process of developing a bilateral understanding could serve to demonstrate that there is significant agreement between the two states on issues such as the SLC and could significantly reduce the differences observed today in such forums as the official debate in the IAEA Board of Governors and the annual resolutions on safeguards at the IAEA General Conference.

Developing these principles would improve U.S.-Russian relations in the Vienna context by reopening channels that closed several years ago, when an earlier effort of this type ended without a shared understanding of how to move forward collaboratively. These channels should remain active and open, because regular exchanges on the status of IAEA safeguards policy development and implementation could help to avoid future standoffs in the IAEA boardroom and provide a significant impetus for further strengthening IAEA safeguards.

Strengthening the State Evaluation Process

Throughout the CENESS-NTI project, the evolution and implementation of the SLC was a recurring element during discussions and in written products. Since questions from Russia (and other member states) about the SLC had initially prompted debates in Vienna, it is no surprise that the participants spent a significant amount of time exploring this topic. A number of participants suggested that the IAEA needed to do more to strengthen the state evaluation process, the review conducted by state evaluation groups within the IAEA to develop safeguards approaches and implementation plans for individual states. These state-level approaches (SLAs) have begun to replace the safeguards criteria that were previously used, when the IAEA's focus was primarily on individual nuclear fuel cycle facilities. SLAs, rather, devise safeguards approaches by looking at each state as a whole.

The SLC is a valuable framework for considering state-specific factors and guarding against an overly simplistic approach that could fail to discover undeclared nuclear activities. However, its more tailored nature raised concerns among participants that SLAs could incorporate subjective criteria for determining safeguards procedures and drawing conclusions. Participants called for a procedure to establish measurable performance targets for determining the frequency and intensity of IAEA verification activity in a state. In particular, they noted that performance targets for detecting undeclared nuclear materials and activities should be well described.

The IAEA announced in July 2019 that it had launched an SLA improvement project, which would address a number of these issues, including standardizing the assessment of key fuel cycle capabilities in a state and establishing better defined performance targets. In light of the NTI-CENESS dialogue, both Russia and the United States should support this effort by the IAEA Secretariat.

Increasing Transparency and Communication

A number of participants highlighted the need for the IAEA to better communicate issues related to safeguards, both to its member states and to the general public. U.S. and Russian participants expressed frustration about how the IAEA Secretariat handled its reporting to member states on the SLC, which led to significant confusion and misunderstanding and may have deepened concerns by states that had raised questions about the SLC. Follow-on reports and technical briefings by the IAEA Secretariat have helped to clarify many of these questions, but the secretariat could do more to increase transparency through improved communication. That said, participants recognized that the IAEA safeguards implementation has improved and evolved since the initial briefings and that there is value in looking forward at issues related to IAEA capacity and implementation rather than backward.

Participants recommended augmenting and expanding the Safeguards Implementation Report (SIR) to include more information on some of the issues mentioned above: the development and implementation of SLAs, metrics on technical objectives and performance targets, and data on the effectiveness and efficiency of safeguards. Several participants also suggested resurrecting the classified Safeguards Technical Report, formerly prepared in conjunction with the SIR, which was eliminated several years ago; although the information such reports contained was not public, it provided useful background reporting for states that could serve to prevent future misunderstandings about IAEA safeguards procedures and conclusions. Other regular reporting on the implementation of the SLC through periodic technical briefings to member states, as well as publications in the *IAEA Bulletin*, would also improve understanding. In particular, participants recommended a detailed briefing and/or publication on the IAEA's SLA improvement

The future credibility and sustainability of the NPT and the nuclear non-proliferation regime depend on the IAEA, and the IAEA depends on its two most powerful sources of resources: expertise, and rhetoric. It is in the world's best interest for the United States and Russia to work together.

project and its implications for the state evaluation process. Finally, several participants suggested a more active role for advisory groups within the IAEA, such as the Standing Advisory Group on Safeguards Implementation, or the appointment of a "safeguards auditor" to provide avenues for feedback and improvement.

Drawing Conclusions Based on IAEA Safeguards Activities

In addition to the broader discussion over the SLC, specific cases have drawn attention in recent years to the IAEA's use of national information and open-source information as part of its process for drawing safeguards conclusions. Participants noted that the IAEA's mandate is to draw conclusions that are based on its own safeguards activities. The IAEA does not take such information at face value; rather, it has a process for evaluating information provided by member states or collected through open sources. IAEA safeguards officials may use this information to formulate plans and approaches for safeguards activities, but in drawing its conclusions, the IAEA relies on the objective findings it has reached through its own independent safeguards activities.

Participants suggested that the IAEA could do a better job of explaining how it undertakes this review process and describing how it uses national and open-source information. Safeguards officials could prepare a briefing for member states on this subject or even produce a more formal publication. Some participants also commented that the IAEA might wish to

develop a standardized framework or protocol for receiving such information, which could be briefed to member states.

Planning for and Investing in the IAEA's Future

Finally, participants generally shared the view that the IAEA should be undertaking significant efforts to plan for future safeguards implementation challenges. There were a wide variety of recommendations, including:

- Reviewing current management and staffing procedures, including retention, rotational assignments, and training
- Preparing for safeguards in new types of facilities, including advanced reactors and floating nuclear reactors
- Addressing outstanding issues for safeguards implementation in the decommissioning of permanently shut-down or closed-down reactors and with the legacy of spent fuel and
- Assessing and investing in new technologies for monitoring and verification, including remote monitoring and advanced data analysis.

The participants suggested that it would be useful to Russia and the United States to establish an arrangement to facilitate ongoing cooperation on technical and administrative topics germane to the future of IAEA safeguards implementation.




Conclusion

Unified support from the United States and the Russian Federation is vitally important for the IAEA in its safeguards implementation efforts. Concurrently, Russian and U.S. interests are best served when IAEA safeguards function effectively, efficiently, and with international public confidence. These two countries have much in common in the non-proliferation area, and neither is served when the IAEA is used for mutual recriminations and criticisms that often have no direct bearing on safeguards or IAEA issues. The future credibility and sustainability of the NPT and the nuclear non-proliferation regime depend on the IAEA, and the IAEA depends on its two most powerful sources of resources: expertise, and rhetoric. It is in the world's best interest for the United States and Russia to work together.

The background of the cover is a photograph of the International Atomic Energy Agency (IAEA) building in Vienna. The building is a large, curved, multi-story structure with a facade of blue-tinted glass windows. In the foreground, a row of flags from various member states is displayed on tall poles. Below the flags is a reflecting pool that mirrors the building and the sky. A large red geometric shape, resembling a stylized arrow or a large 'P', is overlaid on the left side of the image, containing the title and authors' names.

Principles and Recommendations for Implementation of the IAEA Safeguards System

Grigory **Berdennikov**, John **Carlson**,
Thomas **Countryman**, and Anton **Khlopkov**



In 2019 and 2020, the Moscow-based Center for Energy and Security Studies (CENESS) and the Washington, D.C.-based Nuclear Threat Initiative (NTI) conducted a series of brainstorming sessions on the issue of the future of the International Atomic Energy Agency (IAEA) safeguards system.¹ These meetings assembled a group of nuclear experts and representatives of the academic community, as well as former diplomats and IAEA officials from Russia, the United States, and other nations in an effort to see whether it is possible to reinvigorate the non-proliferation regime through building bridges and enhancing cooperation on the issue of safeguards. The system of safeguards traditionally was the topic where the United States and the former Soviet Union were able to find common ground even during the most intense periods of the Cold War. This was due, on the one hand, to the mutual interest in preventing the spread of nuclear weapons and, on the other hand, to the mainly technical nature of the issues involved that were relatively free of political or ideological considerations.

However, relations between the two sides have recently deteriorated to the point where no constructive dialogue on the official level has been possible even on previously uncontroversial issues. It is quite obvious that such a state of affairs not only goes against each state's national security interests, but also puts in jeopardy the international peace and security architecture as a whole. Therefore, establishing a channel for an expert Russian-U.S. dialogue on safeguards aimed at finding points of convergence in this field in times of controversy and even adversity can contribute to overcoming the current deteriorating non-proliferation environment. This article is a collaborative attempt to look for suggestions on what can be a common set of principles for implementation of the IAEA safeguards system.

Historical Background of Safeguards

Although the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) provided a strong impetus for the further development of the IAEA safeguards system, in fact, the idea of safeguards predates the NPT. The 1956 Statute of the IAEA contains provisions for a system of measures to safeguard against the misuse of special fissionable and other materials, services, equipment, and technical information provided by the agency or under its supervision or control in such a way as to further any military purpose. The NPT drafters decided not to create a completely new system to verify compliance with the treaty but to use and develop what was already provided for in the statute.

¹ The expert meetings on “The Future of the IAEA Safeguards: Bridging the Gap,” as part of a joint CENESS-NTI project, were held in Moscow and Valday, Russia, and in Vienna and Baden, Austria, on January 28–30 and September 18–20, 2019, respectively, and in a virtual setting on July 21, July 23, July 28, August 4, and August 11, 2020.

Both the United States and Russia favor the universalization of the Additional Protocol, which should become the standard for verifying the peaceful character of nuclear applications.

The IAEA safeguards system therefore serves as the NPT verification mechanism. It acts through the implementation of comprehensive safeguards agreements (CSAs) concluded between the States Parties to the NPT and the IAEA. The obligations of states and the responsibility of the IAEA are formulated in paragraphs 1 and 2 of the CSA, based on Articles II and III of the NPT.²

As a reaction to the discovery in the 1990s of a clandestine nuclear program in Iraq, the IAEA in collaboration with member states embarked on a major program to strengthen the safeguards system, initially known as Programme 93+2. Perhaps the most important measure introduced to all states through Programme 93+2 was the concept of state evaluation, which led to the development of the state-level concept (SLC), under which safeguards conclusions are drawn for the state as a whole. Another major outcome of Programme 93+2 was the development of the Model Additional Protocol, adopted by the IAEA in 1997 to be freely concluded by states.³ This document substantially strengthened the agency's capabilities to gain access to nuclear and special fissionable material and to related facilities and activities in states within the framework of the concluded safeguards agreements.

Both the United States and Russia favor the universalization of the Additional Protocol (AP),

which should become the standard for verifying the peaceful character of nuclear applications.

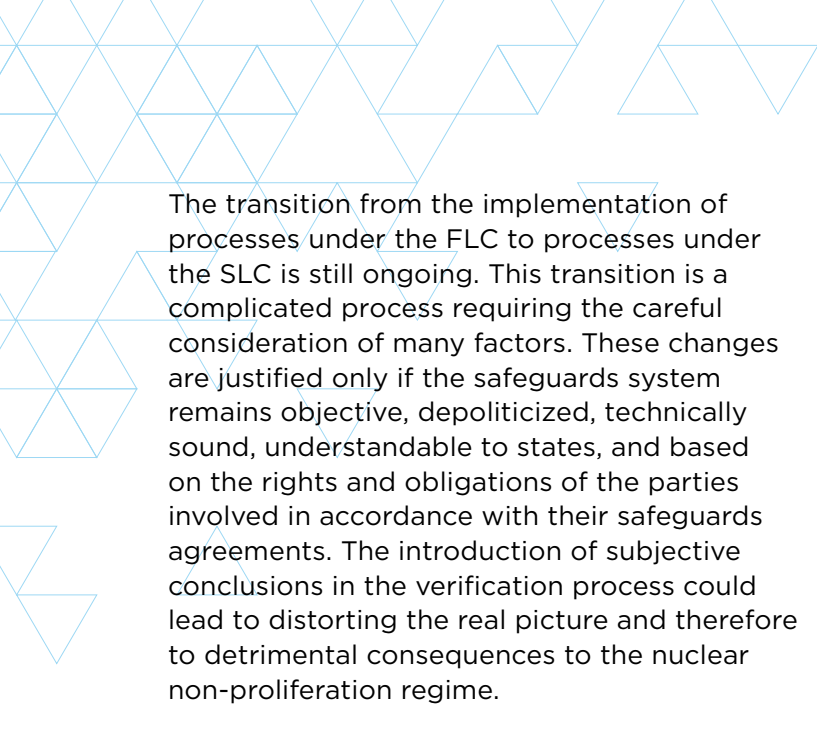
An important feature of the system is that it evolves with time. There were two main implementation concepts used over the entire period of system's existence: the facility-level concept (FLC), applied from 1961 until 2003, and the SLC, applied from 2003 to the present.

