IAEA SAFEGUARDS: EXPERIENCE & CHALLENGES

BY BRUNO PELLAUD

Much progress has been made in the world of safeguards over the past four years, since the IAEA Board of Governors chose to revise the safeguards system in response to revelations about Iraq's clandestine nuclear-weapons programme. In the world at large, the indefinite extension of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and the increase in the number of NPT parties are only two of the major events that have taken place. The IAEA itself has taken major steps to bring safeguards to a higher level of effectiveness and efficiency.

This article provides an overview of the experience accumulated in the implementation of safeguards in recent years. It summarizes important aspects and reviews forthcoming major challenges.

FACTS & TRENDS

The IAEA's implementation of safeguards has been influenced by several major developments from 1993 to the end of 1996. In particular, they include a significantly increased number of safeguards agreements, the introduction of new verification measures of the Strengthened Safeguards System, and new verification assignments.

Safeguards Coverage. Twenty-one States entered into safeguards agreements, increasing the number from 110 in 1992 to 131 in 1996. The number of States with significant nuclear activities, i.e. more than one significant quantity (SQ) of nuclear material, increased by one in the period 1992-96 from 68 to 69. In 1996 the IAEA had 214 safeguards agreements of all types in force, compared to 188 in 1992 (an increase of 14%).

The number of nuclear facilities under safeguards has grown steadily from 493 in 1992 to 558 in 1996 (an increase of 13%). Taken together with the locations outside facilities, the total number of locations under safeguards has increased by 102 — from 814 in 1992 to 916 in 1996 (an increase of 13%).

Another important parameter for the workload of safeguards operations is the amount of nuclear material under IAEA safeguards. The total number of SQ's increased by 43% from 65,878 in 1992 to 94,294 in 1996. Most of the SQ's consist of plutonium, the amount of which has steadily increased: 404 tonnes in 1992 to 587 tonnes in 1996 (an increase of 45%). This refers to the total amount of plutonium contained in irradiated fuel and as separated plutonium. The amount of separated plutonium is only a fraction of the total amount: 53.7 tonnes of separated plutonium were subject to IAEA safeguards in 1996 compared to 35.3 tonnes in 1992 (an increase of 52%).

The amount of highly enriched uranium (HEU, 20% of uranium-235) increased from 11 tonnes in 1992 to 21 tonnes in 1996 (an increase of 82%), for reasons discussed later. Low-enriched uranium (LEU, less than 20% of uranium-235) under safeguards has grown from 35,833 tonnes in 1992 to 48,620 tonnes in 1996 (an increase of 36%), and other source material from 77,958 tonnes in 1992 to 105,395 tonnes in 1996 (an increase of 35%).

To summarize, the quantities of nuclear material under IAEA safeguards at the beginning of 1997 were equivalent to approximately 94,000 significant quantities, made up of roughly 100,000 tonnes of source material, 50,000 tonnes of LEU, 20 tonnes of HEU, 500 tonnes of plutonium in irradiated fuel, and 50 tonnes of separated plutonium.

Resources and Inspection Effort. In 1996, the regular budget expenditure for safeguards was US $86.2 million ($64.5 million for operations, $18.7 million for support and $2.7 million for management). There has been no real growth in the regular budget since 1992.

Staff resources for safeguards inspection have increased only marginally — from 200 persons in 1992 to 209 in 1996 (an increase of 4%). Despite this small increase in

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inspection resources, the total person-days of inspection increased from 8385 in 1992 to 10,831 in 1996 (an increase of 29%).

Staff of the Support Divisions of the Department also participate in the inspection effort, although the main functions of these divisions are to develop, purchase and maintain equipment, develop better standards and procedures, process and analyze computerized information, elaborate concepts, train, evaluate and administer. Currently, the total staff of the Department of Safeguards amounts to 565 (with no change since 1992).

Priority continues to be given to improving the attainment of the inspection goal in major facilities, and attainment of the quantity component has increased from 69% in 1992 to 73% in 1996.

