PROJECT ON MANAGING THE ATOM

Future Directions in IAEA Safeguards

John Carlson

HARVARD Kennedy School
BELFER CENTER
for Science and International Affairs

DISCUSSION PAPER
NOVEMBER 2018

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About The Project On Managing the Atom

The Project on Managing the Atom (MTA) is the Harvard Kennedy School's principal research group on nuclear policy issues. Established in 1996, the purpose of the MTA project is to provide leadership in advancing policy-relevant ideas and analysis for reducing the risks of nuclear and radiological terrorism; stopping nuclear proliferation and reducing nuclear arsenals; lowering the barriers to safe, secure, and peaceful nuclear energy use; and addressing the connections among these problems. Through its fellows program, the MTA project also helps to prepare the next generation of leaders for work on nuclear policy problems. The MTA project provides its research, analysis, and commentary to policy makers, scholars, journalists, and the public.

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Based in Australia, John Carlson is an Associate with the Project on Managing the Atom and a consultant to the Nuclear Threat Initiative (NTI) and others on international nuclear security, safeguards and verification, and management of the nuclear fuel cycle. He is a member of the Asia Pacific Leadership Network, the Advisory Council of the International Luxembourg Forum, and VERTIC's International Verification Consultants Network. Carlson was an official in the Australian government for more than four decades.

Before retiring from government, Carlson was director general of the Australian Safeguards and Non-proliferation Office. He was appointed as chairman of the Standing Advisory Group on Safeguards Implementation by former International Atomic Energy Agency (IAEA) Director General Mohammed ElBaradei and served from 2001 to 2006. He also served as Alternate Governor for Australia on the IAEA Board of Governors.

Carlson was a member of the Advisory Board of the International Commission on Nuclear Non-Proliferation and Disarmament and was founding chair of the Asia-Pacific Safeguards Network. He is a fellow of the Institute of Nuclear Materials Management and recipient of the Institute's Distinguished Service Award. Carlson has written numerous papers and presentations on nuclear nonproliferation, disarmament and verification issues. In June 2012 Carlson was awarded the national honor of Member of the Order of Australia (AM).

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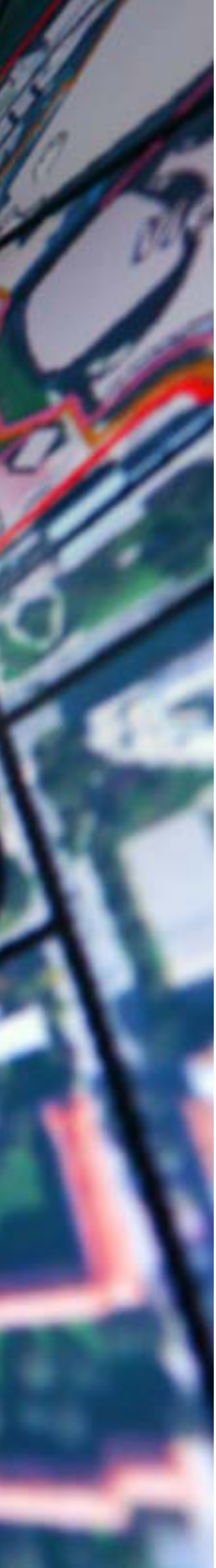
Satellite Imagery facilities at the IAEA Department of Safeguards, March 2015 (Dean Calma/IAEA via Flickr).



I. Introduction

The concept of nuclear safeguards was outlined by the United States, United Kingdom and Canada in the 1945 Agreed Declaration on Atomic Energy. This called for the establishment of an Atomic Energy Commission to make proposals, *inter alia*, for:

> *… effective safeguards by way of inspection and other means to protect complying states against the hazards of violations and evasions.*[1]

The first safeguards inspections were undertaken by nuclear exporters, to verify peaceful use commitments which they required from states to which they supplied nuclear equipment and materials. After the International Atomic Energy Agency (IAEA) was established in 1957, it gradually took over this inspection activity and began the development of the IAEA safeguards system. Subsequently, through its role under the Nuclear Non-Proliferation Treaty (NPT), the safeguards system has evolved into a key mechanism contributing to international peace and security.

Prior to the NPT, many states were considering the development of nuclear weapons, or at least establishing nuclear latency, that is, the technical capability to develop nuclear weapons. With the conclusion of the NPT in 1968, non-nuclear-weapon states joining the treaty committed, under Article III, not to acquire nuclear weapons, and to accept IAEA safeguards on all their nuclear material to verify this commitment.

Without effective verification, states would have continued to regard each other's nuclear programs with suspicion, and many would have continued to pursue a nuclear weapon option "just in case". The growth of civilian nuclear programs would have led to increasing international tensions. Instead, IAEA safeguards provide confidence that civilian nuclear activities are not a cover for military programs.

1 Harry Truman, Clement Attlee, and W. L. MacKenzie King, "Agreed Declaration Relating To Atomic Energy," Washington D.C., November 15, 1945. https://iea.uoregon.edu/treaty-text/1945-declarationatomicenergyentxt.

Today all non-nuclear-weapon states but one (the new state of South Sudan) are party to the NPT. Accordingly, all the world's nuclear material outside the nine nuclear-armed states[2] is legally subject to IAEA safeguards.

Although usually thought of in terms of combatting the spread of nuclear weapons (horizontal proliferation), effective safeguards are also essential to achieving a nuclear-weapon-free world. Non-proliferation is not only an important end in itself, but a necessary condition for achieving nuclear disarmament. The nuclear-armed states will never proceed with substantial nuclear reductions and elimination of nuclear weapons if they believe new nuclear threats will emerge.

For safeguards to continue upholding non-proliferation, and to provide a foundation for nuclear disarmament, it is essential for all states to have confidence that safeguards are effective, that they will enable the detection of major violations in time for preventive action to be taken. In 1991, confidence in safeguards received a serious setback with the discovery of Iraq's clandestine nuclear weapon program. This was a clear case of safeguards non-compliance, that is, the diversion of nuclear material to nuclear weapons or to "purposes unknown."[3] A safeguards violation sufficiently serious to constitute non-compliance is effectively a violation of the NPT itself.[4]

Since 1991 a number of other cases of non-compliance have come to light. The Iraq case led to an international program by the IAEA and member states to strengthen safeguards, particularly the capability to detect undeclared nuclear activities. This work remains ongoing.