The SLC is being developed in order to respond to emerging challenges and technical capabilities. In 2000 the IAEA Secretariat came up with an idea to develop a modified safeguards approach, initially in internal discussions termed "risk-informed safeguards" and subsequently announced as "information-driven safeguards." Underlying this development was the argument, inter alia, that because the number of facilities under safeguards was growing rapidly, the IAEA, faced with lack of sufficient resources, could not spread its safeguards activities evenly on all of them without diminishing their effectiveness. Therefore, consistent with the provisions in the CSA authorizing the IAEA to address "the characteristics of the state's nuclear fuel cycle," the agency should be provided with a possibility to distinguish those activities that give more grounds for bona fide non-proliferation concerns in order to be able to focus its safeguards efforts on them.⁴

² IAEA, *The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*, (INFCIRC/153 (Corrected)), June 1972, www.iaea.org/sites/default/files/publications/documents/infcircs/1972/infcirc153.pdf.

³ IAEA, *Model Protocol Additional to the Agreement(s) between State(s) and the IAEA for the Application of Safeguards*, (INFCIRC/540), September 1997, www.iaea.org/sites/default/files/infcirc540c.pdf.

⁴ IAEA, *The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*, (INFCIRC/153 (Corrected)), June 1972, www.iaea.org/sites/default/files/publications/documents/infcircs/1972/infcirc153.pdf.



The transition from the implementation of processes under the FLC to processes under the SLC is still ongoing. This transition is a complicated process requiring the careful consideration of many factors. These changes are justified only if the safeguards system remains objective, depoliticized, technically sound, understandable to states, and based on the rights and obligations of the parties involved in accordance with their safeguards agreements. The introduction of subjective conclusions in the verification process could lead to distorting the real picture and therefore to detrimental consequences to the nuclear non-proliferation regime.

General Principles Applicable to Both the FLC and SLC

Principles for both the FLC and SLC processes include:

- Adherence to the legal framework (safeguards agreement and protocols to the agreement, as well as any subsidiary arrangements)
- High effectiveness (ability to detect non-compliance)
- High efficiency (highest output within the resources available)
- Non-discrimination (using a common set of principles/criteria to govern the intensity of verification activities in a state) and
- Transparency of verification and conclusion-drawing procedures (providing information to states through the Safeguards Implementation Reports (SIRs) and through other means).

The last principle is not least: states will be able to judge whether the first four principles have been satisfied by the secretariat only if the fifth has been satisfied.

The statement of conclusions published in the SIR for 2003 was the first to be formulated at state level—which means that safeguards conclusions were drawn for each state as

a whole in accordance with that state's obligations under each type of safeguards agreement. The actual transition from the facility-level to the state-level concept has taken considerable time and remains incomplete.

These principles all apply to the agency itself, but reciprocity should also be considered; some responsibilities should also apply to states. This suggests a further principle: *safeguards should be implemented in collaboration, as a shared responsibility.*

In this context, “collaboration” is understood as both collaboration between the agency and states (individually or collectively, depending on the context) and collaboration between states so as to advance the common interest in a well-functioning safeguards system.

It is essential for states not to regard safeguards as adversarial or an imposition. Safeguards provide a vital service to states, building confidence and enabling suspicions to be investigated and resolved in an impartial manner. For this reason, it is in the interest of all states to demonstrate that they are honoring their non-proliferation commitments through full cooperation with the agency's safeguards system—not only cooperation in safeguards implementation, but acceptance of the most advanced form of safeguards, the AP.

The agency and member states should work toward developing and promoting a collaborative safeguards culture, recognizing the common interest of both sides in seeing the achievement of the other key principles discussed here.

The IAEA Secretariat should be prepared for open discussion of the application of safeguards in the organs of the agency and to defend its use of information in drawing conclusions about a state's nuclear activities. Conclusions should be drawn on the basis of the secretariat's technical findings, including the independent evaluation of information obtained by or provided to the agency.

SET OF PRINCIPLES AND RECOMMENDATIONS FOR THE IMPLEMENTATION OF THE SAFEGUARDS SYSTEM

Based on those considerations, the following set of principles can be applied for the development of the IAEA safeguards systems. Both Russia and the United States could use these principles in their work in the IAEA, both individually and jointly:

- Within the existing legal framework for IAEA safeguards, it is essential to increase confidence that states are abiding by their IAEA safeguards obligations. The IAEA Secretariat currently implements the SLC in order to realize this goal.
- The IAEA safeguards system should be technically credible, impartial, and implemented through processes that are transparent to states.
- In that regard, as requested by the General Conference, the IAEA Secretariat should report to the Board of Governors on the conceptualization and development of the approach to safeguards implementation developed by the secretariat to clarify the role of objective state factors in the planning, implementation, and evaluation of safeguards. The report should include a description of reasons that made it necessary for the secretariat to develop modified approaches to safeguards implementation, as well as a complete list of the objective state factors it takes into account. The secretariat should report to the board on any changes to these objective state factors in the future.
- The SLC should be implemented pursuant to the authorities and obligations contained in safeguards agreements. It is not designed as a functional substitute for the absence of the AP in states that lack them. Secretariat and member states' efforts to promote universal AP adherence should be continued and strengthened, with the goal of achieving universal recognition that a CSA and an AP together constitute the internationally recognized verification standard.
- Safeguards effectiveness must remain paramount. Efforts to reduce costs should not compromise effectiveness.
- Only objective state factors should be used to determine safeguards implementation. Political considerations are not appropriate.
- The Standing Advisory Group on Safeguards Implementation should continue its review of objective state factors and make recommendations for inclusion in the Secretariat's report to the Board of Governors.
- Safeguards conclusions should be based on the IAEA Secretariat's safeguards activities, including its collection, analysis, and evaluation of safeguards-relevant information, and not on a political judgment about a state's presumed intentions regarding the acquisition of nuclear weapons. Conclusions should be based on objective data, including IAEA inspections.
- The state-level approaches developed by the IAEA Secretariat should remain non-discriminatory by applying common state-level objectives to all states with similar types of safeguards agreements in force and by utilizing uniform implementation processes in objectively determining the state-level approach for each state.
- The specific safeguards measures and the manner and intensity with which they are applied in an individual state will differ based on objective state factors and technical considerations.


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- The state-level approaches developed by the IAEA Secretariat should ensure a high probability of detection of any violation by states of their IAEA safeguards agreements. Timely detection of diversion of declared material—and deterrence of such diversion by the risk of early detection—should remain a fundamental safeguards objective.
- Nuclear material accountancy remains the primary basis for deriving a conclusion of non-diversion of declared material.
- For a state with a CSA in force, the IAEA Secretariat must ensure that safeguards are applied on all source or special fissionable material in all peaceful nuclear activities in the state, and address credible indications of undeclared nuclear activities.
- In a state that does not have an AP in force, the secretariat is not expected to reach the broader conclusion regarding the absence of undeclared nuclear material and activities. However, the absence of an AP does not prevent the secretariat from assessing indications of undeclared activities, seeking clarifications from the state, and reporting to the IAEA Board of Governors if the secretariat finds the state has not provided the necessary cooperation for inspectors to verify that all nuclear material in the state remains in use for exclusively peaceful purposes. The secretariat should report on its findings, along with background information, to the board for its decision.
- State evaluations using all safeguards-relevant information available to the IAEA Secretariat should be strengthened and continuously updated. While taking into account the effectiveness of the state and/or regional system of accounting and control, the secretariat must not delegate its responsibility for verification of nuclear material accountancy to the national and/or regional systems of accounting and control, but maintain the capability for the agency's independent conclusions.
- Having in mind the goal of ensuring effective and efficient safeguards application, all technically feasible diversion and acquisition pathways for a state should be addressed by the IAEA Secretariat on the basis of all available safeguards-relevant information.
- The secretariat should give high priority to collecting objective data, first and foremost through inspections, in order to address questions and inconsistencies and resolve discrepancies and anomalies. In so doing, the secretariat should operate within the parameters of existing safeguards authorities and technically credible and impartial measures.
- In its operational work, the IAEA Secretariat should analyze any information relevant to safeguards, and determine pursuant to such analysis whether to take further steps to investigate credible indications of undeclared activities. The secretariat should thoroughly describe to the IAEA Board of Governors the information that served as the basis for corresponding conclusions and be prepared to defend it in an open discussion of the board.
- The IAEA Secretariat should draw independent, objective conclusions using impartial and technically credible evaluation methods. These conclusions should be based on the secretariat's own safeguards activities.
- The IAEA has the responsibility to ensure that nothing it does could contribute to nuclear proliferation. Consistent with the obligations of parties to the NPT, the IAEA Secretariat should seek assistance from experts supported by the P5 states (China, France, Russian Federation, the United Kingdom, and the United States) on specific matters that might go beyond peaceful nuclear activities in NPT non-nuclear-weapon States Parties.

IAEA Safeguards: Reaching Safeguards Conclusions

Mark **Hibbs**, Vladimir **Kuchinov**,
Laura **Rockwood**, and Alexander **Tuzov**





The ongoing evolution of the safeguards system of the International Atomic Energy Agency (IAEA or Agency) and the introduction of the state-level concept (SLC) have posed challenges for the IAEA Secretariat in reaching safeguards conclusions, including challenges in the processes for decision-making, information management, and the evaluation of effectiveness, which are critical for drawing conclusions. Mastering these processes and communicating them in the 2020s to states, particularly to those that have comprehensive safeguards agreements (CSAs) with the IAEA, will be of paramount importance, because the credibility of IAEA safeguards depends on a clear procedural basis that permits the IAEA Secretariat to draw conclusions that are impartial and technically sound. This article addresses these issues.

IAEA Safeguards Conclusions

Of the 184 states that have concluded safeguards agreements with the IAEA, 176 are non-nuclear-weapon states that have concluded CSAs in connection with the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), based on the IAEA's INFCIRC/153 (Corr.)⁵; five of them are nuclear-weapon states party to the NPT, all of which have what are commonly referred to as voluntary offer agreements (VOAs); and three of them are states that are not party to the NPT, each of which has concluded one or more agreements that apply to facilities, material, or equipment specified in the relevant agreement (item-specific safeguards agreements).⁶

At the close of each calendar year, the IAEA Secretariat draws a safeguards conclusion with respect to the implementation of safeguards

in each state that has concluded a safeguards agreement with the IAEA. The IAEA has regularly published an annual Safeguards Statement reflecting the safeguards conclusions in the Safeguards Implementation Report (SIR) since 1979.

