

SYMPOSIUM ON INTERNATIONAL SAFEGUARDS: NEW CHAPTERS OPEN

BY LOTHAR WEDEKIND AND JAMES LARRIMORE

Verification of nuclear energy's peaceful uses has entered challenging new territory. At the IAEA's Symposium on International Safeguards in October 1997, leading authorities in the field met to review the changing landscape, from technical, financial, and political perspectives.

At the forefront stands a Strengthened Safeguards System that has the added dimension of providing the international community with early warning about possible clandestine nuclear activities. To this end, States agreed on a set of new verification measures in May 1997 after years of negotiation. They adopted what is officially called the "Additional Protocol" to safeguards agreements that grants the IAEA greater rights of access in conducting its verification activities. The Symposium gave technical experts and policymakers alike greater insight into the practical demands and expectations underlying these and other new chapters that have opened.

From the opening to closing addresses of Dr. Mohamed ElBaradei and Dr. Hans Blix – then, the incoming and outgoing Directors General of the IAEA – the Symposium left little untouched in its review of the expanding verification field. Its 22 plenary, technical, and poster sessions featured topics related to technological and policy aspects

from national, regional, and global perspectives. Key elements of the IAEA's safeguards experience and work towards implementing the Strengthened Safeguards System drew considerable attention, and were summed up in papers by Mr. Bruno Pellaud, IAEA Deputy Director for Safeguards and by Mr. Richard Hooper, Director of the Division of Concepts and Planning, among others. *(See their articles beginning on pages 21 and 26, respectively.)* Setting the historical context was Mr. David Fischer, former IAEA Assistant Director General and author of a new book about the IAEA. He presented an informative retrospective of safeguards developments over the past four decades, on the occasion of the IAEA's 40th anniversary. *(See the article on page 31.)* Participants also paid tribute to the 30th anniversary of the Tlatelolco Treaty *(see box, page 20)*, and to twenty years of cooperation through IAEA Safeguards Support Programmes that today are carried out by fourteen States and the European Atomic Energy Community (Euratom).

Overall, the Symposium served to provide the international community with a "reality check", as Dr. ElBaradei described it, of where nuclear safeguards and verification stand today, in terms of the growing demands

and expectations. As important, it offered thoughtful perspectives on where safeguards are headed within the broader context of verification issues. As Dr. Blix noted in his closing address, developments have shown that "nuclear verification, like verification of arms control measures, is a vital factor in international security." *(See the article by Dr. Blix on page 37.)*

A selected topical overview drawn from the Symposium's more than 200 technical and policy papers follows.

EXPERIENCE & TRENDS

When safeguards experts last met at this international symposium in 1994, times were different. The future of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) was not yet clear, the IAEA's safeguards development programme known as "93+2" was headed for heavy debate by the Agency's Board of Governors, and the verification of nuclear

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materials from defense programmes was down the road a bit. Still much in the forefront at the 1994 Symposium were the watershed cases of Iraq, the Democratic People's Republic of Korea (DPRK), and South Africa. In different ways, each held important lessons for the evolution of safeguards in the 1990s.

By the time of this year's meeting, major achievements had shifted the focus. The NPT's indefinite extension in 1995, the positive outcome of Programme "93+2" that led to new safeguards measures and the Additional Protocol, and the initiation of verification of ex-military nuclear material principally changed the picture, as the opening session made clear. One result was that at the 1997 Symposium the watershed cases formed more of a backdrop to topics on the *implementation* of new elements of the stronger, expanded verification system that today commands centre stage. The past years' accomplishments placed new challenges on the table for the IAEA and the global community.

One challenge concerns resources, both human and financial, at a time when the normal workload of safeguards is growing considerably and new verification assignments are being carried out and are in store. "While diligent work and goodwill can help moving ahead," Mr. Pellaud pointed out, "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 several years, he said,

the single most important factor will certainly be the rate at which States accept the Additional Protocol.