The overall result of the IAEA safeguards implementation activities is expressed each year in the Safeguards Implementation Report (SIR) as the Safeguards Statement: "In fulfilling the safeguards obligation... all the information available to the Agency suggests the conclusion that the nuclear material and other items which had been placed under Agency safeguards remained under peaceful nuclear activities or were adequately accounted for". This statement relates only to declared nuclear material and is derived from — *inter alia* — the qualitative assessment of the accumulated knowledge of facilities and material at facilities, and up-to-date design information.

Since 1992, the Statement has included a paragraph related to the verification of the correctness and completeness of State declarations. In one case, the Democratic People's Republic of Korea (DPRK), the Agency has been unable to conclude that no diversion of nuclear material had taken place.

HIGHLIGHTS

An important objective of the recent and future work of the IAEA is to improve cost-efficiency. Significant progress in this area has been made through the so-called New Partnership Approach (NPA) with Euratom. First established some five years ago, its key objectives were to allow both sides to make savings while retaining their ability to reach independent conclusions. Under the NPA, co-operation procedures have been established at all facility types except enrichment plants. Since the start of the NPA, the IAEA has significantly reduced —by more than 1500 person-days — its inspection effort in European Union non-nuclear-weapon States while continuing to reach its independent safeguards conclusions. The features of the NPA are now quite well known; briefly, they include common R&D, shared and compatible equipment, common training, exchange of analytical data and most important, more efficient joint inspections.

ABACC, Argentina and Brazil. The Quadripartite Safeguards Agreement between the IAEA, Argentina, Brazil, and ABACC entered into force on 4 March 1994. Under this Agreement the IAEA has continued its work with the Brazilian and Argentine authorities and started close co-operation with ABACC, the Argentine-Brazilian Agency for Accounting and Control. The IAEA and ABACC apply safeguards on a wide range of facilities. including enrichment plants, a light-water reactor, heavy-water on-load reactors and fuel fabrication plants as well as numerous smaller facilities. Consideration now is given to developing a co-operative approach with ABACC, which may include elements taken from the NPA with Euratom. IAEA-ABACC co-operation foresees jointly performed inspections, joint use of equipment, exchange of information, co-operation in training and inter-comparison of laboratory results. Both organizations, however, will retain the ability to reach independent conclusions. These efforts should enable in the future a more efficient and effective application of IAEA safeguards under the Quadripartite Agreement. This co-operation is now formalized in a Co-operation Agreement between the IAEA and ABACC approved in September 1997.

NIS — The Newly Independent States. The break-up of the former Soviet Union in 1991 resulted in the creation of 14 Newly Independent States (NIS). Quite remarkably, all 14 have now signed the NPT and all those with significant nuclear activities have concluded a Safeguards Agreement with the Agency, while two have already adopted the Additional Protocol and asked for its provisional implementation. Currently, seven safeguards agreements with NIS have

Photo: Safeguards inspectors collect samples that are analyzed at the IAEA Safeguards Analytical Laboratory in Seibersdorf near Vienna. (Credit: IAEA)

been brought into force. A wide variety of nuclear facilities are located in the NIS; they include mining, fuel fabrication, power reactors, research reactors and storage facilities. Even before any safeguards agreements were in force, IAEA representatives went on technical visits to assess the situation and advise on what safeguards measures might be appropriate. When implementation began a number of problems had to be faced: they related to logistics, communication, health physics, and harsh weather conditions, for example.

Significant progress has been made in introducing safeguards in the NIS, but some of these problems still exist. The international community and the donor-States to the NIS should continue to provide support for advancing the goal of proper accounting and safekeeping of nuclear material in the NIS.

More Facilities. The IAEA continues to face an increase in workload due to the introduction of new facilities or nuclear activities. By the year 2000 this is expected to lead to approximately a 10% increase in inspection effort over the 1997 figure, using current assumptions. These facilities or activities include a new enrichment plant in China, the increased use of mixed-oxide (MOX) fuel in light-water reactors, a laser enrichment facility in South Africa and large plutonium stores in Europe.

