IAEA Inspections for Undeclared and Declared Activities: Is a More Robust Approach Needed?

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INMM ABSTRACT

The United States has long supported a strong international safeguards system and for many years has served as the foremost supplier of technology, equipment, and training to the International Atomic Energy Agency (IAEA). In doing so, it drew in many instances on DOE sponsored R&D and training that was directed towards domestic safeguards and then adapted for IAEA purposes. This was relatively straightforward because of the strong overlap between the development of nuclear material accountancy measures needed for both domestic and international purposes.

Three factors have emerged that have made this strong reliance on domestic measures less and less able to be a source of support for the IAEA. One is the shift by the IAEA safeguards system towards detecting undeclared activities. The second is the shift of domestic attention away from nuclear material accountancy and towards physical protection. As a result, a gap in US sponsored R&D and training relevant to international safeguards has developed. The NNSA Next Generation Safeguards Initiative (NGSI) and the DOE NA-22 Safeguards R&D program are intended to help fill this gap and, thereby, permit the U.S. to remain as the pre-eminent supplier of technology for international safeguards purposes. A third important factor is the reduction in nuclear fuel cycle facilities and capabilities at the USDOE National Labs, which has made it more difficult to provide training opportunities or assist with technology development in these areas. However, the reasons for this reduction are complex and deep seated, and there is no ready means to reverse this trend.

In this context, IAEA challenges have been examined from the perspective of detecting the diversion of nuclear material from declared stocks; detecting undeclared production of nuclear material and activities at locations declared under INFCIRC/153; and detecting undeclared nuclear material and activities elsewhere in a state. Of these, the detection of undeclared nuclear material and activities is, perhaps, the IAEA’s most significant challenge. It is a challenge that even the international community finds difficult to meet because of the scope and the geographic scale of the problem, the technical constraints, the knowledge required, and the significant resources needed to deploy effective systems world-wide (e.g., satellite surveillance systems).

The IAEA’s success in carrying out this mission hinges on its capability to evaluate the declarations made by the state for completeness, correctness, and consistency in order to detect possible indications of undeclared nuclear material and activities. Three elements go into this evaluation: (1) evaluating the internal consistency of a State’s declaration and comparing it to information gathered by IAEA inspectors on the basis of their access to the locations, facilities, sites, personnel, and documents disclosed in the state’s declarations; (2) comparison of States’ declarations with other information.
available to the IAEA, including the information it gathers from its review of open sources, including scientific and technical literature and data bases, trade journals, and media reports; and (3) its ability to archive, retrieve, organize, and analyze all available information for indications of potential undeclared nuclear material and activities, and, when warranted, to request states to provide further information and access in order to investigate and clarify any questions or inconsistencies.

In the past, there has been a strong tendency to consider the IAEA activities in the field and IAEA activities at Headquarters as two different domains. This may have been adequate in the context of detecting diversion from declared stocks in low throughput, low complexity facilities. However, the focus on detecting undeclared nuclear material and activities and diversion from high throughput complex facilities places a higher emphasis on the ability of inspectors in the field to make informed decisions on the spot about whether indicators of such activities exist, and, if so, how to investigate them. Such informed decision-making is even more critical when conducting investigations such as those the IAEA has pursued in recent years in Iran and Syria.

Increased emphasis is called for on linking the inspector in the field in real-time with headquarters. The credibility and timeliness of the IAEA’s results can be improved by improving communications between the inspectors in the field and headquarters in a way that would permit analysis of inspector observations through real-time expert advice on all nuclear fuel cycle related and weaponization indicators, and focused feedback on next steps. Of course, there is also great value in the deployment of new technologies focused on detecting undeclared nuclear material and activities, but the deployment of such new tools will be benefited by such feedback.

INTRODUCTION

Dramatic changes have taken place in the spread and availability of nuclear fuel cycle technologies since the entry into force of the NPT in 1970 and the adoption of the NPT safeguards system as set forth in INFCIRC 153. Besides well known activities outside of or in violation of the NPT or NPT safeguards agreements in Iraq, DPRK, Iran, and the Khan network, the global nuclear industry itself has reduced its very heavy reliance on the civilian nuclear capabilities of the nuclear weapon states. This is not a surprising development with the national concerns over the cost of energy, the desire to be energy independent as a national security strategy, the potential for economic benefits to a State as a supplier of technologies and services, and the impact of global warming. All have converged resulting in, for example, enrichment and reprocessing technologies maturing outside of nuclear weapon states.

In addition, as the need for economies of scale became important, facilities have grown substantially in size. This has resulted in increases in throughput of bulk nuclear materials by orders of magnitude in complex reprocessing and enrichment facilities that are under full scope IAEA safeguards. At the same time, there has not been a corresponding reduction in measurement error for quantifying nuclear material nor efficient techniques to quantify it in all areas of a facility. Measurement uncertainty
alone for a process stream or product can exceed the IAEA goal quantities within the timeliness criteria. Although the IAEA does compensate for these measurement deficiencies, these compensatory approaches tend to be labor intensive, and new technologies do not seem to offer any promise of relief in the near future.