This Safeguards Statement includes technical information and secretariat findings, as well as the overall safeguards conclusions based on this information and the findings. The formulation of the Safeguards Statement, and of the underlying safeguards conclusions, has evolved over four decades, particularly regarding conclusions drawn in connection with CSAs, in light of the discovery of undeclared nuclear activities in Iraq and the Democratic People's Republic of Korea (DPRK) in the 1990s, the approval of the Model Additional Protocol in

⁵ IAEA, *The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*, (INFCIRC/153 (Corrected)), June 1972, www.iaea.org/sites/default/files/publications/documents/infircs/1972/infirc153.pdf.

⁶ IAEA, "Status List: Conclusion of Safeguards Agreements, Additional Protocols and Small Quantities Protocols," August 13, 2020, www.iaea.org/sites/default/files/20/01/sg-agreements-comprehensive-status.pdf.

...it is especially important to be sure that the process of preparation of these overall conclusions is impartial and technically sound to maintain confidence in the IAEA and its safeguards.

1997 and the introduction of the SLC for safeguards, as described below.⁷

Whereas the pre-2003 Safeguards Statement referred to safeguarded nuclear material in all countries with a safeguards agreement generally without specifying the type of agreement, since the SIR for 2003 (which was issued in 2004), it has contained the findings and overall conclusions grouped according to the type of safeguards agreements in force and whether the state is implementing an additional protocol (AP). Given the evolution of the IAEA safeguards concept as well, it is especially important to be sure that the process of preparation of these overall conclusions is impartial and technically sound to maintain confidence in the IAEA and its safeguards.

The focus of this paper is on aspects of decision-making that lead to the IAEA Secretariat's drawing of safeguards conclusions for states with CSAs that are published in the annual Safeguards Statement in the SIR.

Safeguards Conclusions in Connection with CSAs

As stated in paragraph 2 of INFCIRC/153, the IAEA has the “right and obligation” to ensure that safeguards be applied “on all source or special fissionable material in all peaceful nuclear activities within [the] territory [of a state], under its jurisdiction or carried out under its control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices.”⁸ This means that, pursuant to its right and obligation to implement safeguards, the IAEA must draw conclusions with respect to the compliance by states with their respective safeguards agreements. These conclusions are presented by the IAEA Director General to the IAEA Board of Governors in the Safeguards Statement in the annual SIR.⁹

This expression of purpose is translated into technical language in paragraph 28 of the INFCIRC/153, which describes the “objective of safeguards”¹⁰ as “the timely detection of the

⁷ IAEA, *Model Protocol Additional to the Agreement(s) between State(s) and the IAEA for the Application of Safeguards* (INFCIRC/540 (Corrected)), December 1998, www.iaea.org/sites/default/files/infirc540c.pdf.

⁸ IAEA, *The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*, (INFCIRC/153 (Corrected)), June 1972, www.iaea.org/sites/default/files/publications/documents/infircs/1972/infirc153.pdf.

⁹ The safeguards conclusions contained in the SIR Safeguards Statements are not the technical conclusions specified by paragraph 30 of INFCIRC/153 and reported to the states in accordance with paragraph 90(b) of INFCIRC/153.

¹⁰ Whereas INFCIRC/153 refers to the “objective of safeguards,” the model text for CSAs (IAEA, *The Standard Text of Safeguards Agreements in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons* (GOV/INF/276/Annex A), August 22, 1977) and the CSAs themselves refer in Article 28 to the “objective of the safeguards procedures set forth in this part of the Agreement.”

diversion of significant quantities of *nuclear material* from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection.”

Although the IAEA’s right and obligation extend to ensuring that all nuclear material required to be safeguarded is in fact placed under safeguards, prior to 1991, the implementation of safeguards under CSAs was primarily focused on verifying the nuclear material and facilities declared by a state. This was a matter of practice and not a matter of law, as was later confirmed by the IAEA Board of Governors and the General Conference. Consequently, the process of drawing safeguards conclusions prior to 1991 was predominantly centered on the timely detection of the diversion of significant quantities of *declared* nuclear material from peaceful nuclear activities.

That objective was linked to four numerical parameters: significant quantities, detection time, detection probability, and false alarm probability.¹¹ A general description of the approaches to safeguards and to specific activities based on these technical parameters for each type of facility used in peaceful nuclear programs was provided in the *IAEA Bulletin* in 1980.¹² In 1990, the IAEA Secretariat developed the safeguards criteria for 1991–1995, which went into effect in January 1991. These criteria reflected the effort and experience of the secretariat as well as the state of art of safeguards development, including issues concerning the evaluation method used for the preparation of the annual Safeguards Statement

in the SIR. These criteria were used for the planning of safeguards implementation activities in the field and at the agency’s headquarters for all facilities and locations outside facilities (LOFs) covered by safeguards, as well as for the evaluation of safeguards implementation at facilities and at the state level.¹³

The criteria were provided to the member states in 1991 to assist in their assessments of the credibility of the IAEA’s inspection procedures and to facilitate cooperation between member states and the IAEA in the implementation of safeguards.¹⁴

The early SIRs included information about the inspection activities conducted each year and were relatively straightforward; they focused on achieving timeliness and quantity goals for the detection of diversion. The safeguards conclusion in the Safeguards Statements in those SIRs generally provided that none of the nuclear material placed under IAEA safeguards had been diverted from peaceful activities, or that all such material had been accounted for. Some also contained a reservation that the Safeguards Statement was not absolute, without diminishing the significance of that statement. Such a reservation was justified because, as stated in the SIRs, the IAEA conclusion should be seen in the light of certain observations. These included, for example, that the level of assurance associated with the IAEA Secretariat’s findings for a particular installation or state depended on the type of safeguards agreement concluded with that state, on the cooperation of the state and of the facility operators in it, and on the manpower and equipment available to the agency.

¹¹ See V. Fortakov, “Nuclear Verification: What It Is, How It Works, the Assurances It Can Provide.” Paper presented at the IAEA Technical Workshop on Safeguards, Verification Technologies, and Other Related Experience, Vienna, Austria, May 11–13, 1998, www.inis.iaea.org/search/search.aspx?orig_q=RN:30050964. The paper describes these four technical parameters and their relationship to IAEA safeguards inspection goals. Detection probability is to be maintained “as high as possible” and false alarm probability “as low as possible”; See also IAEA, *IAEA Safeguards Glossary, 2001 edition* (International Nuclear Verification Series No. 3), 2002, www.iaea.org/sites/default/files/iaea_safeguards_glossary.pdf.

¹² “The Present Status of IAEA Safeguards on Nuclear Fuel Cycle Facilities,” *IAEA Bulletin* 22, no. 3–4 (August 1980), (www.iaea.org/publications/magazines/bulletin/22-3/present-status-iaea-safeguards-nuclear-fuel-cycle-facilities), 5: “The Agency establishes in each particular situation the frequency and timing with which it must draw a conclusion as to whether there has been no diversion, as well as the quantity of material to which the conclusion refers, the probability of detection and the probability of a false alarm.

¹³ James A. Larrimore, “IAEA Safeguards Criteria,” *Journal of Nuclear Materials Management*, 21, no. 3 (May 1993), 19–23, www.resources.inmm.org/system/files/jnmm/vol_21/V-21_3.pdf.

¹⁴ IAEA, *Safeguards Implementation Report for 1990, Note by the Director General*, (GOV/2503), April 30, 1991.

The discovery of undeclared nuclear material and facilities in Iraq, as well as problems with the IAEA's efforts to ascertain the completeness of the DPRK's initial nuclear material declaration in 1992, raised a number of questions about the...practice of safeguards implementation and the drawing of safeguards conclusions.

Toward the State-Level Concept

The discovery of undeclared nuclear material and facilities in Iraq, as well as problems with the IAEA's efforts to ascertain the completeness of the DPRK's initial nuclear material declaration in 1992, raised a number of questions about the aforementioned practice of safeguards implementation and the drawing of safeguards conclusions. Importantly, those questions were not related to the application of IAEA safeguards to the declared nuclear material or facilities. Concerns were voiced only about the agency's efforts to confirm the completeness of the national declarations on nuclear material subject to IAEA safeguards in light of paragraph 2 of INFCIRC/153 (and, consequently, in accordance with all CSAs), which provides that the agency has "the right and obligation to ensure that safeguards will be applied ... on all source or special fissionable material in all peaceful nuclear activities within the territory of the State, under its jurisdiction or carried out under its control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices."¹⁵

In response to these concerns, the IAEA Board of Governors confirmed in February

1992 its understanding that the agency must provide assurances regarding the correctness and completeness of the nuclear material declarations by states that have concluded CSAs with the IAEA.

The Safeguards Statement for 1991, which was published in June 1992, used slightly modified language to the effect that the IAEA had not detected any event that would indicate the diversion of a significant quantity of nuclear material "placed under Agency safeguards."¹⁶ The Safeguards Statement for 1991 included a further passage prompted by the discovery of Iraq's undeclared nuclear material and activities recognizing that, "owing to limitations in the information available to the Agency and in the existing safeguards practices, non-compliance with agreements could occur without detection by the Agency, particularly at *non-declared facilities*. The Agency has, as a matter of urgency, examined these limitations and measures to strengthen the safeguards system have been proposed."¹⁷

Putting the IAEA Board of Governors' understanding into practice, in December 1993 the IAEA initiated Programme 93+2, which resulted in a set of measures designed to improve the IAEA's ability under CSAs to verify

¹⁵ IAEA, *The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*, (INFCIRC/153 (Corrected)), June 1972, Part I, para. 2, www.iaea.org/sites/default/files/publications/documents/infcircs/1972/infcirc153.pdf.

¹⁶ IAEA, "The Future of Nuclear Verification," Remarks of the Director General, October 17, 1997, www.iaea.org/newscenter/statements/future-nuclear-verification.

¹⁷ Ibid.

...almost 80 percent of the NPT non-nuclear-weapon states, or 145 states, have either signed or brought into force an AP to their respective CSA.

the non-diversion of declared nuclear material and to provide assurances of the absence of undeclared nuclear material and activities.

This culminated in the approval by the Board of Governors in May 1997 of the Model Additional Protocol, which contained provisions for broader access by the IAEA to locations within a state, more information to be provided by the state, and a number of administrative items designed to facilitate the implementation of safeguards.¹⁸ As requested by the board, the Model Additional Protocol is used as the standard for APs that are concluded by states and other parties to CSAs. At the time of this writing, almost 80 percent of the NPT non-nuclear-weapon states, or 145 states, have either signed or brought into force an AP to their respective CSAs—that is, almost 80 percent of the NPT non-nuclear-weapon states.¹⁹

In the intervening years, the Safeguards Statements in the SIRs for 1992 through 1998 distinguished between conclusions regarding the non-diversion of material that had actually been declared/placed under safeguards and issues associated with verifying the absence of undeclared nuclear material and activities (completeness), particularly in the cases of Iraq and the DPRK.

