

Key Nuclear Verification Priorities – Safeguards and Beyond

John Carlson

Consultant

john.carlson.safeguards@gmail.com

Abstract. In addressing nuclear verification priorities, we should look beyond the current safeguards system. Effective safeguards are essential for advancing disarmament – and safeguards issues, approaches and techniques are directly relevant to the development of future nuclear verification missions. The extent to which safeguards challenges are successfully addressed – or otherwise – will impact not only on confidence in the safeguards system, but on the effectiveness of, and confidence in, disarmament verification. To identify the key nuclear verification priorities, we need to consider verification objectives and the challenges to achieving these. The principal strategic objective of IAEA safeguards might be expressed as: To support the global nuclear non-proliferation regime by: (a) providing credible assurance that states are honouring their safeguards commitments; and (b) early detection of misuse of nuclear material and technology. Or to summarise – confidence-building, detection capability, and deterrence. These will also be essential objectives for future verification missions. Confidence is largely a political matter, reflecting the subjective judgment of governments. Assessments of detection capability and deterrence have a major impact on confidence. Detection capability is largely thought of as “technical”, but also involves legal and process issues. Deterrence has both political and institutional aspects – including judgments on risk of detection and risk of enforcement action. The traditional focus of safeguards is detection capability. As important as this and other “technical” priorities are, it is essential to also address issues of confidence and deterrence. Failures in these areas will undermine the value of the safeguards system and constrain the development of future nuclear verification missions.

1. Introduction

The purpose of this paper is to discuss nuclear verification priorities, not only for the current safeguards system, but beyond. The safeguards system underpins the non-proliferation regime. Non-proliferation is not an end in itself, but an essential condition for achieving and maintaining nuclear disarmament. Thus effective safeguards are essential to maintaining the conditions required for disarmament to progress. Further, as will be discussed, there are many commonalities between safeguards and the new nuclear verification missions anticipated in support of disarmament.

Safeguards issues, approaches and techniques are directly relevant to the development of these future verification missions. The extent to which safeguards challenges are successfully addressed – or otherwise – will impact not only on confidence in the safeguards system, but on the effectiveness of, and confidence in, the verification arrangements needed for disarmament.

1.1 *Current verification objectives and priorities*

IAEA safeguards have a number of **strategic objectives**. The most important of these might be expressed as follows:

To support the global nuclear non-proliferation regime by:

- (a) providing credible assurance that states are honouring their safeguards commitments; and*
- (b) early detection of misuse of nuclear material and technology.*

Clearly (a) and (b) are closely linked – it is the capability of early detection that supports credible assurance. Credible assurance removes a potential motivation to proliferate; and proliferation is deterred by the risk of early detection, which would enable timely intervention by the international community.

Thus there are a number of specific objectives here, which can be reflected in broader policy-level objectives, namely: **confidence-building**, **detection capability**, and **deterrence**. As will be discussed, these broader objectives are all interrelated. These objectives apply not only to current safeguards – all of them will be essential for future nuclear verification missions.

Do current safeguards priorities reflect these objectives? The traditional focus of safeguards is **detection capability**. Here, the greatest single priority is improving the capability to detect **undeclared** nuclear programs. Another key priority is achieving greater **efficiency** in safeguards implementation, to meet an expanding workload – while avoiding vulnerabilities. Both these priorities are closely linked to another priority – the further development of **information-driven** safeguards. Other priorities relating to detection capability include addressing innovative fuel cycle developments, and maintaining safeguards skills and knowledge. An “external” priority – external because here the IAEA is dependent on its members – is ensuring adequate resources.

As important as are these more “technical” priorities, it is also essential to address the broader subjects of **confidence** and **deterrence**. To some extent, due to the interrelationship between all of these issues, confidence and deterrence are being addressed through action on detection capability. But failures in the areas of confidence and/or deterrence will undermine the value of the safeguards system and constrain the development of future verification missions. It is necessary to consider whether more attention needs to be given to confidence and deterrence as specific priorities.