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2 In the case of the five nuclear-weapon states recognized by the NPT (United States, Russia, United Kingdom, France and China), and the three nuclear-armed states that never joined the NPT (India, Pakistan and Israel) IAEA safeguards can potentially be applied to all or some civilian nuclear activities (depending on which state), although in most of these states actual safeguards inspections are quite limited. The IAEA prioritizes its limited safeguards resources to verifying the non-proliferation commitments of non-nuclear-weapon states. North Korea, which was an NPT party but declared that it had withdrawn in 2003, currently does not accept safeguards.

3 Safeguards non-compliance is referred to in the IAEA Statute, Article XII.C, and the model NPT safeguards agreement, INFCIRC/153, paragraphs 19 and 28.

4 There is no established definition of "non-compliance," but it is generally considered to be a safeguards violation in circumstances where a nuclear weapon purpose could be involved. See John Carlson, "Defining Noncompliance: NPT Safeguards Agreements," *Arms Control Today*, Vol. 39, No. 4 (May 2009), http://www.armscontrol.org/act/2009_5/Carlson. See also Trevor Findlay, *Proliferation Alert! The IAEA and Non-Compliance Reporting*, Project on Managing the Atom, Belfer Center for Science and International Affairs, Harvard Kennedy School, October 2015. https://www.belfercenter.org/sites/default/files/files/publication/proliferationalert-web.pdf

Today the safeguards system faces further serious challenges. The international nuclear order is being shaken by developments including:

- a rise in international tensions—essentially a new Cold War—largely due to increasingly nationalistic policies and greater competition among the major powers, and increasing disregard for international rules and institutions;
- inaction on nuclear arms control, nuclear risk reduction and disarmament, exacerbated by nuclear "modernization" programs and new strategic doctrines that increase the salience of nuclear weapons and lower the threshold for their use;
- the prospect of greater spread of proliferation-sensitive nuclear technologies, and increasing interest in the Middle East and elsewhere in developing latent nuclear weapon capabilities;
- political discussion within a few key non-nuclear-weapon states about whether they should acquire their own nuclear deterrents, thereby abandoning the NPT.

Specific problems include the North Korean nuclear challenge and uncertainty about the long-term nuclear intentions of Iran and other states in the Middle East, exacerbated by the U.S. withdrawal from the Joint Comprehensive Plan of Action (JCPOA), the nuclear arrangements agreed between Iran and the major powers.

These and related developments increase proliferation pressures, making it more important than ever for the safeguards system to be effective, and to be perceived as such.

At the same time there is increasing dissatisfaction within the NPT about the lack of progress on disarmament, resistance to key aspects of strengthening safeguards, and chronic underfunding of the safeguards system. Governments remain fixated on the primacy of national sovereignty over the wider international interest and are unable or unwilling to see the safeguards system as an international good that benefits the national security of all states.

Under such conditions, can the safeguards system remain effective and meet the expectations of the international community? What are the major issues affecting international confidence in IAEA safeguards and the future of the safeguards system?

II. Safeguards in a broader context

Safeguards are the verification system for the NPT's non-proliferation provisions. They can be described as a technical system aimed at meeting political objectives. At the technical level, safeguards comprise procedures and measures to detect, identify, characterize, and quantify nuclear material, and to assess the significance of nuclear activities. An international inspectorate, the IAEA, applies these procedures and measures with the cooperation—in theory and in the vast majority of cases in practice—of national authorities. At the political level, the principal objective is to support the global nuclear non-proliferation regime—and also the prospects of nuclear disarmament—by:

- providing credible assurance that states are honoring commitments they have made not to acquire nuclear weapons—specifically, not to divert nuclear energy from peaceful purposes to nuclear weapons; and
- ensuring early detection if states misuse nuclear material and technology in violation of this commitment, thus deterring violations by the likelihood of discovery and subsequent enforcement action.

In thinking about issues of safeguards effectiveness, therefore, key concepts are IAEA *detection capability*, *deterrence* of potential proliferators, and *assurance* or confidence-building among third parties.

The form and substance of safeguards are influenced by many factors—political, legal, technical and cultural. These include: political attitudes and expectations; legal obligations; fuel cycle technologies; verification

capabilities; and cultural influences. The relative weighting of these factors will vary from time to time, but there is an overall trend: the challenges facing safeguards are increasing in complexity. As a consequence, safeguards practice is also becoming more complex, and safeguards conclusions are becoming more qualitative. In particular, the range of information taken into account and the role of expert judgment in drawing safeguards conclusions are both increasing.[5] There is a need for safeguards to become more intrusive, and it is increasingly important for safeguards to be complemented by mechanisms such as transparency and confidence-building measures.

Currently these developments are generating push-back from some governments concerned that safeguards are becoming more political—for instance, as will be discussed, Russia and others have been questioning the IAEA's application of the "State Level Approach" that is central to strengthened safeguards. But safeguards inspectors cannot fulfil their mandate if they are limited to the quantitative methods of the past. The challenge is to develop methodologies, quality assurance systems, and safeguards cultures that are clearly understood and supported and that ensure objective and valid outcomes.

III. Some specific safeguards issues

There are controversies over how much information the IAEA should reveal, to build confidence in the effectiveness of its safeguards approaches, and how much it should keep confidential, to maintain cooperation with inspected states; over ways the IAEA can incorporate a broader range of information, to improve its ability to understand whether there are discrepancies in the information inspected states are providing; and over whether and how different verification regimes can share information, contributing to the effectiveness of each. Also new verification missions will

5 See John Carlson, "Defining the Safeguards Mission," (paper presented at IAEA Safeguards Symposium, Vienna, Austria, October 16-20, 2006), www.belfercenter.org/sites/default/files/legacy/files/uploads/2006SymposiumMission.pdf.

be required in the future—the verification requirements of the JCPOA for uranium mining and for weaponization, for example, are among the most recent new missions for the IAEA. These will impact on the safeguards system whether or not they are made part of the IAEA's safeguards remit for other states. How these issues are resolved will have a specific impact in particular cases, and will also have a broader impact in terms of states' attitudes towards, and confidence in, the safeguards system.

A. Safeguards as an influence on states' behavior

Most non-nuclear-weapon states take their commitment to non-proliferation seriously and have emphatically renounced nuclear weapons (though a number take advantage of a "nuclear umbrella", that is, extended nuclear deterrence provided by a nuclear-weapon state). Nevertheless, if there was no verification system to underpin the NPT, even states strongly opposed to nuclear weapons might feel the necessity to develop at least a nuclear weapon option if they feared others were doing the same. In the pre-NPT period, many states were looking at developing such a capability, and for some this interest continued until the safeguards system was well established.