In the SIR for 1999, published in 2000, the IAEA Secretariat, for the first time, included text reflecting in its safeguards conclusions the results of its implementation of APs in two states: “Having completed the evaluation of all the information available to the Agency in respect of two States, including information obtained through activities pursuant to their comprehensive safeguards agreements and additional protocols, the Agency found no indication either of diversion of declared nuclear material or of the presence of undeclared nuclear material or activities in those States.”²⁰ The SIR for 1999 was also the first time a reference was made in the SIR to a “broader conclusion.”²¹

Naturally, the clarification that the IAEA must provide assurances regarding the correctness and completeness of the states’ declarations under CSAs led to changes in the approaches to the application of safeguards. These changes were discussed in detail in the course of Programme 93+2. Among the principal points made was the need to change from a facility-based approach to implementing safeguards to one in which the IAEA would look at the state as a whole, integrating the measures provided under the new authority granted to the IAEA with the measures under the IAEA’s

¹⁸ IAEA, *Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards* (INFCIRC/540 (Corrected)), December 1998, www.iaea.org/sites/default/files/infirc540c.pdf.

¹⁹ IAEA, “Status of the Additional Protocol,” August 13, 2020, www.iaea.org/topics/additional-protocol.

²⁰ IAEA, *Safeguards Implementation Report for 1999, Note by the Director General*, (GOV/2000/23), May 12, 2000.

²¹ GOV/2000/23, Section 1, “Background to the Safeguards Statement,” para. 7, reads as follows: “To be able to draw a conclusion about non-diversion of declared nuclear material and the broader conclusion about the absence of undeclared nuclear material and activities *for a State as a whole*, the Secretariat must first have drawn the conclusion about the non-diversion of declared nuclear material ...” (italics in original).

then-existing legal authority under CSAs. The fundamental premise of integrated safeguards was that, as confidence increased regarding the absence of undeclared activities required to convert declared nuclear materials into weapons materials, the intensity of safeguards on these declared materials might be lessened.

The IAEA Secretariat provided the Board of Governors with two reports on the development of integrated safeguards in 2000.²² In 2001, the IAEA began implementing state-level approaches (SLAs) for states for which the broader conclusion had been drawn. Although some considerations relating to the state as a whole were reflected in these approaches, the primary basis for determining safeguards activities at declared facilities in these states remained the safeguards criteria (adjusted to take into account the broader conclusion for those states).²³ In February 2002, the secretariat presented a report, *The Conceptual Framework for Integrated Safeguards*, to the board, outlining the overall objective and basic principles of integrated safeguards.²⁴ The report also described the safeguards concepts, approaches, guidelines, and criteria that govern the design, implementation, and evaluation of integrated safeguards.

These changes also brought about the evolution of the process used in the drawing of safeguards conclusions. Safeguards activities were no longer based solely on the application of safeguards to each facility; their new basis was an analysis at the level of the state of all

potential technically feasible acquisition paths that could be used to obtain nuclear material for a nuclear explosive device by means of both declared and undeclared nuclear activities, with subsequent verification.

The expression “state-level concept” was used for the first time in the SIR for 2004 to describe safeguards implementation that is based on SLAs developed using safeguards objectives common to all states with CSAs and taking into account state-specific factors. It was simply another term for the implementation of safeguards looking at the state as a whole rather than at the level of facilities, and tailoring those safeguards for individual states, which the IAEA had been doing since the mid-1990s. The IAEA Secretariat noted that the SLC was being implemented for states with integrated safeguards (i.e., for states with both a CSA and an AP and for which the broader conclusion had been drawn), and that it would be extended to all other states with CSAs.²⁵ In each of the Director General’s reports to the General Conference on safeguards from 2005 forward, a description of the SLC was included.²⁶

SLC Evolution and States’ Concerns

During this process of evolution, concerns were expressed by some member states about the implementation of the SLC, particularly with respect to the state-specific factors and information obtained from external sources (e.g., open-source data, information provided

²² IAEA, *The Development of Integrated Safeguards*, (GOV/INF/2000/4), March 9, 2000; IAEA, *The Development of Integrated Safeguards* (GOV/INF/2000/26), November 17, 2000.

²³ IAEA, *The Conceptual Framework for Integrated Safeguards* (GOV/2002/8), February 8, 2002.

²⁴ Ibid.

²⁵ IAEA, *Safeguards Implementation Report for 2004, Report by the Director General*, (GOV/2005/32), May 13, 2005, para. 68.

²⁶ IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System and Application of the Model Additional Protocol* (GC(56)/14), July 25, 2012, Section C.2; IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System and Application of the Model Additional Protocol* (GC(55)/16), July 26, 2011, Section C.2; IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System and Application of the Model Additional Protocol* (GC(54)/11), July 27, 2010, para. 12; IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System Including Implementation of Additional Protocols* (GC(53)/9), August 7, 2009, para. 12; IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System Including Implementation of Additional Protocols* (GC(52)/13), July 31, 2008, para. 4; IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System Including Implementation of Additional Protocols* (GC(51)/8), July 23, 2007, para. 7; IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System Including Implementation of Additional Protocols* (GC(50)/2), August 7, 2006, para. 7; IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System Including Implementation of Additional Protocols* (GC(49)/9), July 22, 2005, para. 7.



by other states). In 2012, several states objected that states lacked a clear description of the concept and that discussion was needed in the IAEA Board of Governors. Some states voiced the concern that practical implementation of the SLC could potentially lead the IAEA Secretariat in the direction of biased and politically motivated conclusions.

These concerns were discussed by the IAEA's Board of Governors and General Conference over a two-year period, which ended with the adoption in 2015 of a General Conference resolution calling for the implementation of state-level safeguards to be carried out in strict accordance with the existing safeguards agreements, and for the development and implementation of SLAs to be carried out in consultation with the respective states.²⁷

In the meantime, the IAEA Director General, acting in accordance with the 2012 General Conference's safeguards resolution,²⁸ submitted a report, GOV/2013/38,²⁹ to the Board of Governors that contained the first detailed description of the SLC. The report states that in order to exercise its right and discharge its obligation to ascertain the correctness and completeness of state declarations, the IAEA defines and carries out safeguards activities to achieve the following generic objectives at the state level. For states with CSAs, these generic objectives are (a) to detect any undeclared nuclear material or activity in the state as a whole; (b) to detect any undeclared production or processing of nuclear material at declared facilities or LOFs where nuclear material is customarily used; and (c) to detect any diversion of declared nuclear material at declared facilities or at LOFs where nuclear material is customarily used.³⁰

In response to requests made by several member states at the Board of Governors meetings in September 2013 and during consultations held in 2013–2014, the Director General circulated a supplemental document, GOV/2014/41,³¹ which clarified the information about the SLC provided in GOV/2013/38. As described in GOV/2014/41, the IAEA Secretariat, working in pursuit of generic objectives, develops for each state a set of technical safeguards objectives for use in the planning, implementation, and assessment of safeguards activities with regard to the state concerned. The technical safeguards objectives may differ from state to state depending on such factors as the state's nuclear fuel cycle and related technical capabilities.³² The technical

²⁷ IAEA, *Strengthening the Effectiveness and Improving the Efficiency of Agency Safeguards* (GC(59)/RES/13), September 2015, para. 23–25, www.iaea.org/sites/default/files/gc/gc59res-13_en.pdf.

²⁸ IAEA, *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System and Application of the Model Additional Protocol* (GC(56)/RES/13), September 2012, www.iaea.org/sites/default/files/gc/gc56res-13_en.pdf.

²⁹ IAEA, *The Conceptualization and Development of Safeguards Implementation at the State Level* (GOV/2013/38), August 12, 2013, armscontrollaw.files.wordpress.com/2012/06/state-level-safeguards-concept-report-august-2013.pdf.

³⁰ *Ibid.*, para. 15.

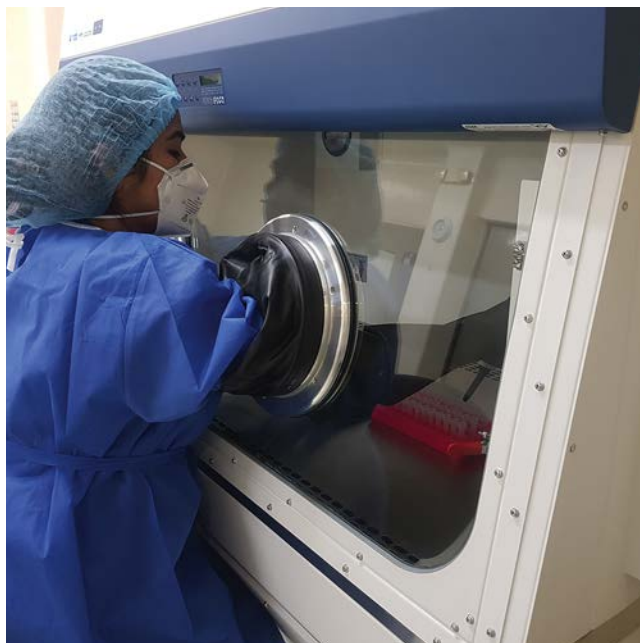
³¹ IAEA, *Supplementary Document to the Report on the Conceptualization and Development of Safeguards Implementation at the State Level* (GOV/2013/38) (GOV/2014/41), August 13, 2014, armscontrollaw.files.wordpress.com/2014/09/iaea-state-level-safeguards-document-august-2014.pdf.

³² *Ibid.*, para. 14.

objectives remain within the scope of the state's safeguards agreement and constitute a framework for defining the safeguards measures and carrying out safeguards activities with regard to the state as a whole.

These objectives are defined on the basis of the IAEA Secretariat's analysis of the pathways to the acquisition of nuclear material suitable for use in a nuclear weapon or a nuclear explosive device. As part of that analysis, the agency conducts a technical assessment for each state of the specific steps that the state could potentially take for each possible acquisition path (e.g., combining declared and undeclared nuclear activities), taking into account the state's nuclear fuel cycle and its existing capacity. The technical objectives are designed to detect such steps; achieving all these objectives should enable the secretariat to achieve all generic objectives with respect to that state. The document also emphasized that the focus of these measures is on nuclear material and does not involve judgments about a state's intention to pursue any such path.³³

To illustrate: If a state has a declared uranium conversion facility and a declared research reactor, then one of the possible acquisition pathways would consist of diverting some of the declared uranium from the conversion facility; undeclared production of uranium targets from the diverted uranium at an undeclared facility; undeclared irradiation of targets using the declared research reactor in order to produce plutonium; and undeclared reprocessing of the targets to extract plutonium from them. In such a case, the technical objectives may be set with the specific goal of detecting each step on that acquisition pathway: detecting the diversion of declared uranium from the conversion facility; detecting the undeclared production of uranium targets; detecting the misuse of the research reactor to irradiate the undeclared targets; and, finally, detecting the undeclared reprocessing of the irradiated targets.³⁴ Consequently, in order to detect the diversion of declared



uranium from the conversion facility and the misuse of the research reactor to irradiate the undeclared targets, the IAEA could use the already tried-and-tested approaches to facility-level safeguards. The new element in this concept is the setting of technical objectives for the detection of undeclared production of uranium targets and the detection of undeclared reprocessing of the irradiated targets. The approaches to achieving the technical objectives related to such actions by the state could include collecting environmental samples at the state's research facilities and assessing available open-source information about the state's research activities, as well as additional access in accordance with an AP (where applicable).