2. Verification commonalities

The current safeguards mission is aimed primarily at proliferation, i.e. the acquisition of nuclear weapons by additional states. Progress with nuclear disarmament – the elimination of nuclear weapons held by the recognized nuclear-weapon states and the other nuclear-armed states – will require a stepwise approach, involving a range of new verification missions. At this stage we cannot predict the exact steps, but the new missions are expected to be along the following lines (no particular sequence implied):

- **fissile material cut-off** – proscribing production of fissile material for nuclear weapons, with verification to confirm that all production after entry-into-force is for peaceful or non-proscribed purposes;
- **fissile material disposition** – transparency measures for fissile material inventories, and verification of progressive, irreversible transfer of fissile material to peaceful or non-proscribed purposes;
- **nuclear weapon limitations** – verification that deployed nuclear weapon numbers are within agreed limits;
- **nuclear weapon dismantlement** – verification that nuclear weapons are dismantled as agreed, and the resulting fissile material is irreversibly transferred to peaceful or non-proscribed purposes;
- establishing **nuclear inventory baselines** (involving “nuclear archaeology”) – to help assure there is no nuclear material outside the purview of verification arrangements.

To varying degrees these new verification missions can be expected to involve features similar to those of current safeguards, such as:

- legally binding (i.e. treaty-based) commitments to undertake, or refrain from, specified actions and to accept verification measures;
- an international **inspectorate**;
- **declarations** – requirement for parties to declare relevant materials, items and activities, and to maintain records and reporting;
- ongoing **inspections** and other verification measures to confirm parties’ declarations;
- verification activities aimed at detecting possible **undeclared** materials, items and/or activities – including information collection and analysis, monitoring and other detection techniques, and necessary additional access rights for inspectors; and
- procedures for determining **compliance** and taking **enforcement** action.

Experience gained from safeguards is likely to make a significant contribution to the new verification missions. In addition, novel situations will be encountered which will require innovative solutions. Some possibilities are listed here – there are already precedents for some of these:

- mutual or regional inspection arrangements – preferably as a complement rather than an alternative

- to international inspections;
- data monitoring and sharing by the parties themselves;
- wide area environmental sampling and other forms of monitoring;
- transparency measures – including Open Skies and similar arrangements;
- forms of societal verification.

Having regard to the many commonalities between these new verification missions and current safeguards, areas identified as priorities for safeguards are just as likely to be priorities for the new missions.

3. Confidence

A key objective of safeguards is to provide **credible assurance** that states are honouring their treaty commitments for the peaceful use of nuclear material and technology. Credible assurance supports **confidence** in the non-proliferation regime. Confidence reinforces commitment to the regime – if a state is confident that others are not seeking nuclear weapons, this removes a possible motivation for that state to seek nuclear weapons itself.

3.1 What is credible assurance?

Credibility is usually taken to mean *trustworthy* or *believable* – while these are matters of subjective judgment for states to make, they are based on observation, experience and fact. Here, an essential factual matter is the Agency's **detection capability** – credible assurance, detection capability and confidence are closely linked.

For safeguards conclusions to be credible, states must understand, and have confidence in, how these conclusions are reached. Assessments of the IAEA's detection capability and its processes for drawing conclusions will be a major influence on confidence. *Assurance* involves more than safeguards findings. Assessments of the degree of **deterrence**, how well the process for determining non-compliance works, and the likelihood of states taking effective compliance enforcement action will also be important factors.

3.2 Safeguards and confidence

All that being said, safeguards are not the only, or even the major, source of confidence about a state's commitment to non-proliferation. Other factors are also important, especially the **behaviour** of the state – not only in its interaction with the safeguards system, but especially as seen e.g. in its international relations and its military activities. Establishing confidence about a state's commitment to non-proliferation is not primarily the responsibility of the Agency and the safeguards system. First and foremost, it is **the responsibility of the state itself**.

Safeguards are an important tool to enable the state to demonstrate to others that it is meeting its non-proliferation commitments. An essential first step is for the state to accept the most effective form of safeguards – currently, a comprehensive safeguards agreement (CSA) **and** an additional protocol (AP). The IAEA has made it clear that without an AP in force it cannot provide credible assurance about the absence of undeclared nuclear material and activities. Further, the state must show **full cooperation** with the Agency in implementing safeguards, under both the CSA and the AP. Anything less will mean the Agency is not in a position to provide credible assurance, and the state will fail to establish confidence on the part of other states.

This is where legalistic arguments – e.g. whether the AP is “mandatory”, whether in a non-compliance case particular facts constitute “evidence” or “proof” – miss the point. Far from maintaining confidence, recourse to legalism in place of cooperation will have the opposite effect.

In terms of verification priorities, attention should be given to confidence issues – how to ensure confidence in safeguards conclusions and outcomes, and a clear understanding of the respective roles of the IAEA and the state.