Safeguards aim to reinforce a state's commitment to non-proliferation:

- positively, by providing assurance that other states are observing their non-proliferation commitments, thereby removing a primary motivation to acquire nuclear weapons; and
- negatively, by deterring violations through the risk of detection and the likelihood of enforcement action.

Whether safeguards are successful in this will depend on states being convinced of the IAEA's detection capability. This is the case for both positive and negative reinforcement: if states have doubts about the risk of detection, this undermines their assurance about the actions of others, and it reduces the deterrent effect of safeguards. It is also important to appreciate

that deterrence depends not only on the safeguards system but on the readiness of the international community to enforce treaty compliance.

There have been several cases of safeguards non-compliance, where evidently the states concerned did not consider the risk of detection was sufficiently high to deter them. "Break-out" to nuclear-armed status is essentially a race, where the proliferator aims to have nuclear weapons before its efforts are detected. Clearly, examples of safeguards failing to detect clandestine nuclear programs until they are well advanced will damage confidence in safeguards and embolden other states considering such programs.

As already mentioned, the first case of safeguards non-compliance was found in Iraq, in 1991. Following its defeat in the First Gulf War, Iraq was discovered to have an extensive clandestine nuclear program, aimed at producing nuclear weapons. Until that time the IAEA had focused safeguards primarily on *declared* nuclear materials and items, believing that any undeclared nuclear program would have links to the declared program, so would be detected by safeguards on declared material and facilities. Safeguards inspections had failed to detect Iraq's weapon program because there had been no obvious links to declared activities.

The Iraq case shook confidence in the safeguards system and prompted a fundamental review of the IAEA's approach, with particular emphasis on the ability to detect *undeclared* nuclear material and activities. Information collection and analysis and ensuring wider access by inspectors to places relevant to nuclear activities is central to the strengthening of safeguards. The Additional Protocol, approved by the IAEA's Board of Governors in 1997, grants the IAEA additional legal authorities in these respects, for those states that adopt the Protocol.

The next case of non-compliance was North Korea, where major safeguards violations were detected in 1993.[6] This was not a case of safeguards failure. Inspections had barely begun before it was discovered that North Korea had failed to declare nuclear activities from before the commencement of

6 Mention should also be made of Romania, found in non-compliance in 1992. This was small-scale, involving nuclear material that had been exempted from safeguards under rules that applied at that time.

safeguards.[7] North Korea then expelled inspectors and later announced its withdrawal from the NPT.

North Korea was followed by the case of Iran. There was information in the 1990s suggesting Iran had obtained undeclared nuclear material, but no location-specific information to justify inspections at a particular site emerged until 2002. In the following years, IAEA inspectors unearthed the various elements of a complicated clandestine program. In this case the impact on confidence in safeguards came not so much from the initial failure to detect undeclared activities, but from the handling of the case at the IAEA's decision-making level. The then IAEA Director General refused to report Iran's violations as non-compliance, taking the view that it was for the Board of Governors—in other words, governments—to make this determination. Political factors—particularly the effort to reach a negotiated outcome with Iran—then interfered with what should have been a decision based on the facts. It took until the end of 2005 for the Board to reach the decision that had been obvious for over three years: that Iran was in safeguards non-compliance.

Meanwhile, a further case of non-compliance came to light in Libya in 2004. In this case, Libya agreed, in a secret negotiation with the United States and Britain, to terminate its incipient nuclear weapon program, and those states then shared intelligence information with the IAEA to enable it to take prompt action to verify Libya's return to its safeguards obligations.

The damaging consequences of the way the Iran case had been handled became apparent in 2007, when Israel bombed a clandestine reactor nearing completion in Syria. At the time, Israel was condemned for taking unilateral action rather than reporting the discovery of the reactor to the IAEA to investigate. However, Israel considered it could not afford to have its national security dependent on an uncertain process within the IAEA, and for that matter within the Security Council. There was also a concern that if due process were followed, the outcome might have been "safeguarded proliferation," namely, Syria operating the reactor under safeguards and building a future break-out capability. Syria denied that the facility was a reactor and aggressively cleaned up and covered over the site;

7 North Korea had joined the NPT in 1985 but had delayed its safeguards agreement until 1992. The IAEA determined North Korea was in safeguards non-compliance in 1993.

after allowing one later visit by inspectors, Syria refused further inspections, and the IAEA never called for a special inspection.[8] The Syrian civil war has since interrupted inspections of the country's remaining nuclear activities.

The lessons from these various non-compliance cases are that confidence in safeguards depends not only on the IAEA's detection capabilities, but also on having technical processes that are free of political influence. All of the cases, but perhaps especially the Syrian case, highlight the importance of states sharing intelligence information with the IAEA, and also the importance of decision-making and enforcement processes working properly. The ability of safeguards to deter treaty violations depends not only on the risk of detection but also the certainty of consequences, namely, enforcement action. But the Iraq case—resulting in a devastating war with huge regional consequences as a result of erroneous conclusions about Iraq's nuclear, chemical, biological, and missile activities—also highlights the importance of care in getting conclusions right before enforcement action is taken.

The positive aspect from these cases is that, to date, there is only one example of an NPT violator succeeding in acquiring nuclear weapons—North Korea—and as discussed, this did not involve a failure of the safeguards system.

Ultimately the confidence each state has in IAEA safeguards conclusions is a matter for that state to determine. This judgment will depend on the state's knowledge and understanding of safeguards processes, methods and decision-making, and on information it receives on the states of greatest concern to it, including information collected by intelligence agencies. It follows that it is essential for states to be fully informed on how the safeguards system works, and to have a realistic understanding of its strengths and weaknesses. The IAEA itself has a responsibility here to ensure it is communicating effectively with states on these matters. It also follows that states should contribute as best they can to addressing problem areas. Those states with the resources to do so need to give higher priority to practical and political support for IAEA safeguards.

8 See Leonard Spector and Avner Cohen, "Israel's Airstrike on Syria's Reactor: Implications for the Nonproliferation Regime," *Arms Control Today*, Vol. 38, No. 6 (July/August 2008), https://www.armscontrol.org/act/2008_07-08/SpectorCohen, and Olli Heinonen, "The Case for an Immediate IAEA Special Inspection in Syria," *Policy Watch*, November 5, 2010. https://www.belfercenter.org/publication/case-immediate-iaea-special-inspection-syria.