To implement the Additional Protocol, the IAEA will need to reorient its infrastructure, as part of efforts to fully integrate implementation of the Protocol measures with traditional safeguards. The IAEA has started the process of negotiating the Additional Protocol, State-by-State. (Seven countries — Australia, Armenia, Georgia, Lithuania, the Philippines, Poland, and Uruguay — already have signed it.)

Regarding the broader framework for verifying nuclear arms-control and disarmament measures, a number of issues remain to be resolved, including the question of financing the regime. Toward this end, both Dr. Blix and Dr. ElBaradei urged States to strongly consider the establishment of a "nuclear verification fund".

GREATER COOPERATION

The Strengthened Safeguards System's twin goals of greater effectiveness and improved efficiency require enhanced IAEA cooperation with State and regional verification authorities.

The Agency's joint work with Euratom within the framework of the New Partnership Approach (NPA) was reviewed in several papers. The NPA has led to efficiencies, including reduction of the IAEA's on-site inspection effort in the European Union. A central challenge for Euratom safeguards concerns safeguarding the growing stocks of nuclear material under Euratom safeguards, especially stocks of plutonium, which are

rising by 30,000 kg annually, reported Mr. W. Gmelin of the Euratom Safeguards Directorate.

Several papers addressed aspects of the Agency's cooperative work with Argentina, Brazil, and the Argentine-Brazilian Agency for the Accounting and Control of Nuclear Materials (ABACC). Over the past years, IAEA inspectors have been engaged in activities to verify the initial report under the Quadripartite Safeguards Agreement that entered into force in March 1994. The extensive task was facilitated by good cooperation between the parties involved, it was reported.

Significant progress was reported in the Agency's joint work with Newly Independent States (NIS) to introduce safeguards and verify the initial declared nuclear inventories. The IAEA expects to conclude the verification of the initial inventory in most NIS in the coming months. (*See the article beginning on page 9.*)

The evolution of safeguards in Japan — including support for the Strengthened Safeguards Programme and the country's readiness to work with the Agency to modify existing safeguards criteria by combining qualitative and quantitative inspection measures — was reviewed by Mr. Kenji Seyama, Director of the Nuclear Safeguards Bureau of the Science and Technology Agency (STA), and Mr. Hiroyoshi Kurihara, Senior Executive Director of the Nuclear Material Control Centre. They stressed the importance of realizing greater efficiency through the use of unannounced inspections coupled with remote moni-

toring techniques, as well as applying environmental sampling to confirm the absence of undeclared activities. Toward this end, they said Japan intends to establish a clean laboratory for environmental sampling at the domestic level and as part of the international safeguards analytical network.

Also reviewed, in a paper by Ms. Shirley Johnson of the IAEA Department of Safeguards and colleagues, were strides made under a Safeguards Improvement Plan for the Tokai Reprocessing Plant that takes account of new technologies that can reduce verification costs, or reduce the intrusiveness of verification activities and increase the effectiveness of the inspection effort. Established in 1988, the Plan is a tripartite project involving the IAEA, the STA's Nuclear Safeguards Bureau, and the Power Reactor and Nuclear Fuel Development Corporation, which operates the Tokai facility.

Another perspective on the acceptance of new safeguards measures came from the United States, a nuclear-weapons State, and was provided by Mr. Alex R. Burkart of the US Department of State, in a paper co-authored with officials from the US Arms Control and Disarmament Agency, the US Nuclear Regulatory Commission, and the US Department of Energy. He noted that US President Clinton has stated the USA's intention to accept the Protocol in its entirety and apply all of its provisions except where they involve information or locations of

direct national security significance to the United States. In reviewing the issues involved and preparatory steps now being taken, Mr. Burkart said the process will take time, but that the United States hopes to begin negotiation with the IAEA on a US Protocol in early 1998.