4. Detection capability

Detection capability is the core of the safeguards mission. Without effective detection capability, the safeguards system will not be able to provide confidence, and there will be no confidence in the system itself. Technical capability alone, however, is not enough – it is also necessary to ensure that technical findings result in appropriate outcomes. Detection capability, though largely thought of as “technical”, also

involves, inter alia, legal, institutional and process issues.

4.1 The safeguards objective

Under the NPT, the purpose of safeguards is to verify fulfilment of obligations assumed under the Treaty, "... with a view to **preventing** diversion of nuclear energy from peaceful uses to nuclear weapons ..." [1]

The use of the term "preventing" is important – safeguards as such cannot prevent diversion, except through the deterrent effect of the risk of detection. Prevention is likely to require the intervention of the international community – but effective intervention depends on **timely warning**. The IAEA's duty to the international community is, where possible, to provide warning before, not after, a nuclear weapon program has proceeded beyond the point where intervention can be effective. Thus the Agency's responsibility is not just detection, but **early** detection.

This is reflected in the "objective of safeguards" set out in comprehensive safeguards agreements, namely "... the **timely detection** of 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 ..." [2]

4.2 Detection of diversion from declared nuclear material and activities

The traditional focus of safeguards has been capability to detect diversion from declared programs. Complex approaches and methods have been developed over many years, involving inventory verification, inspection frequency, unannounced and short notice inspections, instrumentation, containment and surveillance, remote monitoring, environmental sampling, and so on. Development of safeguards methods and technologies for application in (declared) nuclear facilities continues to be a high priority, to meet the challenges of an ever-increasing safeguards workload as well as from new fuel cycle technologies.

Increasingly, emphasis is being given to **information** collection and analysis – often thought to relate mainly to detection of undeclared nuclear activities (or at least indicators for these), but also important for deciding on safeguards intensity for declared programs. This is closely linked to another high priority, improving **cost-efficiency**. Because of resource constraints, cost-efficiency has always been important, but this is particularly the case as the volume and complexity of the safeguards workload increase.

Even under traditional safeguards, decisions on safeguards intensity took account of risk analysis. Now, particularly with the development of **integrated safeguards**, risk analysis is being extended to take into account a broader range of information. The focus is on **information-driven** safeguards, making the most effective use of information in decisions on safeguards approaches and intensity. Particularly through the **state-level approach**, information analysis is being given a central role in safeguards implementation.

Information-driven safeguards and the state-level approach are often seen as responses to the challenge of detecting *undeclared* nuclear activities – but they are also essential to effective safeguards for declared activities, including ensuring that cost-efficiency measures do not lead to vulnerabilities in safeguards.

4.3 Detection of undeclared nuclear material and activities

Improving the capability to detect undeclared nuclear activities is seen as the greatest single priority facing the IAEA. Confidence in safeguards is very much dependent on this – though it is generally appreciated this is a major challenge, in which the Agency will require substantial assistance from states.

The effort to strengthen the Agency's capabilities is proceeding on a number of fronts, in particular:

- broadening the Agency's authority to obtain information and access to relevant locations;
- development of detection technologies; and
- development of information collection and analysis capabilities.

The IAEA's methods are based on a combination of technical detection techniques and information collection and analysis. Information is especially important – including data the Agency can directly gather for itself (by inspectors in the field or other technical means); data submitted by the state (including, *inter alia*, accountancy data and design information); data the Agency can draw from open sources (including satellite imagery and the application of data-mining techniques); and data supplied by third parties (including governments, NGOs and individuals).

The **additional protocol** is central – without it the IAEA does not have rights to access and information essential to the ability to detect and investigate possible indicators of undeclared nuclear activities. For the

few comprehensive safeguards states with significant nuclear activities that have not yet accepted the AP [3], the Agency is unable to provide assurance about the absence of undeclared nuclear material and activities.

On the technical side, more development is needed, including innovative verification approaches. The IAEA has a soundly-based R&D program to this end, working with Member State Support Programmes. As regards information, major external reviews [4] have identified the need for the Agency to have information on dual use items and export denials, and have recommended amending the AP annexes accordingly. Also needed will be new confidence-building and transparency measures.

Where detection involves “unknowns” – such as undeclared nuclear activities, or undeclared nuclear weapons – the challenges are substantial. Establishing and strengthening the necessary capabilities will remain “work in progress” for the foreseeable future. It is necessary to have a realistic appreciation of what can be achieved – to avoid over-expectation (as well as false positives).