Whereas the generic objectives of state-level safeguards are the same for each state that has concluded a CSA, as noted above, the technical objectives, as described in paragraph 62 of GOV/2014/41, may differ from one state to another depending on various state-specific factors. The term "State-specific factors"³⁵ consist of six safeguards-relevant factors that are particular to a state, which are used by

³³ Ibid., para. 63.

³⁴ Ibid., para. 64.

³⁵ Ibid., para. 219.

the secretariat in the development of a state-level safeguards approach and in the planning, conduct, and evaluation of safeguards activities for that state. These factors are (1) the type of safeguards agreement in force for the state and the nature of the safeguards conclusion drawn by the agency; (2) the state's nuclear fuel cycle and related technical capacity; (3) the technical capacity of the state or regional nuclear material accounting and control system; (4) the implementation of specific safeguards measures; (5) the nature and scope of cooperation; and (6) the IAEA's experience.³⁶

Safeguards Decision-Making Process

The transition from traditional safeguards to safeguards according to the SLC has had a considerable impact on how the IAEA Secretariat implements safeguards. Some aspects of critical components of the concept, such as the above-mentioned state-specific factors and acquisition path analysis, would benefit from further elaboration and refinement. For this paper, of specific interest is the process used in evaluating the IAEA's verification activities for purposes of drawing the annual safeguards conclusions. Clearly, because of the increased work required for the provision of IAEA assurances regarding the correctness and completeness of states' declarations, the secretariat must perform many verification activities, including assessment of all safeguards-relevant information available to it. The secretariat must also analyze any apparent anomalies, discrepancies, questions, or inconsistencies detected as a result of its verification activities, and assess whether they point to matters of safeguards-related concerns.

Independent of the information provided in documents GOV/2013/38 and GOV/2014/4, it may be difficult for member states to understand the interactions between structural divisions of the IAEA Secretariat and their respective responsibilities for evaluating the agency's verification activities and making

judgments that lead to drawing safeguards conclusions. These documents suggest that much of that work is done by the state evaluation groups (SEGs) set up within the safeguards department for each state for which safeguards are implemented. While the documents note that the department has mechanisms for interaction and supervision to ensure that state assessments are conducted meticulously and consistently, and that it has a system of performance indicators related to the IAEA's safeguards objectives, they do not explain in detail how the SEGs conduct their assessments using the department's structured processes and methodologies in order to minimize any errors and avoid bias.

As noted in GOV/2014/14, performance measurement can generally be defined as a process of collecting, analyzing, and reporting information regarding the performance of an organization in achieving its objectives.³⁷ This process is important for the IAEA's ability to measure and report to member states information about its performance in achieving its objectives, which is done in the SIRs. As further noted in GOV/2014/41, "[t]he Agency's performance in regard to the objectives of safeguards implementation is the extent to which the Agency implements effective safeguards for each State in order to draw soundly based safeguards conclusions and provide credible assurances that the States are honoring their safeguards obligations."³⁸ As indicated in paragraph 165 of that document, the performance measures for safeguards activities conducted for declared facilities and LOFs are expressed in the safeguards criteria in terms of the probability of detecting the diversion of nuclear material within a specified period of time. It would be useful to learn more about the performance measures used in the evaluation of safeguards with respect to the verification of the absence of undeclared nuclear material and activities.

³⁶ Ibid., para. 108.

³⁷ Ibid., para. 163.

³⁸ Ibid., para. 164.



Returning to the subject of the safeguards conclusions and the process of formulating them: The main actors in that process are the SEGs, which assess all the available safeguards-relevant information for each state. The SEG is the first level in evaluating safeguards results and drawing safeguards conclusions for a given country, and it documents its assessment, including conclusions on the implementation of safeguards for the relevant state in a State Evaluation Report (SER). The conclusions and recommendations of the SEGs in the SERs are systematically reviewed internally. Their findings

are subject to approval by the director of the relevant operations division and discussed at an internal departmental committee, which then produces recommendations for the Director General on safeguards conclusions. After considering these recommendations, the Director General reports to the Board of Governors in the annual SIR on the evaluations and conclusions with respect to each state in which safeguards are implemented.

According to the 2018 SIR, IAEA safeguards were applied for 182 states in 2018. Safeguards under CSAs were applied for 174 states; of those CSA States, 129 had an AP in force. For 70 of the states with both a CSA and an AP in force, the IAEA Secretariat did not detect any indications of the diversion of declared nuclear material or any indications of undeclared nuclear material or activities. On the basis of those findings, the secretariat arrived at the conclusion that, for those 70 states, all nuclear material remained in peaceful activities.³⁹ The 2002 document on the conceptual framework for integrated safeguards (GOV/2002/8) states that all safeguards conclusions are subject to uncertainty; it might be useful for that point to be reiterated in the SIRs.⁴⁰

³⁹ IAEA, *The Safeguards Implementation Report for 2018* (GOV/2019/22), para. 1.a.

⁴⁰ IAEA, Board of Governors, *The Conceptual Framework for Integrated Safeguards, Report by the Director General* GOV/2002/8, 2002.

CONCLUSIONS AND RECOMMENDATIONS

The IAEA Secretariat is continuously engaged in the process of adjusting the implementation of safeguards to effectively meet the challenges of detecting and deterring non-compliance by states with their respective CSAs. This has meant that IAEA safeguards are evolving in a more complex and ambitious direction than had been deemed necessary before the revelations in the 1990s of systematic efforts by states to defeat detection.

Over the course of this nearly three decades of evolution, the challenges in incorporating the detection of undeclared nuclear material and activities, and perceived deficiencies in transparency about the internal processes of verification and drawing safeguards conclusions, have rendered it more difficult than in the past for member states to be assured that the conclusions drawn by the IAEA Secretariat are based on an adequate level of safeguards activities and careful assessment.

The IAEA has internal guidance documents that address virtually every step in safeguards implementation, as well as processes designed to ensure quality and consistency in the application of that guidance. As the evolution of the SLC proceeds, greater transparency concerning these processes, including sharing additional information by the IAEA Secretariat in that regard, could contribute to a better understanding of the processes and increased trust on the part of member states, in particular in situations where the secretariat detects incidents of safeguards concern or is not in a position to draw a positive conclusion about the non-diversion of declared nuclear material or the absence of undeclared nuclear material or activities. Because these internal processes are not considered particularly safeguards-sensitive, the secretariat should be able to comfortably share descriptive information about them.

Provision of additional descriptive information by the IAEA Secretariat to member states would be of benefit to both the secretariat and the member states. Member states' confidence in the effectiveness of the secretariat should thereby be enhanced, reducing member states interventions into the secretariat's ongoing safeguards implementation activities and decisions.

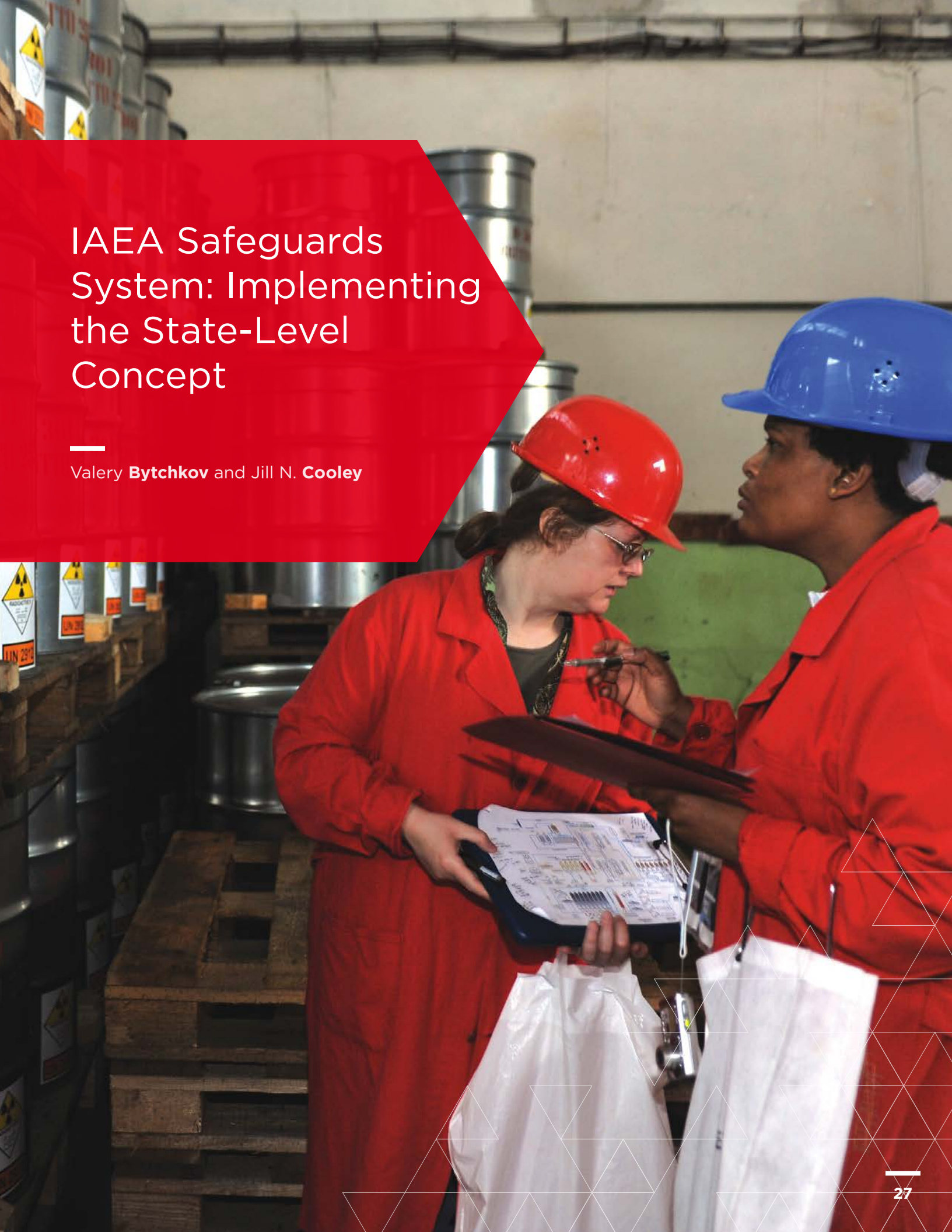
In consideration of the above, the following recommendations can be offered to the IAEA Secretariat:


1. Work in accordance with the key paragraph of GC(58)/RES/14 which “welcome[d] the intention of the Secretariat to continue to engage in open and active dialogue with States on safeguards matters, and to issue periodic update reports as the Agency and States gain further implementation experience.”⁴¹
2. Publish an article in the *IAEA Bulletin* that describes the process of drawing safeguards conclusions, including a description of the relationship between the IAEA structural units and their responsibilities in drawing those conclusions.
3. Prepare informative material for member states about how the secretariat works, with information from open sources and third parties, including a description of the process for corroborating such information for IAEA safeguards purposes.
4. Prepare informative material for member states about the performance indicators used to assess the efficiency and effectiveness of safeguards implementation and about quality control procedures used in the drawing of safeguards conclusions.

⁴¹ IAEA, *Strengthening the Effectiveness and Improving the Efficiency of Agency Safeguards* (CG(58)/RES/14), September 2014, www.iaea.org/sites/default/files/gc/gc58res-14_en.pdf.