Technology is also an issue in the detection of undeclared nuclear material and activities. The authors consider the detection of clandestine nuclear material and activities to be one of the IAEA’s most significant challenges. Besides the need for continued investment in a broad range of technologies for both declared and undeclared facilities, the IAEA needs to assess what else it can do to improve its probability for success. Most importantly, it needs to fully explore areas for such improvements that it has some level of control over.

IAEA INSPECTORATE

In 1978, one author arrived in Vienna to join the IAEA as a safeguards inspector. At that time, the entire training department consisted of a single dedicated individual who pulled expertise from around the IAEA to conduct training courses in whatever conference room was available. Today, the IAEA Training Section is staffed by professionals with the latest digital equipment in fully dedicated training rooms with a suite of instruments routinely used by IAEA Inspectors for hands-on training. This Section not only provides the intense three month Introductory Course on Agency Safeguards (ICAS), but also “on demand” training for inspectors and dedicated specialty training on various aspects of the nuclear fuel cycle.

It is clearly in the best interest of the IAEA to have a well trained and motivated team of inspectors who are qualified to inspect any nuclear fuel cycle facility as well as implementation of INFCIRC/540 activities. The training conducted by the IAEA strives to reach this goal, and this strategy has served the IAEA well over the more than three decades since the NPT. However, as the number of complex high throughput facilities entering full scope IAEA safeguards and the challenges of detecting undeclared nuclear material and activities continue to increase, it is appropriate to look at this model and explore ways to strengthen or add to it.

THE CHALLENGE

As mentioned in the introduction, verification of the nuclear material flows and inventories at new complex facilities under full scope safeguards, such as enrichment and reprocessing plants, and detecting undeclared nuclear material activities require a new and more detailed technological understanding by inspectors of two kinds. One kind is the understanding of the processing technologies themselves and of their capabilities. Inspectors should have a good sense of how the plants operate when in the normal mode, how they might be made to operate in order to conceal diversion of nuclear material, and what indicators might arise if this were done. Complicating this challenge is the consequence of the necessary deployment of unattended monitoring systems that further limit both the time in and access to these facilities by the
inspectorate; further reducing inspectorate exposure to and understanding of the working conditions in these facilities. The second kind is an understanding of the capabilities of modern technologies that have been introduced, or will be introduced, into the realm of safeguards. This includes, for example, new technologies for environmental sampling and, perhaps, more important, new technologies for storing, transmitting, analyzing, and assessing information as well as being sure that it is authentic.

Both kinds of knowledge pose particular problems for inspectors. On the one side is the complexity and, often, flexibility of modern enrichment and reprocessing technologies, as well as the primary and auxiliary systems required for fully functioning plants, that lend themselves to the possibility of diversion pathways that are challenging to appreciate and difficult to detect. Particularly in the area of uranium enrichment, the technology is generally held in strictest confidence by technology holders. This is both for commercial reasons and for nonproliferation reasons. As a result, expertise in modern enrichment technology may not be available to the IAEA on staff. On the information side, the challenges are compounded by the rapid changing technical environment, the steady stream of new technologies, and the vulnerabilities of some digital systems. The rapid change means that most inspectors today grew up on the wrong side of the technological digital divide that tends to separate younger and older professionals. Today’s inspectorate is, thus, unlikely to be able to take best advantage of new tools. This is not ageism, but a fact of modern life. It is no surprise that the New York Times reports that one of the “top young workers” in a US cybersecurity program is a 22 year old college dropout.

The authors believe that the degree of additional knowledge needed by inspectors to meet these challenges is likely to far exceed the capability of any training organization and, indeed, may well exceed, in some areas, the ability of individuals at all. Although inspectors with even decades of extensive experience designing and/or operating these facilities can master knowledge of one type, other elements may be beyond their grasp, if for no other reason than time.

**A MORE ROBUST APPROACH**

A more robust approach would focus on using modern technology and communications to ensure that inspectors in the field are connected to the best available information and knowledge at all times. What would be involved would be the establishment of a new interface between IAEA Headquarters and inspectors. This could be buttressed by establishing also a new interface between the IAEA and subject matter experts around the world, i.e., experts to whom the IAEA could turn for quick responses to technical questions.

As the result of such an interface, inspectors would able to make better decisions in the field because they had better tools in the field but were also connected in near real-time with Agency managers, safeguards experts, and Agency databases. This access was considered especially beneficial during complementary access inspections when access
to up-to-the-minute information could affect the decisions that an inspector makes while onsite. Agency staff in Headquarters, Tokyo, or Toronto would be able to see inspection data in near-real time and could interact with inspectors in the field to ensure that safeguards data is gathered as efficiently as possible. The inspectors would also receive improved support both before and during inspections via an Operations Centre that would be staffed around the clock.