The safeguards system cannot be expected to detect undeclared nuclear activities by itself, the IAEA does not have the resources of a major national intelligence organization. It is necessary for states to actively contribute to the verification effort. States have substantial information, including intelligence (*national technical means*) and data on nuclear-related exports (including items supplied and items denied). States must be prepared to share more information with the Agency. Intelligence and other information is vital in identifying locations of interest, and safeguards provide the means to investigate locations, to get “under the roof”.

Detecting undeclared nuclear activities – or providing credible assurance of their absence – requires an **active partnership** between states and the Agency. States should not see this as threatening – if suspicions are unfounded, it is in everyone’s interest that safeguards operate as an effective mechanism for demonstrating this.

4.4 Determining non-compliance

Under the IAEA’s Statute, safeguards inspectors have the responsibility of determining whether a state is in compliance with its safeguards agreement. The inspectors are required to report any non-compliance to the Agency’s Board of Governors. If the Board finds that non-compliance has occurred, it is required to report the non-compliance to the Security Council.

A finding of compliance or non-compliance depends both on the IAEA’s technical capability to detect and identify non-compliance and on **appropriate handling** of the matter by the Board. While non-compliance involves technical (including legal) and political dimensions, it is essential to avoid conflating the two. Political efforts to resolve non-compliance are a matter for the Security Council, and where necessary government-to-government negotiations (such as the DPRK Six-Party Talks), not the Agency.

The handling of the Iran case illustrates the dangers of mixing technical and political considerations in non-compliance decisions. Concern about the possible adverse consequences of a non-compliance finding led to the finding being delayed for more than two years, with significant risk to the integrity and credibility of the IAEA’s processes. There would be merit in establishing appropriate guidelines for the Board on non-compliance decisions, to help ensure consistency, predictability and confidence in the outcomes.

One major aspect of this concerns the **standard of proof** for non-compliance. In the Iran case, discussion about “evidence” and “proof” suggested that the then Director General had set the bar too high. This is inconsistent with the safeguards agreements themselves, which provide that a state may be found in non-compliance if the Agency is *not able to verify* that there has been no diversion [5], as well as with international practice, which favours the *balance of probabilities* where this is practical or realistic [6].

The wording of safeguards agreements recognises the reality – that in many cases the Agency is unlikely to find irrefutable proof [7], and that states themselves, in making judgments about their confidence in a state’s non-proliferation commitment, consider the balance of probabilities. Divergence between the Agency’s practice and the international community’s expectations will result in loss of confidence.

5. Deterrence

Deterrence – whether a state is deterred from violating its non-proliferation commitments – depends on the state’s assessment of the risks involved: whether the violation will be detected, whether a non-compliance finding will be reached, and whether enforcement action will be taken, i.e. whether other states will

intervene either pursuant to a Security Council decision or on their own account.

It should be noted, this is not an assessment of an **absolute** risk – whether compliance and enforcement decisions will *ever* be reached. Rather, a critical part of the calculation is **timeliness** – whether these decisions will be reached in time for effective intervention. Effective deterrence requires that the risks are sufficiently high at each of these stages – a high risk of detection will not be an effective deterrent if the state assesses that the risk of **timely intervention** is low.

In cases of non-compliance, it is essential that the international community is prepared to take action to uphold compliance. As discussed above, the international community's ability to do so depends in the first instance on the effective operation of the IAEA's processes in identifying and determining cases of non-compliance.

The track record once a non-compliance case is referred to the Security Council has not been reassuring. In the case of the DPRK, the Security Council was unable to reach a decision, and the matter was referred to the Six-Party Talks, where so far the results have been disappointing. In the case of Iran, key states have been reluctant to agree sanctions with sufficient impact (although this situation is improving). These cases illustrate the difficulties of reaching international agreement on effective enforcement action – but the fact is that if the international community is unable to agree effective enforcement action in a case as serious as proliferation of nuclear weapons, this does not bode well for the future of the non-proliferation regime or for efforts to make substantial progress on nuclear disarmament.

6. Verification priorities

The key safeguards priorities are generally considered to be:

- **detection capability**, especially for undeclared nuclear activities;
- **cost-efficiency**; and
- adequate **resourcing**.

These will also be key priorities for future nuclear verification missions.

In addition to these, there are further matters that are not usually seen as “safeguards” priorities but *should* be, given their importance to achieving safeguards objectives. These further key priorities, reflecting the broader political environment within which safeguards operate, include:

- ensuring **clarity of mission**;
- building **political support** for the safeguards mission; and
- preparedness to **enforce compliance**.