Towards a Strengthened Safeguards System. Since the beginning of the 1990s, the Agency has been engaged in a major undertaking to strengthen and streamline the safeguards system that had been created in the early 1970s at the entry into force of the NPT. Several measures to strengthen the safeguards system with respect to undeclared nuclear materials and activities were approved by the Board of Governors in 1991-92 already and they have been put in place. These measures include the early provision of design information, and the voluntary reporting of exports, imports and production of nuclear material for peaceful purposes and of exports and imports of specified equipment and non-nuclear materials.

A more ambitious political, legal, and technical process aimed at strengthening the effectiveness and improving the efficiency of the IAEA safeguards system was initiated in 1993 with the launching of the development programme known as “Programme 93+2”. A first milestone occurred in June 1995 when the IAEA Board endorsed a new set of measures that could be used by the Agency without modification to the safeguards agreements. This included the right to take environmental samples in nuclear facilities.

In May 1997, the Board of Governors endorsed the Additional Protocol to safeguards agreements between States and the IAEA. This Additional Protocol is now published in a blue booklet as INFCIRC/540. Seven States (Australia, Armenia, Georgia, Lithuania, the Philippines, Poland, and Uruguay) have already signed the Protocol and two have said that it can immediately apply provisionally pending formal ratification.

These efforts have led to what is now called the Strengthened Safeguards System. The name implies that the added strength will result in both a better effectiveness in verification and a better efficiency in the use of resources.

Other Developments. Based on a request by the UN Security Council, the Agency has maintained since 1994 a continuous inspection presence in the DPRK. Due to the

reluctance of the DPRK to accept some safeguards measures, the Agency has not been able to verify the DPRK's initial declarations under its NPT safeguards agreement. Issues regarding safeguards implementation in the DPRK are routinely reported to the IAEA Board of Governors, the Agency's General Conference, and the Security Council.

The nuclear disarmament process between the United States of America and the Russian Federation leads to the removal from weapons programmes of large quantities of nuclear materials of high quality. The Agency implements safeguards in the nuclear-weapons States within the framework of their so-called "Voluntary Offer Agreements". In 1994-95, three American facilities with highly enriched uranium or plutonium (for a total of 12 tonnes) were added to the list of facilities eligible to the application of safeguards under the US Voluntary Offer. All three facilities have been selected by the Agency for the implementation of safeguards and they are being inspected in accordance with the current safeguards criteria.

The Department of Safeguards has other assignments as well. In particular, they include coordinating the Agency's programme to help governments and operators to prevent illicit trafficking in nuclear material. Nuclear material must be protected at its source. Physical protection and adequate nuclear material accountancy and control systems provide the first line of defense.

NEW SAFEGUARDS

The greatest challenge in implementing the new safeguards system lies in its duality. The strengthening is indeed twofold. At the first level, new measures, new rights have been added to the existing safeguards agreements, and this without amending and renegotiating these agreements. This was decided by the Board of Governors between 1991 and 1995. The second level goes much farther since a new legal instrument specifically came into being, the Additional Protocol of 1997.

The first level will pertain to States that have only a safeguards agreement in force. The existing agreements will continue to be applied. On nuclear materials and nuclear facilities, the quantitative — and some might say, "mechanistic" verification activities — will remain centre stage. The second level will pertain to States that have added the Additional Protocol to their safeguards agreement. A new kind of verification — more qualitative, non-mechanistic — will in these States be introduced in parallel with the conventional verification activities.

For some time to come, the first level of the Strengthened Safeguards System will apply to the majority of States. Gradually, States will sign up to accept the Protocol. This two-level application of safeguards will make the work of the IAEA more complex, but not impossible nor really new. The Agency has for a long time experienced the verification of safeguards commitments carried out under different legal instruments with different objectives. Important examples are the comprehensive safeguards agreements (INFCIRC/153), the INFCIRC/66 agreements, and the Voluntary Offer Agreements with nuclear-weapons States. In addition, there is experience with the special mandate in Iraq and more recently the Agreed Framework in the DPRK. Ultimately, the majority of States is likely to join the Additional Protocol which will become the norm for States with comprehensive safeguards agreements. Important elements of the overall Strengthened Safeguards System will hopefully be in wide use in other States as well. *(See the article beginning on page 26 for an overview of the Strengthened Safeguards System.)*