B. Safeguards strengths and limitations

Compared with the alternatives available to states in need of understanding others' nuclear intentions and capabilities, the IAEA safeguards system has significant advantages, including:

- objectivity/impartiality, through being an international institution;
- substantial expertise, due to specialization and the ability to compare factual situations across all states;
- the legal authority and technical capacity to undertake on-site inspections on a routine, non-confrontational basis; and
- the IAEA's conclusions are available to all states.

The IAEA is the only international mechanism able to definitively resolve suspicions about a state's nuclear program—provided the state cooperates. A state wishing to demonstrate its good standing will cooperate in providing information and resolving questions; conversely, a lack of cooperation will strengthen suspicions (though it must be admitted that some states, suspecting the IAEA of being unduly influenced by Western powers, may be reluctant to cooperate even when they do not have non-compliant activities to hide).

It must be recognized that the safeguards system also has significant limitations. A major issue is inadequate resourcing. For example, IAEA safeguards have a fraction of the resources available to the national intelligence agencies of major powers. A former IAEA Director General used to say the IAEA's safeguards budget was less than that of a major city police force. Some thought this was an exaggeration, but in fact it is a massive *understatement*—for example, the IAEA's annual safeguards budget is equivalent to a little over 3 percent of the budget for the City of New York Police Department.[9] While the tasks are very different, this comparison illustrates that the current level of safeguards funding is extraordinarily low

9 The IAEA safeguards budget for 2017 was around $185 million, while the budget for the New York Police Department was $5.2 billion.

considering safeguards are at the front line in global efforts against the proliferation of nuclear weapons.

The IAEA has built up its skills in information collection and analysis, including acquiring satellite imagery, but the demands of routine safeguards implementation are such that there is a very definite limit to how much effort the IAEA can devote to looking for indicators of undeclared nuclear programs. This is not just a question of resources: such secret activities are genuinely difficult to find, particularly in the absence of the kinds of capabilities the intelligence agencies of major powers can bring to bear. It is essential for states to work in partnership with the IAEA, sharing information with the IAEA, including data on nuclear-related exports and intelligence information where this can contribute to more effective safeguards. Intelligence and other information is vital to help identify locations of concern, and safeguards provide the means to investigate—to "get under the roof."

While the language of the NPT in Article III tasks the safeguards system with *preventing* diversion of nuclear energy to nuclear weapons, realistically, safeguards cannot be expected to do this. Safeguards can only prevent diversion to the extent that the risk of timely detection deters states from diversion. It must be appreciated that with proliferation-sensitive technologies and materials, such as centrifuge enrichment and separated plutonium, material for a nuclear weapon could be diverted rapidly, and timely detection will always be very difficult, if not impossible. It is essential for safeguards to be complemented by other measures to support non-proliferation and disarmament objectives, discussed below.

C. Safeguards and information

Safeguards are only as robust as the information on which they are based. In considering how the IAEA's information collection and analysis can be improved, the Agency and its member states should take into account issues such as those in the following discussion.

State Level Approach

Information analysis is an essential aspect of the State Level Concept, which is perhaps the most important single innovation in the development of the IAEA safeguards system. The State Level Concept has enabled safeguards to move from a mechanistic system, in which safeguards measures are implemented identically in all states with similar nuclear materials and facilities, to the application of an individual State Level Approach (SLA) designed for each state. Under the SLA, state-specific factors, such as the characteristics of each state's fuel cycle and the acquisition paths available to the state, are taken into account in designing safeguards implementation for each state.[10] The SLA enables the IAEA to meet its effectiveness objectives, focus and prioritize the use of safeguards resources, and address cost-efficiency objectives.

Russia and some others have raised concerns about the IAEA's application of the State Level Approach.[11] The issues raised include the possibility that a state's implementation of its safeguards obligations might be judged by the IAEA Secretariat in a subjective manner, and the apparent lack of reliable mechanisms to protect against falsified or forged information.

According to media reports,[12] some state representatives are concerned that in some way the basis of safeguards has moved from material balance accounting to assessments based on information analysis. This is a misunderstanding: a determination of safeguards compliance is based on

10 The State Level Approach builds on paragraph 81 of INFCIRC/153.

11 Most recently in the IAEA General Conference and Board of Governors meeting in September 2018.

12 See "Big Data and the Controversy over IAEA Safeguards," *Nuclear Intelligence Weekly*, September 21, 2018.

verification of whether there has been diversion of nuclear material. This requires either implementation of the usual safeguards verification methods—inspections, nuclear material accountancy, sampling and analysis, containment and surveillance—or demonstration of a failure by the state to cooperate in such implementation. Information is not a substitute for safeguards inspections, but rather allows for inspections and other safeguards activities to be prioritized and helps identify locations that may warrant inspection. As to whether information may, for whatever reason, be incorrect, if the information is location-specific it can be readily tested by inspection. If the information is incorrect it is in the state's interest to allow the IAEA to establish this.

These continuing concerns and misapprehensions suggest that the IAEA needs to do more to explain its methods to member states.

Drawing conclusions on the absence of undeclared nuclear activities

"Traditional" safeguards, focused on declared nuclear materials and facilities, operate on a relatively quantitative basis, where inspection intensity (frequency of inspections, procedures used, and so on) flows from probabilistic analysis. However, addressing the possibility of undeclared activities requires a more *qualitative* approach, making use of all available sources of information and applying expert judgment.

The problem of undeclared nuclear activities raises the question of how to prove a negative: can *absence of evidence* be taken to be *evidence of absence*? It might be argued that the absence of something is inherently unverifiable. However, the international community expects the safeguards system to provide assurance of the absence of undeclared nuclear material and activities. The IAEA's ability to reach valid conclusions is affected by factors such as:

- authority—the ability to access locations, information, and people;

- capability—having the necessary verification technologies and resources;
- methodology—ensuring effective detection strategies, analytical techniques and evaluation processes.

Safeguards staff develop a safeguards strategy for each state based on *acquisition path analysis*, considering: the various ways the state could acquire nuclear material; how undeclared nuclear activities, if any, could be linked to declared parts of the fuel cycle; the indicators that might be present if there were undeclared activities; and how such indicators could be detected.

Widening the range of information available to the IAEA, to enhance its knowledge and understanding of a state's nuclear activities, is a vital part of this process. The IAEA gets the information it needs for safeguards analysis and planning in a variety of ways. It may gather the information itself—for example, through the use of inspectors in the field or from open sources such as data mining and commercial satellite imagery. The state concerned is obligated to provide certain information in accordance with its safeguards agreement and, if applicable, the additional protocol, and may be asked to provide additional information for explanatory or transparency purposes. And third parties, including other states, may volunteer useful data such as export approvals and denials or intelligence information.