SAFEGUARDS TECHNOLOGIES & SYSTEMS

Advances in safeguards technologies and in testing new techniques and systems were extensively reviewed at the Symposium. They included reports on field trials of unannounced inspection schemes carried out at different types of facilities in cooperation with Sweden, South Africa, and Canada; programmes for developing safeguards approaches for the "backend" of the nuclear fuel cycle, and specifically the final disposal of spent fuel in geological repositories; and advances in fields of science and technology, ranging from new sensor technologies to satellite systems and specialized computer networks, being examined for possible safeguards application over time.

Environmental Sampling

Considerable interest was shown in the IAEA's environmental sampling programme. Experience in the initial implementation of environmental sampling techniques at enrichment facilities and certain types of hot cells in more than 20 States was reviewed in an informative overview presented by Ms. Jill Cooley and Mr. Erwin Kuhn of the IAEA Department of Safeguards and Mr. David Donohue of the

IAEA Department of Research and Isotopes. Also reviewed was the role of the IAEA's "Clean Laboratory" at Seibersdorf, which opened in early 1996 and now is in full operation analyzing baseline environmental samples.

Environmental sampling and analytical techniques can help to detect the presence of certain types of undeclared activities. Samples have been taken from surfaces of equipment and inside buildings. Field trials carried out so far have demonstrated that the techniques are technically feasible, reliable and extremely sensitive.

In addition to creation of the "Clean Laboratory", the global Network of Analytical Laboratories for safeguards has been expanded to include specialized laboratories in three countries to assist in the analysis of environmental samples. The IAEA also has set up an internal training programme to instruct inspectors in planning campaigns for sampling and in proper collection and handling procedures; more than 100 inspectors, including nine from Euratom, have been trained. Through September 1997, more than 750 swipe samples have been collected in more than 40 facilities during baseline sampling activities for distribution to network laboratories for analysis.

Remote Monitoring Other papers reported on the considerable experience gained in the use of RMS, or unattended verification and monitoring techniques, in the interests of both greater effectiveness and lower costs. They included reports on the evaluation of a six-month field trial of a remote

monitoring system (RMS) installed at a mixed-oxide fuel storage vault in Switzerland; the installation of RMS components at a high-enriched uranium (HEU) storage vault in the United States; activities related to RMS at an HEU storage vault in South Africa; and initiation of tests on new digital image surveillance systems that have been installed in various facilities.

Though RMS is not a new technology, advances in the field are dramatically improving the prospects of its broader cost-effective use. Its application is expected to become more visible and widespread under the Strengthened Safeguards Programme. It typically involves the use of digital surveillance cameras together with electronic/fiber optic seals or radiation detectors and sensors, with the transmission of data via satellite or telephone lines to off-site locations. The technology makes it possible to conduct what some participants described as “virtual inspections”, since its use can replace the need for inspectors to physically access materials on-site for measurement or surveillance purposes.

A number of RMS projects and field trials involving the IAEA and partners in Member States are in various phases of work. National programmes include the US International Remote Monitoring Project, which was reviewed by Mr. Stephen Dupree of Sandia National Laboratories, which coordinates the project, and Mr. Cecil Sonnier of the USA. Field trials in different types of nuclear facilities in the United States and other countries are

demonstrating the effective operation of the installed systems. The huge quantity of data generated spotlighted a practical problem: the need for well-developed data handling and processing systems. These and other field trials that the IAEA is conducting with its Member States enable the reduced presence of inspectors at the tested sites (*see box, page 18*); in Switzerland, the use of RMS showed that it can be effective in monitoring events of safeguards relevance in a cost-effective way when compared with current methods, noted Mr. Reza Abedin-Zadeh of the IAEA Department of Safeguards in reporting on the Agency's experience. Results suggest that reduction in on-site inspection efforts can be realized through the use of RMS in combination with scheduled inspections, and more effectively with unannounced inspections.

The Symposium also featured a range of hands-on demonstrations and poster displays on the wide range of safeguards equipment and techniques in use or under research and development for nuclear material accountancy, containment and surveillance purposes, and environmental sampling. Many of these tools are being developed under national support programmes that assist the IAEA in keeping pace with the evolution of new technologies.