Besides the Agency, its Member-States as partners will also be confronted with a series of challenges, among them:

- Even though most States with a substantial nuclear infrastructure have readily available the additional information required under the Protocol, it will need to be submitted in a systematic form compatible with the proposed guidelines in order to allow an efficient processing and review by the Agency.
- All potentially relevant industry, government agencies and research facilities will need to be informed of the new requirements for reporting and for potential inspector access, and the reasons explained why the Agency needs them.

THE BROADER OUTLOOK

A key issue deserves mention — that of the resources required by the Agency, as well as by the States involved to implement the Strengthened Safeguards System in all

Member States parties to safeguards agreements, in particular in those that have concluded an Additional Protocol. While diligent work and goodwill can help moving ahead, it is clear that the momentum achieved in strengthening the system and the expectations placed on the Agency must be reflected in the resources available and the priorities set for their use. For the next couple of years, the single most important factor will certainly be the rate at which States move to accept the Additional Protocol.

Whatever the resources available, it seems reasonable at this time to assume that the priorities for the use of resources would be as follows:

- First, the mandatory verification activities such as those under INFCIRC/153 and INFCIRC/66;
- Second, the verification of Additional Protocols in non-nuclear weapon States (INFCIRC/153 combined with INFCIRC/540);
- Third, the inspection activities in nuclear-weapon States (Voluntary Offer Agreements and Additional Protocols); and
- Fourth, other non-mandatory activities.

SAFEGUARDS INTO THE NEXT CENTURY

How will the Strengthened Safeguards System look beyond 2000?

To answer this question, it is useful to go back to the beginning of the 1990s, to the dual call for increased effectiveness and improved efficiency that launched the revision of the safeguards system. The events of Iraq called for a strengthening of the effectiveness of safeguards, while the increasing complexity and cost of safeguards implementation in nuclear facilities called for a better efficiency, a better use of resources. At that time, the expressions "integrated system" and "trade-offs" were very much present in the discussions dealing with effectiveness, strengthening, and efficiency. In the meantime, these concepts slipped to the background. The time will soon come to revisit them.

But, first of all, sufficient experience must be accumulated on the combined implementation of conventional safeguards and the new measures under the Additional Protocol. The sooner the Protocol is implemented and practiced, the sooner the opportunities for "trade-offs" can be thoroughly evaluated.

While the different nature of the verification carried out under each of the legal instrument will remain, the overall activities of the IAEA in such States will gradually require an integrated approach once sufficient experience has been gained with the new measures. There is at least one good reason for that view.

The word "integration" implies almost automatically the words "optimization of resources". In a State with a comprehensive safeguards agreement and the Additional Protocol, the better transparency and the more generous access provided by the State will improve and broaden the assurances that Agency's safeguards can provide to its Member States. This should be taken into account through an adjustment of verification measures to avoid inefficient redundancies. Such an optimization would bring benefits to the Agency, to the State and to the facility operators.

An integrated and optimized safeguards system could include *inter alia* the following elements:

- Increased cooperation between States and the IAEA. This is essential both for effectiveness measures and for efficiency measures;
- Modification or elimination of measures that can be seen as redundant when and where an Agreement and a Protocol are both in place;
- Adoption of revised technical or timeliness parameters to better focus verification on critical elements of the fuel cycle, while using resources judiciously;
- More unpredictability (for example, as to the timing and contents of inspections); and
- More sophisticated use of advanced technologies, such as remote monitoring.

Overall, it can be said that the recent adoption of the Additional Protocol opens a new chapter in safeguards history, a chapter that will see the broad implementation of the Strengthened Safeguards System.

A new challenge now confronts the Agency and its Member-States. The immediate objective will be to ascertain that such implementation has been put in place successfully by the time of the NPT Review Conference in the Spring 2000. ❐

Photo: Digital instruments are part of new safeguards technologies. (Credit: Pavlicek/IAEA)