The IAEA's ability to provide its members with the assurance they are looking for regarding the absence of undeclared nuclear activities depends on the support it receives for expanding the scope and improving the quality of the information it gathers and the resources it can bring to bear on the analysis and evaluation it carries out. It is essential for member states to provide this support.

Using intelligence information

The IAEA occasionally receives information that a state has obtained through its national intelligence activities. Russia has questioned the appropriateness of states providing the IAEA with intelligence information.

[13] However, doing so is consistent with the IAEA Statute and the declarations of successive NPT review conferences. If a state has information that could indicate an NPT violation, it should not withhold this information. Indeed, it has a responsibility to other NPT parties to pass this to the IAEA for investigation.

The IAEA Statute provides that each member state should make available such information as would, in the judgment of that state, be helpful to the Agency.[14] NPT review conferences have called on states parties that have concerns regarding safeguards non-compliance by other states to direct such concerns, along with supporting evidence and information, to the IAEA to consider, investigate, draw conclusions and decide on necessary actions in accordance with its mandate.[15]

The safeguards system provides a vital service to the NPT parties through being the means of determining treaty compliance. In exercising this responsibility, the IAEA needs the benefit of any information that can help ensure safeguards are more effective. Intelligence information has proven important in bringing to light all of the non-compliance cases to date.

As already mentioned, one objection to the IAEA receiving intelligence information is that the information may be incorrect, or even intentionally misleading. Iran, for example, has consistently maintained that hostile states provided fabricated intelligence to raise suspicions of possible military dimensions of its nuclear program. The IAEA conducts its own information collection and analysis to avoid over-dependence on third-party information, and so it can exercise independent judgment when allegations are made. In the case of Iran, the IAEA provided its assessment in a December 2015 report, after nearly a decade of controversy.[16] The Agency made clear—then and in the 2011 annex—that the relevant

13 Foreign Minister Sergey Lavrov raised this issue in a speech at the CENESS Nonproliferation Conference in Moscow on October 20, 2017.

14 Article VIII.A.

15 This call was made in the final documents of the 1995, 2000 and 2010 review conferences (no final documents were agreed on at the 2005 and 2015 review conferences). See paragraph 9 of NPT/CONF.2010/50 (Vol. I), http://www.un.org/ga/search/view_doc.asp?symbol=NPT/CONF.2010/50%20(VOL.I).

16 See IAEA, *Final Assessment on Past and Present Outstanding Issues regarding Iran's Nuclear Programme*, GOV/2015/68, December 2, 2015, https://www.iaea.org/sites/default/files/gov-2015-68.pdf. The Agency assessed in this case that "a range of activities relevant to the development of a nuclear explosive device were conducted in Iran prior to the end of 2003."

information came from multiple states, not one; that it was integrated with and checked against a great deal of other information available to the IAEA independently (such as inspection information and procurement information); and that the IAEA assessed the information and found it generally consistent and credible.

As discussed there is a limit to the IAEA's resources for this purpose. If a state has incorrect information about another, it is in the interest of the state under suspicion, as well as the international community as a whole, to resolve the matter as quickly as possible. As the Iraq war tragically emphasizes, it is in no one's interest for a state to take unilateral action based on suspicions, especially if the suspicions are unfounded.

Framing of safeguards conclusions

Closely related to the drawing of conclusions on the absence of undeclared activities is the framing of the conclusions themselves. Today, in the case of states with a comprehensive safeguards agreement and an additional protocol in force, if the IAEA has completed all evaluations and found no indication of the diversion of declared nuclear material from peaceful activities and no indication of undeclared nuclear material or activities for the state as a whole, the IAEA concludes that "all nuclear material remained in peaceful nuclear activities." While it may seem reasonable to reach such a conclusion, this is an inference that goes beyond the IAEA's direct knowledge. The conclusion might be considered more soundly based if it is limited to what the IAEA has actually established, namely, that it has found no indication of undeclared nuclear material and activities. The scope of the IAEA's safeguards conclusions is an aspect that could warrant further review.

The relationship of confidentiality and confidence

For the IAEA's conclusions on the absence of undeclared nuclear activities to be credible, a number of conditions must be satisfied:

- states must understand the process for looking for indicators of undeclared activities and accept that these are appropriate;
- states must be satisfied that the process is applied consistently and at the requisite standard;
- states must be satisfied that judgments are exercised and conclusions drawn in a suitably disciplined way.

This calls for a substantial level of transparency into the workings of the safeguards system. The IAEA needs to ensure it is explaining its processes adequately to states, and must be responsive to states' suggestions and concerns. Confidence in the way the safeguards system operates could be enhanced through establishing a safeguards audit function, a small group of trusted experts reporting to the IAEA Director General who could review the way safeguards decisions are taken in specific cases and where appropriate make recommendations on process. The author understands such an arrangement operated in the 1980s, and it could have a useful role today where states are looking for assurance on the directions in which safeguards practice is evolving.

Closely related to the issue of transparency is the issue of confidentiality: the question of whether, and to what extent, information available to the safeguards system should be shared with states. IAEA safeguards agreements require the IAEA to maintain confidentiality of information obtained in connection with the implementation of the agreement. However, too much confidentiality can work against confidence.

This proscription on the IAEA sharing information contrasts with more recent treaty-based regimes. Under the 1997 Chemical Weapons Convention (CWC), for example, much of the information in parties' declarations and summary data from inspections are made available to the treaty parties at large. The 1996 Comprehensive Nuclear Test-Ban Treaty (CTBT) takes information sharing further: parties are given equal access to all data collected by the CTBT's International Monitoring System. Any party is able to analyse the data for itself and to seek clarification of a suspect event, including through calling for an on-site inspection.

Thus under both the CWC and the CTBT parties are in a position to cross-check the information available to the verification agency—to identify gaps in that information where they may be able to assist, and to reach an informed assessment on how well the verification system is operating. This is a direction the safeguards system might usefully take. A more transparent system, where greater information is available on states' nuclear activities, the IAEA's activities, its conclusions and the basis for these, would have major benefits in terms of confidence-building and ensuring verification effectiveness.

These issues could be tackled at several levels. The interpretation of the confidentiality restraints considered to apply to the IAEA could be reviewed by the Board of Governors, to assess whether some adjustment is required in how confidentiality is applied. Individual states or a group of states could consider developing a transparency initiative—for example, agreeing on voluntarily making public parts of their safeguards declarations, or voluntarily authorizing the IAEA to make public such information from inspections in their states as might be helpful to building confidence.