Such capabilities could also be valuable during Agency investigations of potential violations of safeguards agreements. Incorporating such a robust approach can help establish a “CSI: Vienna” like unit or team supported by Member State subject matter experts. Pursuit of these suggestions could spur development of new technologies that might not be used routinely, but would create a need for new skills. If such an operations center were developed, it would require improvements or additions to many aspects of the Agency’s work in the field and in HQ, for example better telecommunications and development of databases for HQ Center staff to use in near-real time.

This topic was addressed in the IAEA-USSP “Safeguards Tools of the Future” workshop held in Newport, Rhode Island in 2005. Its purpose was to “to explore technology trends and to identify the characteristics of technology that would be available in five to ten years to enable Agency safeguards inspectors to perform their jobs more effectively and efficiently.” The participants’ strongest recommendation was to establish an operations centre at Agency Headquarters.

It is worth citing directly the report:

**Operations Centre Recommendation**

The workshop participants identified the need for a Headquarters-based operations centre. The purpose of the operations centre is two-fold: to provide Agency staff a common operational picture (COP) of safeguards activities worldwide and to provide inspectors with a single point of access to Agency managers and subject matter experts who might be needed to support inspection or maintenance activities. The operations centre would provide Agency staff with command, control, communications, and intelligence sharing tools. Agency managers would use the operations centre to assess at a glance ongoing activities in the world of international safeguards. Inspectors could use the room to prepare for inspections, checking to see if equipment has been delivered or receiving the latest intelligence and safety briefings.

The operations centre would also benefit inspectors by providing a single point of access at Headquarters for solving emergent problems, answering inspection-related questions, and for exchanging information with other staff members to facilitate timely, well-informed decisions in the field. Inspectors could contact the operations centre staff via telephone, satellite link, or the Internet. The operations centre staff, in turn, would be able to
reach key Agency managers, technicians, and subject matter experts quickly via the telecommunications system, thereby providing field personnel access to others who might provide assistance. This would enable the field personnel to resolve technical problems, make decisions, expedite clearances or authorizations, and solve emergent problems. The field personnel could work more confidently in the field knowing that they could access any type of expertise quickly.4

Although not addressed specifically in the workshop report, to address these new challenges, the authors propose that the “operations center” suggested in the workshop be established at the IAEA within the Department of Safeguards and that it be structured so that there is a separate team that focuses on three primary areas:

1. Detection of undeclared nuclear material and activities, including the conduct of complementary access on the sites of facilities;
2. Verification of uranium enrichment facilities
3. Verification of reprocessing facilities.

The office would be matrixed into the work of the Agency and would be staffed by experts in these fields with the following responsibilities:

1. Provide 24 hour access at any time from any location to on-call experts at IAEA headquarters for the safeguards inspectorate to address questions (requires dedicated communications capability for both the headquarters experts and the inspectorate).
2. Establish a world-wide cadre of on-call experts to augment the IAEA operations center’s in-house experts (perhaps using Member State Support Programs).
3. Deploy in the field to perform inspections/investigations upon request by the inspectorate or IAEA management.
4. Provide advice and support to:
   a. Concepts and Planning to assure the implementation of effective safeguards approaches.
   b. Technical Support to assure the development and implementation of effective safeguards technologies
   c. Information and Analysis Section for undeclared facility indicators
   d. Training section on the content and teaching of dedicated courses on the focus areas.
5. Participate in drafting and review of State Evaluation Reports so that the results of reports would be informed by the best available expertise.
CONCLUSIONS

As the nuclear renaissance unfolds, the demands on the IAEA will continue to increase. It is not the number of facilities, though, that will place the greatest strain on inspectors. More demanding will be the size and complexity of new facilities and the need to provide credible conclusions not only about the non-diversion of declared nuclear material but also about the absence of undeclared nuclear material and activities. Integrated safeguards and the concomitant development of State Level Approaches speak in favor of a new modality for implementing safeguards. In this modality, the conduct of an inspection or complementary access would be an exercise in which the inspectors’ field operations would be integrated with headquarters operations in a seamless manner. In turn, IAEA headquarters activities could be informed by the establishment of a new interface that would permit the IAEA to draw on a world-wide cadre of subject matter experts. Such a new inspection modality will be challenging, calling both for a new organizational model for the IAEA and for a new set of technologies that can provide for the real time interface in a secure and reliable manner. To date, IAEA resources have not grown in response to meet these new demands. Yet, the world is relying on IAEA capability to assure State’s compliance with its obligations under the NPT and other agreements.

1 Carnegie Endowment, Issue Brief, Non-Proliferation, Vol. VIII, No. 8, September 7, 2005
3 New York Times, May 1, 2009, p. 4 “Contractors vie for plum work, Hacking for the U.S.”