IAEA Safeguards System: Implementing the State-Level Concept

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The International Atomic Energy Agency (IAEA) safeguards system has evolved dramatically over the past 25 years: its primary focus on individual facilities placed under safeguards has been expanded to the state as a whole pursuant to the type of safeguards agreement concluded with the IAEA. Reporting in the Safeguards Implementation Report (SIR) changed from conclusions drawn with regard to nuclear material and other items placed under safeguards at individual safeguarded facilities in the 1999–2003 period to safeguards conclusions drawn for each state with a safeguards agreement in force. The Model Additional Protocol, which was introduced in 1997, provided the IAEA with additional tools for verification of the correctness and completeness of states’ declarations for states with comprehensive safeguards agreements (CSAs). Such verification tools could not be applied at the facility level only; they required state-level considerations. State-level considerations first resulted in the development of integrated safeguards for states with CSAs and additional protocols (APs) for which the broader conclusion⁴² has been drawn. The initial version of integrated safeguards was a formal superposition of state-level verification procedures of additional protocols and facility-level verification procedures of CSAs. These two sets of verification activities, balanced to provide optimized effectiveness and efficiency, were defined in state-level approaches (SLAs) developed for each individual state under integrated safeguards.

Further elaborations led to formulating a more general idea of performing safeguards evaluations and verifications at the state level: the state-level concept (SLC) of safeguards implementation. This term was first introduced to the IAEA Board of Governors in the SIR for 2004. The idea arose on the grounds of safeguards effectiveness considerations. The traditional definition of the effectiveness of safeguards implementation—“the extent to which the safeguards objective is attained”—

had to be applied under the new circumstances of integrated safeguards. The safeguards objective—more precisely, the objective of verification procedures—was to be established now at the state level. Consequently, new generic objectives at the state level were developed for implementation in CSA states and reported in the SIR for 2005. The important clarification made in the SIR for 2005 was that the verification objective associated with the responsibility of the IAEA to verify the

⁴² The “broader conclusion” is a safeguards conclusion for a state with a CSA and AP in force that all nuclear material in the state remains in peaceful activities. It is drawn when the IAEA determines it has sufficiently high confidence in both the correctness and completeness of the state’s declarations of nuclear material based on an evaluation of all safeguards-relevant information available to the agency and on finding no indications of diversion of declared nuclear material or of undeclared nuclear material or activities.

completeness of a state's declarations was to be applied to all states with CSAs. Whereas the 2004 SIR noted that the SLC would be extended to all states with CSAs,⁴³ IAEA efforts during the 2000s were concentrated on implementing APs being brought into force, conducting verification and evaluation activities necessary to draw broader conclusions, and progressively developing and implementing SLAs for such states. Although these original SLAs were customized for individual states, the primary basis for determining safeguards activities at declared facilities in states under integrated safeguards remained the safeguards criteria, albeit with their application adjusted to take into account the broader conclusion for such states.

In 2010, internal IAEA efforts were refocused to further develop the SLC and apply it to all states, specifically integrating the state evaluation process with safeguards verification activities and moving from criteria-driven to objectives-based implementation through SLAs. These efforts, with a detailed description of the elements of SLC implementation, were described in two IAEA Board of Governors reports, in 2013 and 2014.^{44,45}

Since 2014, the IAEA has been progressively developing and implementing customized SLAs as described in the two Board of Governors reports, with a first priority on updating the 53 SLAs for states under integrated safeguards that existed as of 2014. (The task was completed in 2016.) As detailed in the 2019 Safeguards Statement and Background to the Statement,⁴⁶ as of December 31, 2019, SLAs had

been developed for 132 states: 67 states with the broader conclusion, 37 states with a CSA and AP in force without a broader conclusion (of which 25 are states with small quantities protocols (SQPs)), 27 states with a CSA only (all SQP states) and one NPT nuclear-weapon state with a voluntary offer agreement (VOA).⁴⁷ In 2018, a Board of Governors report was prepared containing the IAEA Secretariat's analysis of experience gained and lessons learned in the updating and implementation of SLAs for states under integrated safeguards.⁴⁸ Brief updates on the status of SLC development work and implementation are provided in the annual SIR and annual report to the General Conference. In addition, occasional technical meetings are conducted in Vienna for representatives of member states, providing more details on various aspects of safeguards implementation.

While the efforts to date are laudable and encouraging, there remain important questions and concerns from various member states on implementation of the SLC. This paper is structured around the five elements of SLC implementation. First the element and status of its implementation are described, and then relevant issues and concerns are identified. The paper concludes with recommendations regarding specific aspects of SLC implementation that warrant further development and/or reporting on in order for member states to understand safeguards implementation under the SLC; be assured that safeguards are being implemented objectively, effectively, efficiently, and without discrimination for all states; and have

⁴³ Later SIRs (beginning with the SIR for 2009) noted that the SLC was applicable to all states with safeguards agreements in force.

⁴⁴ IAEA, *The Conceptualization and Development of Safeguards Implementation at the State Level* (GOV/2013/38), August 2013, armscontrolaw.files.wordpress.com/2012/06/state-level-safeguards-concept-report-august-2013.pdf.

⁴⁵ IAEA, *Supplementary Document to the Report on the Conceptualization and Development of Safeguards Implementation at the State Level* (GOV/2013/38) (GOV/2014/41), August 2014, armscontrolaw.files.wordpress.com/2014/09/iaea-state-level-safeguards-document-august-2014.pdf.

⁴⁶ www.iaea.org/sites/default/files/20/06/statement-sir-2019.pdf.

⁴⁷ As of this date, there were 183 states with safeguards agreements in force and being applied as follows: 69 states with the broader conclusion, 62 states with a CSA and AP in force without a broader conclusion (43 with SQPs), 44 states with a CSA only (34 with SQPs), 5 states with VOAs, and 3 states with item-specific safeguards agreements.

⁴⁸ IAEA, *Implementation of State-Level Safeguards Approaches for States under Integrated Safeguards — Experience Gained and Lessons Learned* (GOV/2018/20), July 2018.

confidence in the safeguards conclusions being drawn and reported. Although the SLC is applicable to all states, detailed descriptions for several SLC elements are provided only for states with CSAs.

Elements of State-Level Concept Implementation

Establishment of Safeguards Objectives for a State

Element description and its status: The purpose of IAEA safeguards is to verify a state's compliance with its obligations under its safeguards agreement with the agency. To this end, the IAEA conducts verification and evaluation activities aimed at detecting possible indications of non-compliance. To develop and implement effective verification and evaluation procedures, the IAEA Secretariat establishes generic objectives on the basis of states' safeguards agreement; these generic objectives are common to all states with the same type of safeguards agreement. Under a CSA, the agency seeks to verify that all nuclear material required to be safeguarded is not diverted to nuclear weapons or other nuclear explosive devices. To do so, it conducts safeguards verification and evaluation activities to address the three generic objectives common to all states with CSAs, namely:

- To detect any diversion of declared nuclear material at declared facilities or locations outside facilities where nuclear material is customarily used (LOFs)
- To detect any undeclared production or processing of nuclear material at declared facilities or LOFs and
- To detect any undeclared nuclear material or activities in the state as a whole.

To address the generic objectives for a state, the secretariat establishes technical objectives to guide the planning, conduct, and evaluation of safeguards activities for that state. For states with CSAs, technical objectives are

established and prioritized through acquisition path analysis, a structured analytical method aimed at identifying technically plausible paths by which a state could acquire nuclear material suitable for a nuclear explosive device. Each path is made up of steps connecting the different stages of the nuclear fuel cycle (processes or activities), both declared and undeclared, leading to weapons-usable nuclear material. A technically plausible path is described by the secretariat as a path where a state could acquire a significant quantity of weapons-usable material in five years or less (path length). The technical objectives are focused on detecting and deterring any proscribed activity for each step along each technically plausible path. Technical objectives are prioritized to focus verification effort where it is most effective (i.e., not all steps in a path nor all paths need to be covered with the same level of verification effort). Factors considered in prioritization include path length, type and quantity of nuclear material, the state's technical capabilities, the agency's ability to address the path step, and the number of paths covered by a technical objective. Acquisition path analysis is conducted for a state by the state evaluation group (SEG) responsible for that state. (The roles of SEGs are described in more detail below.)

Issues/concerns:

- The results of acquisition path analysis depend on the judgment of each SEG about the technical capabilities of a particular state and the time it would need to develop a missing capability.
- The desire to produce narrow, customized technical objectives for each state may be, at the end, counterproductive; the results may lack objectivity and transparency.
- Comparative analysis of the existing SLAs by the IAEA Secretariat should be carried out to ensure consistency of SLAs with regard to technical objectives and the safeguards measures to attain them.

Development of a Customized Safeguards Approach for a State

Element description and its status: An SLA contains the generic and prioritized technical objectives and the applicable safeguards measures to address the objectives for an individual state. The identification of applicable measures takes into consideration the scope of the IAEA's legal authority and other state-specific factors (e.g., the possibility for the IAEA to carry out unannounced inspections effectively). Where possible, an SLA identifies more than one measure that could be used to address each technical objective, to provide for flexibility in implementation as well as comparison of the cost-effectiveness of the different measures. Frequency and intensity of implementing safeguards measures are determined on the basis of priority assigned to each technical objective. An SLA is executed through an annual implementation plan (i.e., a schedule of safeguards activities to be conducted for a state during a calendar year to meet the technical objectives).

Issues/concerns:

- The customized SLAs developed for individual states are internal documents not available to safeguards experts outside the IAEA Secretariat, including the state itself; an independent assessment of the effectiveness and efficiency of SLAs has not been performed.
- There is a need for evaluating the effectiveness of implementation of each SLA in order to see to what extent and how efficiently the technical objectives for each state have been attained and what implementation problems have been encountered.
- To enable the evaluation of the effectiveness of SLA implementation, performance targets determining the intensity and frequency for verification and evaluation activities need to be established.



Consideration and Use of State-Specific Factors

Element description and its status: State-specific factors are safeguards-relevant features and characteristics particular to an individual state that are used in the development of an SLA and in the planning, conduct, and evaluation of safeguards activities for that state. The IAEA has identified six state-specific factors: (1) the type of safeguards agreement in force for the state and the nature of the safeguards conclusion drawn by the IAEA; (2) the nuclear fuel cycle and related technical capabilities of the state; (3) the technical capabilities of the state or regional system of accounting for and control of nuclear material (SSAC/RSAC) (e.g., does the state authority conduct national inspections or audits; does it possess and use its own verification equipment); (4) the ability of the IAEA to implement certain measures in the state (e.g., remote data transmission; unannounced/short-notice inspection schemes); (5) the nature and scope of cooperation between the IAEA and the state in the implementation of safeguards (e.g., the timeliness and completeness of state reports; facilitation of inspector access; responsiveness to addressing anomalies,

questions, or inconsistencies); and (6) the IAEA's experience in implementing safeguards in the state (e.g., the number and type of unresolved anomalies; local security conditions impeding IAEA access). These six factors have been identified based on experience gained during safeguards implementation in states for many years. Under the SLC, more systematic consideration and better use of state-specific factors is intended to facilitate the further optimization of safeguards implementation.

Issues/concerns:

- The objectivity of several state-specific factors (e.g., cooperation, SSAC technical capabilities) has been questioned.
- How state factors are systematically and objectively assessed and specifically used in safeguards implementation for an individual state is not clear.
- Implementation of state-specific factors should be analyzed within the framework of the effectiveness evaluation and the results reported in the SIR.

