The changing nature of SAFEGUARDS

by Richard Hooper

"One of the most urgent challenges facing the IAEA is to strengthen the Agency's safeguards system in order to increase the likelihood of detecting any clandestine nuclear weapons programmes."

— Mohamed ElBaradei, IAEA Director General

The Statute of the IAEA permits the implementation of safeguards tailored to differing security demands of States parties to non-proliferation and nuclear arms control treaties. The agreements concluded in response to these demands foresee the continuous development of safeguards verification. The safeguards system was first implemented in the 1960s to provide exporters of specified nuclear material, technology and facilities assurances that these were used for peaceful purposes only. With the Treaty on the Prohibition of Nuclear Weapons in Latin America and the Caribbean (the Tlatelolco Treaty), and the Treaty on the Non-Proliferation of Nuclear Weapons (the NPT), the overall objective of IAEA safeguards took a major step forward as non-nuclear weapon State parties undertook to accept comprehensive safeguards on all nuclear material within their territory, under their jurisdiction or control, for the purpose of verifying that such material is used only for peaceful purposes.

The system of comprehensive safeguards, following the structural content of the NPT Safeguards Agreement (INFCIRC/153(Corr.)), has developed continuously with the accumulation of experience and the introduction of new technology and methods. This system, based on material accountancy, has proved reliable in providing assurances about the peaceful use of declared nuclear material and declared facilities (i.e. that States' declarations are correct). However, while the scope of the NPT agreement is not limited to declared material and facilities (the Agency has the basic right and obligation to apply safeguards to all nuclear material and activities of a State), the safeguards system developed through the early 1990s had limited capability to deal with the completeness of States' nuclear material declarations.

The discoveries in Iraq of a clandestine nuclear weapons programme in the early 1990s emphasized the increasing importance of assurances regarding the absence of undeclared nuclear material and activities in States committed, by treaty, to non-proliferation. It was imperative to update the safeguards system by adding measures giving the Agency improved capabilities to detect clandestine nuclear activities. The IAEA Secretariat's response, with the strong support of Member States, was an extensive multi-year programme (termed "Programme 93 + 2") to improve the effectiveness and efficiency of the safeguards system. One objective was to establish the technical and legal basis through which safeguards, while continuing to provide assurance regarding the correctness of States' nuclear material declarations, could also address their completeness. This effort culminated in May 1997 with the Board of Governors approving the Model Protocol Additional to

Safeguards activities include the collection of environmental samples analyzed at the IAEA Safeguards Analytical Laboratory and network laboratories worldwide. (Credit: Pavlicek/IAEA)

Safeguards Agreements (termed "the Additional Protocol" and published as INFCIRC/540 (Corr.)).

This article provides a detailed description of the "completeness problem" and the extraordinary changes in the safeguards system that are providing the basis to effectively and efficiently address it.

The "Completeness" Problem

The problem of providing assurances regarding the completeness of States' nuclear material declarations has to be addressed in three circumstances:

- The completeness of States' initial nuclear material declarations — for States with a significant nuclear programme — upon entry-into-force of their comprehensive safeguards agreement with the IAEA;
- The completeness of States' nuclear material declarations as a continuing feature of the implementation of safeguards; and
- The completeness of States' declarations under circumstances where safeguards inspections are not carried out because of the small quantities of nuclear material involved.

The completeness problem cannot, independent of circumstances, be effectively addressed without a high level of co-operation with the State.

Historically, upon receipt of a State's initial report, implementation of safeguards began with the verification of the correctness of the report and then proceeded, location-by-location, to implement material accountancy safeguards. Implementation proceeded with the tacit assumption that the initial report was complete. Beginning in 1991, with the Board of Governors' instructions to the Director General to verify the completeness of South Africa's initial report, assessing the completeness of a State's initial report has become a routine feature in the implementation of safeguards. Subsequent instances of such assessments include the Democratic People's Republic of Korea (DPRK), the Newly Independent States, Argentina and Brazil. The process involves reviewing thoroughly facility operating histories, comparing declared facilities and material types/amounts with other information available to the IAEA (including from inspections) and resolving any resulting inconsistencies. The completeness exercise in South Africa was also unique in that it included an audit of a disarmament undertaking.

Co-operation between the IAEA and a State is necessary for the successful implementation of safeguards in any context. The level of co-operation essential to the process of verifying the completeness of an initial report, for States with a significant nuclear programme prior to, or at the time of entry-into-force of their safeguards agreement, goes beyond that required to implement a comprehensive safeguards agreement or even an additional protocol to the agreement. The State is obliged to provide any existing facility operating records to the extent they are pertinent to assessing the completeness of present declarations (as was argued in "Programme 93 + 2"). However, the process may require access to individuals and locations that the State is not legally obliged to provide. The contrasting cases of South Africa and the DPRK are instructive in this regard. South African authorities provided a high level of co-operation through a difficult, lengthy and eventually successful process. The DPRK provided a high level of co-operation in the beginning but, as problems surfaced, it eroded quickly. Today, numerous inconsistencies between IAEA inspection data and DPRK declarations are unresolved and the IAEA remains unable to draw any conclusion regarding the completeness of the DPRK's initial report.