Information-sharing with other treaty regimes

Another aspect of information-sharing concerns the relationship between the different treaties and regimes applicable to weapons of mass destruction (WMD). To some extent these regimes overlap, or at least share commonalities. The commonality between safeguards and the CTBT is obvious. The Missile Technology Control Regime (MTCR) is also relevant to safeguards—a state's interest in nuclear-capable missiles could indicate interest in nuclear weapons. The CWC could be relevant to safeguards—historically states interested in one form of WMD have also been interested in other forms. The Panels of Experts operating under certain sanctions resolutions of the U.N. Security Council may collect information relevant to safeguards. Information exchanged between members of the Nuclear Suppliers Group, particularly on export denials, could be important to the IAEA's effort to verify the absence of undeclared activities. There are sound reasons for coordination and information-sharing among the different regimes. Current confidentiality arrangements need to be reviewed to allow for information-sharing where this would contribute to better verification outcomes.

D. Universalizing the Additional Protocol

The IAEA has emphasized on many occasions that the additional protocol is an essential part of the IAEA's safeguards system:

> *It is only in countries with both a comprehensive safeguards agreement and an additional protocol in force that the IAEA has sufficient information and access to provide credible assurances to the international community of both the non-diversion of nuclear material and the absence of undeclared nuclear material and activities.*[17]

Today 133 states have concluded an additional protocol, including 53 of the 62 non-nuclear-weapon states with significant nuclear activities.[18] There are four other such states that have signed but not yet ratified an additional protocol—one of these, Iran, is implementing its protocol provisionally.[19] There are five non-nuclear-weapon states with significant nuclear activities that have not signed an additional protocol: Argentina, Brazil, Egypt, Syria and Venezuela. Also of concern is Saudi Arabia, which plans significant nuclear activities but does not have an additional protocol.

Some states (such as Brazil and Egypt) argue that the additional protocol is voluntary and say they will not conclude a protocol until the nuclear-weapon states meet their NPT disarmament obligations. However, it is misguided to present acceptance of the additional protocol as a political or legal issue. The purpose of safeguards is to provide confidence of a state's commitment against acquiring nuclear weapons, and to ensure timely detection of diversion of nuclear material to nuclear weapons if this occurs. It is notable that none of the safeguards non-compliance cases have involved states with an additional protocol. Where a state refuses to accept

17 "Nuclear Safeguards Conclusions Presented in 2016 Safeguards Implementation Report," last modified July 26, 2017, http://www.iaea.org/newscenter/news/nuclear-safeguards-conclusions-presented-in-2016-safeguards-implementation-report.

18 "Status of the Additional Protocol," last modified September 24, 2018, http://www.iaea.org/topics/additional-protocol/status.

19 The four non-nuclear-weapon states with significant nuclear activities that have signed but not yet ratified an additional protocol are Algeria, Belarus, Iran and Malaysia.

the most effective form of safeguards this raises concerns about the genuineness of that state's commitment to non-proliferation.[20]

Just as it is a matter of serious concern that a minority of states with significant nuclear activities have refused to conclude an additional protocol, it is also very concerning that some nuclear suppliers are prepared to build nuclear capability in states that do not have the most effective form of safeguards. The Nuclear Suppliers Group has set the additional protocol as a requirement for supply of enrichment and reprocessing technology, but has been unable to agree on making this a requirement for all nuclear supply. Russia, for example, has agreed to supply states without an additional protocol, including reactors to Egypt, and the United States is currently negotiating the supply of reactors to Saudi Arabia, which also has not accepted the additional protocol, though it is not yet clear if the protocol may end up as part of the deal the United States and Saudi Arabia reach. These cases are unhelpful to efforts to secure Iranian ratification of its additional protocol.

The negative attitude of some states towards the additional protocol resulted in serious damage to the Treaty on the Prohibition of Nuclear Weapons, concluded in July 2017,[21] as well as potential damage to the NPT. Successive NPT review conferences have recognized that nuclear disarmament will require rigorous and universal safeguards, specifically, the combination of comprehensive safeguards and the additional protocol. The prohibition treaty compromises this standard. The treaty requires only that non-nuclear-weapon states maintain the safeguards obligations they have when the treaty enters into force—so states without an additional protocol are not required to conclude one.[22] This contradicts the declaration by NPT review conferences that the additional protocol should become universal,[23] and could be exploited by states without an additional protocol—such as

20 See John Carlson, "Is the Additional Protocol 'Optional'?," *Trust and Verify*, No. 132, p. 6-9, VERTIC, www.nti.org/analysis/articles/additional-protocol-optional.

21 https://www.un.org/disarmament/ptnw/

22 United Nations, "Treaty on the Prohibition of Nuclear Weapons," A/CONF.229/2017/8, Article 3.1. http://undocs.org/A/CONF.229/2017/8

23 See Action 30, agreed in the 2000 review conference and reaffirmed in 2010, http://www.un.org/ga/search/view_doc.asp?symbol=NPT/CONF.2010/50%20(VOL.I).

those mentioned above—to claim they do not have to conclude an additional protocol to meet their NPT commitments.[24]

The states that refuse to accept the additional protocol are failing to recognize that the most effective safeguards are essential for the confidence needed for major nuclear weapon reductions, and eventual elimination, to proceed. Universalizing the additional protocol is also essential to reinforcing non-proliferation commitments. The holdout states should reconsider their position, taking into account the security advantage they derive from the additional protocol being so widely applied. States with additional protocols—which are today a substantial majority—should do all they can to persuade and assist the holdouts to conclude protocols.

E. Safeguards and weaponization

Russia has questioned whether the IAEA has the authority to investigate possible weaponization activities.[25] Weaponization refers to a range of activities, in addition to the acquisition of fissile material, necessary for the design and manufacture of a nuclear weapon. Some of these activities are *dual-use*, that is, they do not necessarily indicate an intention to manufacture a nuclear weapon. Such activities may be ambiguous seen in isolation, but may be less so in the context of the totality of information known about the state.

Weaponization activities are not defined in IAEA safeguards documents, but the Iran JCPOA describes certain items and activities which could contribute to the design and development of a nuclear explosive device.[26] While the JCPOA is expressed not to establish a precedent, it is inevitable that the weaponization provisions will be seen as providing some guidance

24 See John Carlson, "The nuclear weapon prohibition treaty – a safeguards debacle," *Trust & Verify*, No. 158 (Autumn 2018), http://www.vertic.org/media/assets/TV/TV158.pdf

25 This was raised by Foreign Minister Lavrov at the 2017 CENESS Nonproliferation Conference, and has also been an issue in discussions among the JCPOA parties.