INFORMATION ACCESS & EVALUATION

Under the Strengthened Safeguards System, States will be submitting more information about their nuclear and nuclear-related activities to the

IAEA, and Agency inspectors also will have greater access to facilities and information from other sources. The IAEA's activities to establish a data management and information evaluation system was reviewed by Ms. Anita Nilsson of the IAEA Department of Safeguards, who presented a paper co-authored with Mr. Kaluba Chitumbo, Mr. Richard Hooper, Mr. Kenji Murakami, Mr. Demetrius Perricos, and Mr. Dirk Schrieffer of the Department.

The major sources of information are the State's declaration under its safeguards agreement or the Additional Protocol; information obtained by the Agency through its verification activities; and “open source” information obtained from within and outside the Agency that will be assessed for its relevancy. All of the information will form the basis of a Safeguards State Evaluation of each country's nuclear programme. The information will be subject to strengthened procedures that govern the handling of safeguards confidential information. The Agency has set up an Information Review Committee to ensure that all the extensive knowledge, experience, and information available are adequately brought to bear upon and integrated into safeguards conclusions. The Committee *inter alia* will assess drafts of the Safeguards State Evaluation Reports and recommend any follow-up actions to the Deputy Director General for



Photo: IAEA inspectors are receiving enhanced training in key areas. (Credit: IAEA)



QUICK & EFFECTIVE

In Canada, significant results were achieved during field trials of an unattended verification system for the verification of spent fuel. Called the Spent Fuel Transfer Monitor (SFTM), the system was installed at the Bruce nuclear generating station. A paper by Mr. Bernard Wishard, Ms. June Ahn, Mr. Peter Ikonomou, and Mr. Jean Aragon of the IAEA Department of Safeguards and Mr. Martin Moeslinger of Canberra-Packard reported on test results of the SFTM (pictured here). The system automatically counts, verifies, and stores a spectrum on each Candu bundle of spent fuel transferred from primary to secondary wet storage at rates of up to two bundles per second. Without the use of SFTM, spent fuel bundles have to be visually counted and verified by an IAEA inspector using conventional equipment, a multi-channel analyzer. Among other things, the process required 150 person-days of inspection and was intrusive, requiring stoppage of the transfer and movement of the bundles to enable the collection of a spectrum. The SFTM, which automatically verifies all spent fuel bundles rather than just those selected randomly, is remotely accessible via a secured modem connection, allowing data to be transmitted over a telephone line. It is estimated that the SFTM could save the IAEA more than 120 person-days of inspection (i.e. more than two inspectors) per year at the Bruce facility.

Safeguards. The evaluation and review process is intended to assist the IAEA to draw conclusions on the absence of undeclared materials and nuclear activities.

For those on the front lines of safeguards, the inspectors, the greater accessibility to information and drafting of State evaluations constitutes a new role. As part of steps toward implementing the Strengthened Safeguards System, the IAEA has initiated enhanced training activities for inspectors, as well as staff from IAEA Member States responsible for safeguards implementation, in a number of areas. As reviewed by Mr. Jaime Vidaurre-Henry, who heads the Agency's Section for Safeguards Training, in a paper co-authored with Mr. Vladimir Fortakov and Ms. Cynthia Coolbaugh of the Department, the areas include design information review; environmental monitoring; enhanced observational, communication and management capabilities;

analysis of information on States' nuclear activities; and increased cooperation with SSACs. Since 1993, more than 600 participants have been trained through various activities. Future training activities now are being planned in areas that include the review and evaluation of information; remote monitoring techniques; and project management.

VERIFYING EX-MILITARY NUCLEAR MATERIAL

The IAEA's limited but growing experience in the verification of plutonium and HEU released from defense programmes was reviewed from different vantage points. Several papers from the United States reported on activities there, where the IAEA's is verifying quantities of HEU and plutonium at several sites. A paper presented by Mr. Jean Aragon of the IAEA and co-authored with colleagues Mr. Dirk Schriefer, Mr. René

Lemaire, and Mr. Peter Ikonomo, offered a detailed overview of the Agency's experience in the United States and insight into further challenges once the Russian Federation places ex-military nuclear material under IAEA verification. This is expected within the framework of the Trilateral Initiative between the IAEA, the United States, and the Russian Federation.