Assurances that a State's nuclear material declarations are complete, as a continuing feature in the implementation of safeguards, derive from an IAEA capability to detect undeclared nuclear material and activities. Strengthening this capability was a primary objective of Programme "93 + 2." Elements of this capability include:

- Information about, and inspector access to, all aspects of a State's nuclear fuel cycle from uranium mines to nuclear waste and any other location where nuclear material for non-nuclear use is present;

- Information on, and short-notice inspector access to, all buildings on a nuclear site;
- Information about, and inspection mechanisms for, fuel cycle-related research and development;
- Information on the manufacture and export of sensitive nuclear-related technologies and inspection mechanisms for manufacturing and import locations; and
- The collection of environmental samples beyond declared locations when deemed necessary by the IAEA.

This combination of increased nuclear transparency on the part of States (a new and much broader kind of declaration), expanded physical access for IAEA inspectors and new technical measures (e.g., environmental sampling) is coupled with an information evaluation process. Through it, States' declarations are continuously compared with all information available to the IAEA. Information includes inspection data, open source collections (media, technical publications, trade journals, etc.) and information provided by third parties. Inconsistencies between State declarations and information available to the Agency are subject to follow-up with the State. Resolution of inconsistencies, as part of the process of assuring the *completeness* of States' nuclear material declarations, plays much the same role as the resolution of discrepancies and anomalies in the process of assuring the *correctness* of States' nuclear material declarations. The completeness of a State's declaration is, of course, not limited to States who have concluded an additional protocol. The problem continues to be addressed through available means (e.g., expanded information collection/evaluation and environmental sampling). But the information provided by the State and the access available to inspectors are limited to that stipulated under their safeguards agreement. Therefore the assurances that the Agency can provide for States without additional protocols in force are limited.

A large number of States with comprehensive safeguards agreements have declared that they do not have nuclear material in facilities and do not possess more than minimal amounts of nuclear material. For most such States, the safeguards agreement includes a protocol, referred to as the "Small Quantities Protocol" (SQP), which holds in abeyance most operative provisions of the agreement as long as these conditions continue to apply. As of March 2003, an SQP is part, or is expected to be part, of comprehensive safeguards agreements with approximately 120 States. For these States, the completeness and correctness are synonymous and bear directly on the continuing appropriateness of an SQP as part of their safeguards agreement.

State Evaluations

Material accountancy safeguards is implemented facility-by-facility and at other locations where the State has indicated that nuclear material is present. The conclusions that there have been no diversion are drawn, location-by-location, through a yearly verified closure of material accounts and the verification of material flows throughout the material balance period. There is some evaluation across facilities (e.g., assurances against borrowing where like material is moved between facilities to cover a diversion at the time of an inspection) but the conclusions are derived from verification activities at declared locations.

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Drawing a conclusion that a State's declarations are also complete requires a shift in emphasis from evaluating information on a *facility-by-facility* basis to the consideration of information for the *State as a whole*. This shift in emphasis is best characterized by the development of the State evaluation process. The changes that have occurred over the last five years that have allowed this process to develop and mature include:

- The State evaluation process results in the production and periodic update of State Evaluation Reports (SERs). The Agency documents the basis for its safeguards conclusions in these reports.
- SERs are reviewed by the senior management of the Safeguard's Department, Office of Legal Affairs and the Office of External Relations and Policy Co-ordination.
- A whole new infrastructure related to information collection and management, evaluation methodologies, new technical measures and the implementation of the additional protocol has been put in place.
- The State evaluation process requires a new skill mix to be incorporated into multi-disciplinary evaluation teams developed through training and targeted recruiting.

Changes in structure and practices of the Safeguards Department have been accompanied by a change in culture that is more of a revolution than an evolution. The introduction of SERs means that, for the first time, the Department has systematically documented the basis for its safeguards conclusions. Senior management review of SERs and the identification of follow-up actions have improved consistency of approach and greatly increased accountability.

The SER is the nexus of a myriad of information collection, management, retrieval, evaluation and documentation activities. The information is: (i) provided by States according to the provisions of their safeguards agreements and additional protocol (if it exists) and which may be provided voluntarily; (ii) generated by the Agency through inspections, design information verification and complementary access activities; (iii) collected from open sources; and (iv) provided, in some cases, by third parties. The open source collection is extensive, relying on scientific and technical literature, news media (including news service data bases), country-specific websites and commercial satellite imagery.

The evaluation and verification processes are inextricably linked. In general terms, assurances that declared nuclear material is accounted for, and thus the conclusion that there has been no diversion, derives from a series of time-dependent and technically interrelated verifications. These are verifications and associated evaluations that:

- nuclear material flows and inventories are as declared;
- facility design is in accordance with the declared design and consistent with the corresponding safeguards approach;
- facility operations are as declared (e.g., through the review of surveillance records);
- facility material accountancy systems conform to prescribed standards;
- facility operator measurement systems perform to international standards and are in good statistical control over time; and that
- all anomalies are resolved or otherwise explained.