These too are important both for current safeguards and for future verification missions.

6.1 Ensuring clarity of mission

A clear understanding of the safeguards mission, on the part of the IAEA and states, is absolutely essential. Without this, the safeguards system will not work effectively and will not provide confidence. [8]

Clarity of mission requires a common understanding of the objectives, processes and standards (including the standard of proof) applied in the safeguards system, and the way major decisions, such as compliance determinations, are made. Also required is an understanding of detection capabilities, as well as detection vulnerabilities and how these can be addressed – both to avoid over-expectation and to reinforce the need for states to share information with the Agency.

Clarity of mission is largely a matter for the Agency itself to achieve, although enhancing understanding will require a substantial outreach effort to states.

6.2 Building political support for the safeguards mission

Political support for the safeguards mission is essential at a number of levels: that states see that cooperation with safeguards serves their national interest; that states will support the development and resourcing needs of the IAEA; that states will share information with the Agency; and that states will back the Agency if it meets obstruction or failure to cooperate – or if it finds non-compliance.

Political support is a matter of the policies and decisions of states, but the Agency needs to be actively engaged to promote positive perceptions. It is essential to **depoliticize** attitudes towards safeguards – to help states appreciate the benefit of safeguards/non-proliferation to their own national interest and security,

and to convince states of the confidence dividend that comes from cooperation with safeguards.

This requires clear articulation of the safeguards contribution to confidence-building, and to deterrence. For the Agency, it will involve: working with states championing the safeguards cause; building confidence in safeguards effectiveness through demonstrated performance and outcomes; and ensuring that safeguards objectives and standards are seen to be applied appropriately, including through effective use of the authority given to the Agency.

6.3 Preparedness to enforce compliance

Enforcement of compliance is a vital part of the confidence-building and deterrence objectives of safeguards. If there is an unwillingness to take enforcement action the credibility of the safeguards system will suffer. Enforcement is largely in the hands of states – but states rely on the IAEA to carry out its responsibilities to implement safeguards effectively and to identify and report on non-compliance.

7. Conclusions

For any verification mission, the ability to detect treaty violations is essential. Without the required **detection capability**, no verification regime will provide confidence or deterrence. For current safeguards and for the anticipated new nuclear verification missions, detection capability is the most important priority. Attention must be given to how other “traditional” priority areas, particularly **cost-efficiency** and **adequate resourcing**, impact on detection capability [9].

While detection capability is essential, it is not sufficient in itself to provide confidence and deterrence. The other priorities discussed in this paper – **clarity of mission**, **political support**, and **compliance enforcement** – are also essential to achieving required verification outcomes. For current and future nuclear verification missions to be successful, they must take a holistic approach, addressing policy as well as technical concerns. The final priority identified in this paper is to develop a multi-disciplinary approach to nuclear verification, with a guiding **verification philosophy**, so that technical objectives and priorities are considered strategically, in their overall context.

References

- [1] NPT Article III.1 (bolding added).
- [2] INFCIRC/153 paragraph 28 (bolding added).
- [3] There are **6** NNWS NPT Parties with significant nuclear activities that have no AP – Argentina, Brazil, DPRK, Egypt, Syria and Venezuela. In addition, Algeria has an AP approved by the Board but has not yet signed it. Iran signed an AP and implemented it “provisionally”, then “suspended” it. There are **8** other states – Belarus, Iraq, Malaysia, Mexico, Morocco, Serbia, Thailand and Vietnam – that have signed an AP but not yet brought it into force. There are **46** NNWS NPT Parties with an AP in force.
- [4] The Commission of Eminent Persons (Zedillo Commission), the International Commission on Nuclear Non-Proliferation and Disarmament.
- [5] Paragraph 19 of the standard safeguards agreement, INFCIRC/153.
- [6] As a general rule international tribunals are not bound by strict rules of evidence or standards of proof. International practice is to take into account the circumstances of the case, particularly what is practical or realistic. This has led to the International Court of Justice and other tribunals adopting a *preponderance of evidence* test, drawn from the Civil Law system, in appropriate circumstances.
- [7] A state about to be caught red-handed is more likely to preserve ambiguity by denying inspectors access.
- [8] See the author’s “Defining the Safeguards Mission”, 2006 IAEA Safeguards Symposium.
- [9] Effective detection capability is not solely a function of resources, more complex issues are involved.