Evaluation of All Safeguards-Relevant Information Available to the IAEA about a State

Element description and its status: The collection and evaluation of all safeguards-relevant information available to the IAEA underlies all aspects of SLC implementation. Collection and analysis of a wider range of safeguards-relevant information regarding states' nuclear and nuclear-related activities began in the mid-1990s to assess the correctness and completeness of state declarations, in particular for states with CSAs. Over the years, the agency has improved its infrastructure and analysis capabilities to collect, validate, evaluate the consistency of, disseminate, protect, and archive safeguards-relevant information. Enhancements continue to be made. Under the SLC, the types of information used (i.e., state-provided information, information generated from

safeguards activities, and other relevant information, such as open-source information and information provided voluntarily by other states) remain the same, with the overwhelming majority of information coming from states themselves and agency safeguards activities.

A key element supporting the move from safeguards implementation and conclusions drawn at the facility level to implementation and conclusions drawn at the state level is the state evaluation process. This process involves the ongoing evaluation of all safeguards-relevant information available to the IAEA about a state, in order to assess the consistency of that information in the context of the state's safeguards obligations. Information provided by the state is reviewed for internal consistency, for coherency with results of safeguards verification activities, and for compatibility with all other available information. Critical to the state evaluation process is the identification of anomalies or inconsistencies requiring follow-up through, for example, the acquisition of further information or the performance of additional in-field verification activities.

State evaluation for an individual state is conducted by a SEG assigned to the state. A SEG is a team of safeguards staff members with the appropriate expertise to collaboratively evaluate all safeguards-relevant information available to the IAEA about a state and document the consistency analysis and its findings, including all anomalies, questions, and inconsistencies, in a State Evaluation Report (SER). A SEG is also responsible for conducting the acquisition path analysis, developing the SLA, and preparing annual implementation plans.

It was reported in an IAEA paper presented at a professional society meeting in 2019 that the internal template and guidance for producing SERs had been recently updated to explicitly include state-specific factors, the continued validity of the acquisition path analysis, key assessments supporting the SLA, an evaluation of the state's fulfillment of its safeguards obligations, the consistency of safeguards-relevant information, and the effectiveness in

implementing planned safeguards measures.⁴⁹ A presentation and/or report describing the guidance details and its application would address a number of concerns raised in this paper. Furthermore, it appears that the assessments being conducted and documented in SERs would support more detailed reporting in the SIR.

Issues/concerns:

- Concerns have been raised with respect to the functioning of the SEGs and the thoroughness of their reviews and documentation. (These concerns were recently acknowledged, inter alia, in the publication cited above.)

Drawing and Reporting of a Safeguards Conclusion for a State Each Year

Element description and its status: The final products of safeguards implementation are safeguards conclusions. These conclusions must be independent and soundly based—that is, they must be drawn by the IAEA on the basis of its technical findings. Once a year, the agency draws a safeguards conclusion for each state with a safeguards agreement in force on whether the state has complied with its safeguards obligations. These conclusions are reported to the agency's member states in the annual SIR. These conclusions serve to provide member states with credible assurances that states are meeting their safeguards obligations. The type of conclusion drawn is a function of two aspects: the safeguards agreement in force, and any protocols thereto, and the results and findings of agency verification. The bases for these conclusions are the results of

state evaluations conducted during the course of the previous year, which are documented in an SER prepared for each state by the relevant SEG. To draw an independent and soundly based safeguards conclusion for a state, the agency needs to have conducted a sufficient level of safeguards activities and a comprehensive evaluation of all safeguards-relevant information available to it about the state, including the results of its verification activities. It also needs to have addressed all anomalies, questions, and inconsistencies identified in the course of its safeguards activities, and assessed whether there are any indications that constitute a proliferation concern. A safeguards conclusion that a state is complying with its safeguards obligations is drawn when the necessary safeguards activities have been completed and no indication has been found (i.e., there are no “findings”) by the IAEA Secretariat that, in its judgment, would constitute a proliferation concern.

Issues/concerns:

- The SIR as currently written provides little detail on the IAEA Secretariat's performance in achieving its safeguards objectives (safeguards effectiveness) or on the performance of individual states in meeting their safeguards obligations. Member states are not able to ascertain with the information provided that safeguards implementation was effective and efficient, and the conclusions drawn were technically sound, for each state. More detailed information on state and agency performance needs to be provided in the SIR or another type of report available to member states.

⁴⁹ Massimo Aparo and Therese Renis, “Implementation of Safeguards at the State Level—Developments Based on Recent Experience,” in *Proceedings of the 60th Annual Meeting of the Institute of Nuclear Materials Management* (Red Hook, NY: Curran Associates, 2020), 759–764, <http://toc.proceedings.com/53287webtoc.pdf>.

RECOMMENDATIONS


Recommendations to address the issues and concerns raised throughout this report hinge on the development or refinement of several methodologies and on transparency in the reporting of processes and results. Although transparency needs to be balanced with confidentiality concerns, objectivity, and consistency, the effectiveness and efficiency of safeguards implementation under the SLC need to be demonstrated to member states through more reporting to the IAEA Board of Governors (e.g., through the annual SIR, annual General Conference report, technical meetings, additional board reports). In recognition that the development efforts are a work in progress, the IAEA Secretariat should be encouraged to provide more detailed status reports to the board on the work as it develops, as opposed to presenting it as a *fait accompli* after implementation begins. The following recommendations can be offered to the IAEA Secretariat:

1. Develop standardized methods for assessing states' technical capabilities and estimating the time it would take proliferators to complete acquisition path steps and paths.
2. Develop a technical procedure for establishing performance targets to determine the intensity and frequency for conducting activities and to evaluate the effectiveness of safeguards activities in meeting the technical objectives.
3. Create a presentation (e.g., technical meeting) and/or report on the new SER template as well as guidance for a better understanding of consistency analysis, the evaluation and application of state-specific factors, the evaluation of a state's fulfillment of its safeguards obligations, and the agency's performance in safeguards implementation.
4. Provide more detailed information in the SIR (or other report available to member states) on the IAEA Secretariat's performance in achieving its safeguards objectives (safeguards effectiveness) and on the performance of individual states in meeting their safeguards obligations (state-by-state reporting).

A full-page background image showing a male worker in a yellow protective suit, yellow helmet, and safety glasses. He is wearing white gloves and is focused on a piece of equipment. The equipment has a blue rectangular component with a barcode label. He is standing on a metal platform or walkway. In the background, there is a large industrial facility with a high ceiling, steel beams, and various pipes and structures. A large green pipe runs diagonally across the frame. The overall scene is brightly lit, typical of an industrial environment.

IAEA Safeguards: Preparing for the Future

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The International Atomic Energy Agency (IAEA) safeguards system plays a crucial role today as the principal mechanism for verifying compliance of states with their safeguards agreements with the IAEA and thus enhancing the international nuclear non-proliferation regime. IAEA safeguards also support the peaceful use of nuclear energy, advancing practically all sustainable development goals by assuring that such peaceful use does not contribute to the proliferation of nuclear weapons. To continue to serve these two tasks, the IAEA safeguards system must remain independent, technically sound, and transparent amid growing internal and external challenges to the IAEA's ability to continue providing credible assurances that states are honoring their safeguards obligations—particularly challenges to detecting indications of undeclared nuclear material or activities. Addressing these challenges, the IAEA will continue to need support and cooperation from its member states, especially from such countries as the Russian Federation and the United States.

Present Status of IAEA Safeguards Implementation and Challenges

According to the IAEA, in 2019, IAEA safeguards were applied in 183 states with safeguards agreements in force with the agency, and 136 states had both a comprehensive safeguards agreement (CSA), as required by the NPT, and an additional protocol (AP) in force. Safeguards were implemented at 1,324 facilities and locations outside facilities (LOFs) holding 216,448 significant quantities of nuclear material. Available resources for the IAEA Secretariat for safeguards included 862 staff and consultants from 93 countries, and €142.9 million in regular budget and €20.2 million in extra-budgetary funding. As the result of safeguards implementation in 2019, the IAEA Secretariat concluded that for 69 states all nuclear material remained in peaceful

activities; for 106 states all declared nuclear material remained in peaceful activities; for three states nuclear material, facilities, or other items to which safeguards had been applied remained in peaceful activities, and for five states nuclear material in selected facilities to which safeguards had been applied remained in peaceful activities.⁵⁰

These figures illustrate the amount of activity the IAEA Secretariat expended in implementing IAEA safeguards in 2019. To some extent, they serve as a measure of the amount of work carried out by the agency, though not its complexity or effectiveness. Safeguards effectiveness has at least two components: (a) the ability to detect noncompliance by a state with its obligations under its safeguards agreement and (b) the deterrent effect against such violations created by this detection capability. Therefore, if the ability to detect any

⁵⁰ IAEA, "IAEA Safeguards in 2019," www.iaea.org/sites/default/files/20/06/sg-implementation-2019.pdf.



noncompliance is high, then the deterrence effect is presumably also high.

The IAEA Secretariat is currently going through a transition from the traditional facility-level approach (FLA) to a state-level concept (SLC), which was introduced in 2004 in the context of integrated safeguards for states for which the broader conclusion had been drawn.⁵¹ Pursuing the SLC, in recent years the agency has gained experience in developing and implementing state-level approaches (SLAs) in states with both a CSA and an AP in force, for which the broader conclusion had been drawn. On the basis of that experience, the agency has carried out further activities to enhance the methods and the internal standards used in the developing the SLAs. Finishing the development and finalizing the transition from FLA to the SLA is important, together with considering the effectiveness of the related secretariat activities.

The IAEA Safeguards Statement for 2019⁵² identified some areas where the agency continued to experience difficulties with safeguards implementation:

- Shortcomings in the performance and the effectiveness of state and regional authorities (SRAs) responsible for safeguards implementation and their respective systems of accounting for and control of nuclear material (SSACs/RSACs) had a significant impact on the effectiveness and efficiency of agency safeguards implementation.
- Some SRAs were deficient in one or more of the following areas: providing safeguards information to the agency; providing access to the agency to conduct in-field verification activities; providing sufficient technical effectiveness of SSACs; and providing adequate cooperation and logistical support related to the agency's verification activities in the field or at headquarters. Addressing these deficiencies required additional costs, effort, and resources for the IAEA and also, in many cases, for the SRAs and for nuclear facility operators.
- At the end of 2019, 32 states had operative small quantities protocols (SQPs) that had yet to be amended.

⁵¹ The IAEA believes that, given the full exercise of its inspection rights as provided in a CSA and an AP, when finding no unresolved questions, it is reasonable to conclude that all nuclear material belonging to the state or under its control remains committed to peaceful use. This is the essence of the "broad" conclusion.

⁵² Safeguards Statement for 2019, www.iaea.org/sites/default/files/20/06/statement-sir-2019.pdf.

Looking into the Future and Potential Challenges

The future of the IAEA safeguards system will depend on (1) the sustainability of the international nuclear non-proliferation regime and the possible development of other international instruments that could require IAEA safeguards as stipulated in the Article III.A.5 of the IAEA Statute; and (2) major developments in the peaceful use of nuclear energy.