26 Annex I, Section T of the JCPOA refers to computer simulation of nuclear explosives; explosively driven neutron sources; multipoint detonation systems; and explosive diagnostic systems. Annex I, Section E refers to uranium and plutonium metallurgy. See also Amit Grober, "A Brief History of Nuclear Weaponization", Project on Managing the Atom, Belfer Center for Science and International Affairs, Harvard Kennedy School, forthcoming discussion paper.

in this area. Also relevant here are various items on the Nuclear Suppliers Group's Dual-Use List.[27]

There is a view that, absent some "nexus" to nuclear material, the IAEA's authority to investigate possible nuclear weapons related activity is limited. This raises the question, what is a sufficient nexus? Clearly, development of nuclear weapons must at some stage involve nuclear material. The conduct of certain activities by a state could indicate an intention to misuse nuclear material. It could also raise the question of whether the state has undeclared nuclear materials and facilities.

These issues are directly relevant to the NPT's language on *prevention* of diversion, and to the IAEA's responsibility to provide *timely warning* of diversion. The IAEA cannot afford to ignore possible weaponization activities. States that argue otherwise are ignoring the importance of timely warning and failing to recognize the damage to safeguards if they are seen to have failed.

The real issue here is not whether the IAEA has a *right* to investigate possible weaponization activities, but rather the limits to its detection capabilities in this regard. Some weaponization activities will be very difficult to detect, so the IAEA may well have no actionable leads to investigate. In most cases the IAEA will not be in a position to specifically provide credible assurance of the absence of weaponization activities—although in most cases state evaluation should show there is no reason to believe such activities may be present, and past cases such as Iran and Iraq suggest that weaponization activities may be revealed by the combination of procurement activities, open-source information, and intelligence information.

F. Complementing IAEA safeguards

As suggested above, safeguards alone cannot ensure that states do not violate their non-proliferation commitments. The effectiveness of safeguards depends on timely detection, but ensuring this can be a major challenge

27 See especially Item 5, test and measurement equipment for the development of nuclear explosive devices, and Item 6, components for nuclear explosive devices, https://www.iaea.org/sites/default/files/publications/documents/infcircs/1978/infcirc254r10p2c.pdf.

where proliferation-sensitive technologies and materials are involved. The clearest example is separated plutonium, which a state could remove from safeguards almost immediately—in the time it takes to move a container from storage. While safeguards take into account *conversion time* (the time required to weaponize diverted material), realistically, the opportunity for effective intervention is very limited once weapon-usable material is diverted unless there is precise information on where weaponization is taking place.

Accordingly, it is essential for states to recognize that safeguards need to be complemented by technical and institutional measures to reduce proliferation risk. Technical measures would include development of proliferation-resistant technologies to avoid the production of weapon-usable materials or at least to make these more difficult and time-consuming to obtain.

Institutional measures would include restraints in the development and operation of proliferation-sensitive technologies, for example:

- reprocessing output to be limited to immediate consumption, avoiding plutonium stockpiling;
- enrichment capacity to be limited to demonstrated fuel requirements.

The latter approach is partly reflected in the Iran JCPOA, which contains agreed limits on enrichment capacity, subject to verification as part of IAEA safeguards. In the JCPOA these limits are time-bound, but the approach could be developed for long-term application in Iran and generally.

Another institutional approach is for proliferation-sensitive facilities to be operated under multinational rather than national control.[28] This approach

28 For a general discussion on these issues see John Carlson, "Assessing and Minimising Proliferation Risk," *Limits to Secure Nuclear Tolerance*, International Luxembourg Forum, Moscow, 2014, http://www.luxembourgforum.org/eng/Forums_Library/items/Book_by_VVK_2014_eng.pdf, and John Carlson, "Introduction to the Concept of Proliferation Resistance," International Commission for Nuclear Non-Proliferation and Disarmament, http://d3n8a8pro7vhmx.cloudfront.net/foe/legacy_url/863/Carlson_20ASNO_20ICNND_20Prolif_20Resistance.doc?1471404574.

is reflected in the Nuclear Suppliers Guidelines for transfer of enrichment and reprocessing facilities, equipment, or technology.[29]

A different form of complementary measure for IAEA safeguards is the application of bilateral or regional safeguards arrangements. Mutual or regional inspections could play an important role in circumstances where states are looking for additional confidence-building measures. The existing examples are the European Atomic Energy Community (Euratom) and the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC).

Euratom predates the NPT and IAEA safeguards, having been established in 1957. Today Euratom safeguards apply in partnership with IAEA safeguards. In addition, Euratom safeguards apply to all civilian nuclear material and activities in the United Kingdom and France, which as nuclear-weapon states have limited IAEA safeguards inspections.

Mutual safeguards inspections between Argentina and Brazil commenced in 1990, and ABACC was established in 1991. Mutual inspections predated the two states joining the NPT by some years,[30] and played an important confidence-building role between the two states. Today ABACC and IAEA inspections are conducted jointly.

The mutual or regional inspection model could be of interest, complementing IAEA safeguards in areas such as South Asia (India and Pakistan), the Middle East, and the Korean Peninsula.

A further area of complementarity, touched on earlier, concerns transparency. Conclusions about the absence of undeclared nuclear activities are of necessity less definitive, less certain, than conclusions based on verification of declarations. Confidence can be reinforced by availability of additional

29 The NSG Guidelines, Part 1, paragraph 6(e) states: "If enrichment or reprocessing facilities, equipment, or technology are to be transferred, suppliers should encourage recipients to accept, as an alternative to national plants, supplier involvement and/or other appropriate multinational participation in resulting facilities. Suppliers should also promote international (including IAEA) activities concerned with multinational regional fuel cycle centres." See www.iaea.org/sites/default/files/publications/documents/infcircs/1978/infcirc254r13p1.pdf.

30 Argentina joined the NPT in 1995, and Brazil in 1998.

information supporting safeguards conclusions. There are many potential transparency mechanisms, including:

- wider publication by states of information on their nuclear programs;
- conduct of research and operational programs on a collaborative basis among states;
- broader privatization and globalization of nuclear activities, and establishment of multilateral fuel cycle centers.