Likewise, assurances of the absence of undeclared nuclear material and activities (i.e., that State declarations are complete) derive from determinations that:

- the declared present and planned nuclear programme are internally consistent;
- the nuclear activities and types of nuclear material at declared locations are consistent with those declared (e.g., through the collection and analysis of environmental samples);
- overall production, imports and inventories of nuclear material are consistent with the utilization inferred from the declared programme;
- imports of specified equipment and non-nuclear materials are consistent with the declared programme;
- the status of closed-down or decommissioned facilities (and locations outside facilities) is in conformity with the State's declaration;
- nuclear fuel-cycle research and development activities are generally consistent with declared plans for future development of the declared nuclear programme;
- the declared nuclear programme, research and related manufacturing activities are consistent with all information available to the Agency;
- all plausible acquisition pathways (including facility misuse) through which a State might acquire weapons-useable material are identified and evaluated; and
- all inconsistencies or questions of significant safeguards concern have been resolved.

The SER also contains an assessment of the safeguards significance of any open issue including the failure to fully attain inspection goals. Senior management review of a SER is intended to result in consensus regarding safeguards conclusions and agreement on follow-up actions. While SERs are formally updated and reviewed annually, evaluations are conducted continuously as new information becomes available.

As stated previously, the completeness issue is addressed through State evaluations. The capability to address completeness in a State without an additional protocol is circumscribed. For such States there is no declaration data for some of the completeness evaluation elements identified above. Nor is complementary access an available tool. Obviously, some indications may result from the SER exercise but the Safeguards Department does not come to a formal conclusion on completeness in these cases. When an additional protocol is successfully implemented in a State, i.e., the conclusion of completeness has been drawn and maintained, the State becomes a candidate for the implementation of integrated safeguards.

Integrated Safeguards

The development and implementation of integrated safeguards is the next step in the evolution of safeguards. Article 1 of the Model Additional Protocol deals with the relationship between the safeguards agreement and the protocol. The legal interpretation accompanying Article 1 stipulates, *inter alia*, that the agreement and the protocol

have to be read as a single document resulting in a single, unified safeguards system. It was always foreseen that the increased assurances regarding the completeness of States declarations would result in reduced verification intensity on some types of nuclear material in exchange for the greatly increased nuclear transparency and openness provided by the additional protocol.

The Agency's "timeliness detection goals" are target detection times used for establishing the frequency of safeguards activities at a facility to verify that there has been no abrupt diversion of nuclear material. Historically, the Department of Safeguards has taken timeliness verification goals as synonymous with estimated conversion times (i.e., the time estimated to be necessary to convert nuclear material of a given type into weapons-useable material). The argument was that the system provided little assurance that the clandestine means to convert do not exist at the time of a diversion. The assurances regarding the absence of undeclared nuclear material and activities in a State provides a rationale for decoupling "timeliness" from conversion times for types of nuclear material that require further nuclear processing to become weapons-useable. Under integrated safeguards, the timeliness goal for plutonium in spent fuel and in mixed oxide (MOX) fuel assemblies are extended from the current three months and one month, respectively, to one year and three months respectively. Timeliness of natural and low-enriched uranium remains one year, as the requirement for a yearly verified closure of material accounts stays in place. The intensity of flow verification, however, is reduced. Obviously, this argument cannot be applied to reprocessing and enrichment facilities and any nuclear material that is already in a weapons-useable form.

The development of integrated safeguards, including the development of facility-type specific integrated safeguards approaches, the translation of the approaches into implementation criteria and the development of State-level approaches, is an entire subject in its own right. This development is well advanced. Implementation, to date, is limited to two States with modest nuclear programmes. That is expected to change in the near future with integrated safeguards slated for implementation in a number of States, several of which have large nuclear programmes.

The Future

In the safeguards system we will surely continue to see change necessitated through the challenges to the Agency's verification system. The Board of Governors, in approving the Model Additional Protocol, made clear their hope and expectation that all States would accept an additional protocol to their safeguards agreement. As of April 2003, the Board has approved 78 additional protocols and 32 of those have entered-into-force. The number of States with additional protocols in force could increase dramatically in the near future with the entry into force for 15 European Union States expected before the end of 2003. The changes in culture and approach, so clearly visible in the Department of Safeguards, must continue to keep pace with these developments. Moreover, the implementation of integrated safeguards is in its infancy but this situation too will change dramatically in the coming years as many more States, several with large nuclear programmes, become eligible for integrated safeguards.

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Whether or not the Agency will have the resources necessary to perform the verification tasks it has been asked to do remains an open question. The implementation of integrated safeguards will free some resources that can be directed to dealing with the "completeness" problem but it is now clear that this won't be enough. Through 15 years of zero real growth budgets, the safeguard's programme has become increasingly dependent on extra-budgetary contributions. A strong case has been made to begin correcting this situation with the 2004-2005 budget cycle. The issue is now in the hands of Member States.

Richard Hooper, Former Director of the IAEA Division of Concepts and Planning, Department of Safeguards, served as Programme Manager of "93+2". E-mail: wrci@trib.com.