On (1), there are no indications that in the foreseeable future there will be any change that will have a major impact on the international nuclear non-proliferation regime or that any near-term requirement for an additional safeguards mission for the IAEA under Article III.A.5 of the statute will emerge. There are no negotiations underway to resolve the Democratic People's Republic of Korea (DPRK) file; negotiations on a treaty banning fissile material production for use in nuclear weapons are blocked at the Conference on Disarmament in Geneva; and although the Treaty on the Prohibition of Nuclear Weapons may enter into force, no state possessing nuclear weapons is a signatory of this treaty.

Regarding (2), new developments in the of peaceful use of nuclear energy could create some challenges arising from emerging nuclear technologies in civil nuclear power, such as small- to medium-capacity reactors—especially factory-built units and floating nuclear power plants. Also, major issues remain for safeguards implementation, including the decommissioning of permanently shut-down or closed-down reactors, and the legacy of spent fuel.

It will be important to continue to develop new safeguards technologies and methods for improving safeguards' effectiveness and efficiency. Some topics that should be considered are enhanced physical models of nuclear fuel cycles; robotic techniques for the acquisition and integration of signals from various instruments and sensors; artificial intelligence for safeguards information gathering and analysis and for reviewing

compliance; new methods and procedures to detect undeclared nuclear material and undeclared activities; the use of virtual reality to improve inspector and SSAC training; the use of space-based or aerial drone data-collection platforms under IAEA control; the use of distributed ledger methods for accounting for nuclear material; and the use of analog/digital data-stream-monitoring concepts for liquid-core reactors (e.g., molten salt) and process and waste streams in reprocessing plants (aqueous and non-aqueous processes).

Safeguards by Design

The importance of safeguards by design (SBD) and its relevance to the more efficient development of IAEA safeguards in the past has been extensively documented by the IAEA. Designing and building more safeguardable facilities is not only an aid to the IAEA and to the facility operator in developing and accommodating inspection activities; it can also reduce the complexity and safeguards challenges of design verification and increase the transparency of facility operations. Therefore, it is important that states developing or planning new nuclear installations cooperate with the IAEA at an early stage to understand when and how SBD of these installations will be implemented and contribute to better safeguards. Issues such as verification of the design, construction, and operation of the facility; access to the inventory of nuclear materials and flows; and verification and confirmation that the facility is functioning in the declared mode and is not being misused should be considered priority issues for such discussions. As part of future cooperation, the Russian Federation and the United States could assist the IAEA in encouraging governmental organizations and associated design and engineering companies to incorporate SBD. Further cooperation could also include working with the IAEA in describing how SBD contributes to strengthening an SLA. With transparency in mind, it would be useful if the IAEA could then revise its guidance on the issue in order to clarify the place of SBD in the SLC.

The IAEA has accumulated an impressive inventory of safeguards equipment that currently includes about 30,000 items. Planning new acquisitions, hardware and software maintenance, and phasing out obsolete equipment are continuing challenges for the Department of Safeguards.

Communications, Human Resources, and Competencies

There is a need to enhance communications between the IAEA Department of Safeguards and SRAs, who create national reports that are used by the IAEA to plan timely inspection activities. The reports are later analyzed together with inspection results by the Department of Safeguards and reflected in the Safeguards Implementation Reports (SIRs). Without the timely submission of accurate national reports, inspection activities might be delayed or incomplete, or might result in more intrusive inspections than otherwise necessary. This could possibly result in inadequate or inaccurate information for preparing the SIR and thus compromise the Safeguards Conclusion.

There continue to be situations where IAEA inspectors, SRA representatives, and facility operators may disagree. However, selecting qualified agency staff and training them in the practice of clear and factual communications and educating SRA representatives and facility operators on their safeguards obligations should allow the interests of all parties to be addressed. This is not a new problem, but one that might benefit by joint study.

Regarding IAEA safeguards staff resource management, priority should be given to preserving the expertise of deserving inspectors and analysts and maintaining continuity in the work of the Department of Safeguards. Noting that certain aspects of safeguards staff resource

management have improved over time (e.g., job interviews have become mandatory, the hiring process has become more transparent, and training is intensive and ongoing so that today's inspectors and analysts now have better skills), there remain disparities both in selecting new staff and in terminating marginally performing staff.

Safeguards Instrumentation

Throughout the years, the IAEA has accumulated an impressive inventory of safeguards equipment that currently includes about 30,000 items. Planning new acquisitions, hardware and software maintenance, and phasing out obsolete equipment are continuing challenges for the Department of Safeguards.

Development of multifunctional equipment that can be used in the field for different types of measurements could improve the efficiency of safeguards equipment management. Because equipment failures can wreak havoc, such multifunctional equipment should include capabilities for very high operational reliability, autodiagnosics, and in-field repair by inspectors.

Safeguards Implementation in Extreme External Situations

The COVID-19 pandemic has shown that the IAEA may have to cope with situations that could adversely impact safeguards implementation—for example, by imposing

restrictions on travel, by closing national borders or restricting safeguards access to locations, or by reductions in safeguards funding. Other crises will happen—caused not only by health impacts such as COVID-19, but perhaps by climate change, regional conflict, or economic crises. It would be useful to examine what the Russian Federation and the United States might support to alleviate the impacts of such future events.

Readiness for Potential Verification Activities in the DPRK

Should a new agreement with the DPRK be concluded, it is quite likely that the IAEA would be asked to verify certain of its provisions and eventually apply safeguards under the existing DPRK CSA and a new AP, possibly similar to IAEA verification in Iran under United Nations Security Council Resolution 2231. Although at the moment progress on solving the nuclear issues on the Korean Peninsula seems to have reached a stalemate—and it may take years before the need for verification activities in the DPRK comes—it remains important to preserve the knowledge and skills in this area, building on the experience gained when the IAEA was working in the DPRK. The agency needs to remain ready, but at the same time it should reasonably refrain from significant commitments (both financially and in terms of human resources) until there is an encouraging level of progress to proceed with verification activities.

A related possibility could be to train specialists from the DPRK on IAEA safeguards implementation. The interest in such an initiative has been expressed in Pyongyang. (Similar trainings have previously been conducted in partnership of the IAEA and Australian Safeguards and Non-proliferation Office.) The latest suggestion for a similar system—training on disarmament by the United Nations Office for Disarmament Affairs—was blocked by a European country after a series of DPRK missile tests. In the meantime, this is something that should be kept in mind as an avenue for potential cooperation with the DPRK.

Specific Areas for Cooperation

Ongoing cooperation between the Russian Federation and the United States could include the following:

- Assistance to the IAEA Secretariat in developing or upgrading existing methodologies used in the SLC—for example, acquisition path analysis—to bring them to the state of the art to achieve the stated goal of each SLA. Data analysis methods and tools need to be explored to strengthen the synthesis and evaluation of information, including quantitative and qualitative verification data.
- Assistance to the IAEA Secretariat in developing methodologies for the analysis and validation of open-source information and information from third parties.
- Assistance to the IAEA Secretariat in developing reference materials and tools needed for the state evaluation groups in their assessment of a states' capability to accomplish the individual steps of acquisition pathways analyses. Such assistance could provide a way to increase transparency between the IAEA Secretariat and the IAEA member states.
- Assistance to the IAEA Secretariat in improving and upgrading technical capabilities in and approaches to verification, especially in light of the need, as demonstrated by COVID-19, for flexibility in adapting to demanding circumstances. Possible assistance might, inter alia, include more intensive utilization of unattended containment/surveillance systems and of monitoring and measurement systems with secure data transmission; expanding the use of remote inspection activities utilizing state-of-the-art cyber security technology; and assistance to the IAEA in offsetting limitations in normal services—for example, in providing travel when commercial transportation is stopped.

Cooperation between the United States and the Russian Federation in the area of IAEA safeguards should be organized and implemented at both intergovernmental and non-governmental levels.

- Assistance to the IAEA Secretariat in human resource management and training.
- Joint studies of potential ways to strengthen safeguards implementation: the universality of the AP; the potential relevance of the results of the November 2018 IAEA Safeguards Symposium and other technical meetings on IAEA safeguards; the reaffirmation of broader conclusions; and the future content and format of the SIR.

Potential Mechanisms for Cooperation

Cooperation between the United States and the Russian Federation in the area of IAEA safeguards should be organized and implemented at both intergovernmental and non-governmental levels.

Unfortunately, today it is very difficult to talk about intergovernmental cooperation; relations between the countries are at a very low level. At the same time, it should be remembered that in the past when relations were very difficult, it

was still possible to maintain intergovernmental cooperation on nuclear non-proliferation and IAEA safeguards. It might be possible, for example, to have consultations on topics related to safeguards implementation presented in GOV and GC documents⁵³ under consideration by the IAEA Board of Governors or the General Conference, or in SIRs. It could also be worthwhile to improve the interaction between the Russian and American experts participating in Standing Advisory Group on Safeguards Implementation work and in safeguards technical working groups.

Due to the existing difficulties of interaction at the governmental level, cooperation through non-governmental organizations and interaction of expert communities is becoming increasingly important. The current project between CENESS and NTI is a good example. Given the results obtained during the implementation of this project, a long-term program of joint research in the field of IAEA safeguards could be developed.

⁵³ Official documents provided by the Director General to the Board of Governors or to the General Conference to convey information or to request specific actions.

CONCLUSIONS

1. The IAEA safeguards system plays a crucial role as the mechanism for verifying compliance of states with their safeguards agreements with the IAEA, and thus enhancing the international nuclear non-proliferation regime. IAEA safeguards also support the peaceful use of nuclear energy, contributing to reaching practically all sustainable development goals by assuring that such peaceful use does not contribute to the proliferation of nuclear weapons.
2. To serve these two tasks, the IAEA safeguards system must remain independent, technically sound, and credible.
3. There are growing internal and external challenges to the ability of the IAEA to continue providing credible assurances that states are honoring their safeguards obligations, particularly challenges in detecting indications of undeclared nuclear material or activities.
4. To address these challenges, the IAEA will need support and cooperation from its member states, especially from such countries as the United States and the Russian Federation.
5. Even in light of the fact that relations between these countries are at a very low level, it should still be possible at least to maintain cooperation at the governmental level on nuclear non-proliferation and IAEA safeguards on issues discussed in the IAEA governing bodies.
6. Cooperation through non-governmental organizations and interaction of expert communities is becoming increasingly important, as the current project between CENESS and NTI demonstrates. It seems reasonable to continue consultation by experts and exchange information regarding new developments in the IAEA safeguards area. The results obtained during the implementation of this project suggest that a long-term program of joint research in the field of IAEA safeguards should be developed.

Participants

The following individuals participated in the 2019–2020 CENESS-NTI joint project on the future of IAEA safeguards:

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About the Nuclear Threat Initiative




NTI is a nonprofit, nonpartisan global security organization focused on reducing nuclear and biological threats imperiling humanity. Founded in 2001 by former U.S. Senator Sam Nunn and philanthropist Ted Turner, who continue to serve as co-chairs, NTI is guided by a prestigious international board of directors. Ernest J. Moniz serves as co-chair and chief executive officer; Joan Rohlfing is president and chief operating officer. **www.nti.org**

About the Center for Energy and Security Studies

The Center for Energy and Security Studies (CENESS) is an independent, non-governmental think-tank established in 2009. Headquartered in Moscow, the main goal of CENESS is to promote independent, unbiased, systematic, and professional analyses related to nuclear nonproliferation and atomic energy with a special emphasis on international cooperation of Russia in these areas. The founding director of the Center is Anton Khlopkov. **www.ceness-russia.org**



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