Enhanced cooperation with and transparency towards the IAEA will be particularly important. Strengthened safeguards have brought new requirements for states in terms of information, access, and cooperation. It is no longer sufficient for a state to meet only its minimum legal commitments to the IAEA. Rather, states need to cooperate with the IAEA to the standard necessary to maintain the confidence of the international community. This includes showing full transparency to the IAEA, particularly where there are issues of compliance or confidence-building to be resolved. The challenge for the IAEA will be to develop a sufficiently rigorous method of testing transparency and drawing appropriate conclusions. Failure to cooperate may be obvious, but where the state appears to be cooperating it will be important to avoid being misled, not to draw broader conclusions than are actually warranted.

G. New verification missions

There are a number of verification missions related to nuclear disarmament potentially on the horizon, including the proposed fissile materials cut-off treaty (FMCT), ensuring irreversibility of transfers of excess nuclear material from military programs to civilian programs, and verification of reductions in and dismantlement of nuclear weapons. Decisions have yet to be made on who will be responsible for these different missions, but several of them will involve verification procedures and measures very similar

to IAEA safeguards, so it would make sense to add them to the IAEA's responsibilities.[31]

A further aspect of disarmament will be the need in the future to extend the IAEA safeguards system to cover all civilian activities in the nuclear-armed states.[32] Currently the focus of the safeguards system is countering horizontal proliferation, that is, the spread of nuclear weapons to additional states, but as nuclear disarmament progresses it will become increasingly important to clearly delineate civilian and military domains, to safeguard all nuclear materials and facilities not explicitly devoted to weapons, and to provide assurance against a nuclear-armed state seeking to reverse arms reductions. Eventually all states will be non-nuclear-weapon states, so the current differentiation between nuclear "haves" and "have-nots" may disappear–though in some respects, states that formerly had nuclear weapons may require even more intensive inspection, given their remaining technical potential, than states that never had a nuclear weapons program.

All of these issues have profound implications for the IAEA and any other entities responsible for nuclear verification, and also for national authorities that will be charged with facilitating verification. There will be challenges not only in ensuring necessary funding, but in developing the skilled workforce required.

31 See John Carlson, "Key Nuclear Verification Priorities—Safeguards and Beyond," (paper presented at the IAEA Safeguards Symposium, Vienna, Austria, November 1-5 2010),https://inis.iaea.org/collection/NCLCollectionStore/_Public/42/081/42081446.pdf?r=1&r=1 and "Policy Brief No 57—Verifying the Elimination of Nuclear Weapons and Providing Assurance against Breakout," Asia Pacific Leadership Network, February 2, 2018, http://a-pln.org/briefings/briefings_view/Policy_Brief_No_57_-_Verifying_the_Elimination_of_Nuclear_Weapons_and_Providing_Assurance_against_Breakout. See also Thomas E. Shea and Laura Rockwood, *IAEA Verification of Fissile Material in Support of Nuclear Disarmament*, Project on Managing the Atom, Belfer Center for Science and International Affairs, Harvard Kennedy School, May 2015, www.belfercenter.org/sites/default/files/legacy/files/iaeaverification.pdf.

32 See John Carlson, *Expanding Safeguards in Nuclear-Weapon States*, NTI, September 2011, www.nti.org/media/pdfs/NWS_safeguards_carlson_fin.pdf?_=1337718775.

IV. Conclusions

The IAEA safeguards system fulfils a vital role underpinning the NPT, reinforcing commitment to non-proliferation, and deterring violations through the risk of detection. Though seen primarily in terms of preventing horizontal proliferation, effective safeguards are also essential for progressing towards and achieving a nuclear-weapon-free world.

In many respects, safeguards have become a victim of their own success. The NPT safeguards system has operated for more than 45 years and is now taken for granted. It has been over 20 years since the introduction of the additional protocol, on which the strengthened safeguards system is based. Because safeguards are now so much in the background, states assume the system is working well and there is little they need to do by way of support. Regrettably, this is not the case.

Take the additional protocol. The IAEA has been emphasizing for many years that without the additional protocol it is unable to provide credible assurance of the absence of undeclared nuclear activities. Yet states are not pressing the protocol holdouts, and major nuclear suppliers seem happy to build up the nuclear capabilities of holdout states even though, in the absence of the protocol, safeguards cannot provide full assurance. Reluctance to accept effective safeguards is a warning sign which should not be ignored. Universalizing the additional protocol must be treated as a high priority, and every opportunity should be taken to persuade the holdouts to adopt the contemporary safeguards standard.

It is a matter of serious concern that some states are seeking to limit the IAEA's use of information essential for effective safeguards. It would be a mistake to dismiss this as troublemaking solely motivated by broader international conflicts, though clashing political interests may explain some of the oppositional behavior exhibited within IAEA forums. Rather, part of the resistance to greater transparency may indicate that the IAEA needs to improve its communications with key stakeholders, both explaining its evolving methodologies and seeking input. Transparency is an essential aspect of confidence. Even if the IAEA's performance is exemplary, it will

not succeed if it is not providing confidence. The establishment of a safeguards audit function may be helpful here.

Instilling the highest level of understanding of how the safeguards system works is essential for addressing another potentially serious problem: avoiding unrealistic expectations of what safeguards can deliver. Providing assurance against the existence of undeclared nuclear activities is now central to safeguards objectives, but this kind of verification is extremely challenging and there is an inherent level of uncertainty when drawing broader conclusions. States need to appreciate the limitations of safeguards but also to understand where and how they can contribute to improving the situation—for example, by offering more extensive cooperation and by sharing information.

One worrying development is that growing dissatisfaction with the lack of progress in disarmament is affecting the attitude of some states towards the NPT, and towards safeguards—an example being the refusal to conclude an additional protocol until the nuclear-weapon states show progress on disarmament. It is counterproductive to use safeguards as political leverage in this way—no one will benefit by the erosion of the non-proliferation regime, and without a strong safeguards system nuclear weapons will never be eliminated.

Political attitudes have not kept pace with the evolution in the safeguards system. Most states still think in adversarial terms, seeing safeguards as a challenge to national sovereignty. Reducing and eliminating the danger of nuclear weapons will require a different outlook, especially with respect to the changing balance between sovereign rights and the wider international interest. Changing attitudes, and addressing the various issues touched on in this paper, will require a process of constructive dialogue, involving not only the expert community, diplomats and policy-makers, but also the engagement of national leaders. It is essential for safeguards champions in governments, the IAEA and the general community, to actively promote greater awareness of the evolving requirements for an effective safeguards system and the need for embracing these changes.

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