In the USA, more quantities from the approximately 200 metric tonnes of nuclear material that have been declared excess to defense needs will be made available for IAEA inspection in coming years, noted Mr. Ronald Cherry of the US Department of Energy in a paper co-authored with Mr. John Murphy, Ms. Amy B. Whitworth, and Mr. Robert Whitesel of the USA. To date, about 12 metric tonnes of excess HEU and plutonium have been submitted to IAEA safeguards. In 1996, the US declared that an additional 26 metric tonnes would be made

available and in September 1997, plans to submit another 52 metric tonnes were announced. Materials already being verified by the IAEA are at three sites, the Y-12 Plant in Oak Ridge, Tennessee; the Hanford Site outside Richland, Washington; and the Rocky Flats Environmental Technology Site near Denver, Colorado. Specialists from the USA and IAEA are working together to develop new technology applications to support the implementation of Agency safeguards and to reduce the associated impacts on facilities, Mr. Cherry reported in reviewing progress.

He also briefly reviewed progress in the IAEA's cooperative work with the USA at the Portsmouth Gaseous Diffusion Plant. The main objectives of the verification experiment, which is aimed at verifying the downblending of HEU hexafluoride there, are to enable the Agency to draw independent conclusions that the HEU is in fact being blended down to a form that is not readily usable for weapons purposes, and to provide the Agency with experience in applying new techniques to verify the disposition of excess HEU. A detailed overview of the work at Portsmouth was presented in a paper by IAEA officials, who noted that the experimental verification approach is the result of technical meetings that began in April 1997.

In reviewing the Agency's experience to date in the United States, Mr. Aragon outlined the major challenges the IAEA is facing. They are related to the application of inspection procedures as required under the US-IAEA

Voluntary Offer Safeguards Agreement at defense-related facilities not designed for international safeguards; the measurement of plutonium and the shipment of samples; and the efficient use of limited human resources. The Agency's verification of excess materials in the USA is funded outside of its regular budget by US extrabudgetary contributions.

CHALLENGES AHEAD

As the world of international nuclear verification heads towards the next millenium, the implementation of the expanding and strengthened safeguards system presents formidable challenges. National and global perspectives on the future structure of the verification regime were offered in a number of papers.

"We now have a strengthened safeguards system, but this does not mean that our work is over," cautioned Ambassador Peter Walker of Canada, who chaired the IAEA Board of Governors and the Committee to negotiate the new measures, in reviewing the negotiation of the model Additional Protocol. "Indeed the majority of the work is still in front of us." It includes, he said, preparatory contacts between the IAEA and its Member States leading to the conclusion of individual protocols and implementation of the new measures, and further reviews of the continued utility of some elements of "classical safeguards" in the context of a more integrated approach to nuclear verification.

The accomplishments already registered in the 1990s by the international safeguards



community bode well for the work ahead. Based on activities and results reported at the Symposium, the institutional experience, maturity, and flexibility is at hand to establish and implement a global safeguards system that is more integrated, effective, and efficient in verifying the exclusively peaceful uses of nuclear materials. □

The 1997 IAEA Symposium on International Safeguards was the eighth in a series on the subject since 1965. This year's meeting was organized in cooperation with the Institute of Nuclear Materials Management and the European Safeguards Research and Development Association. It was attended by about 350 specialists and policymakers in the field of nuclear safeguards and verification from more than 50 countries and organizations. Proceedings of the Symposium are being published by the IAEA and will be available for purchase from the IAEA or its sales outlets in Member States. The next IAEA Symposium in the series is planned for the year 2001.

Photo: Tokai Reprocessing Plant in Japan. (Credit: PNC, Japan)

TLATELOLCO TURNS THIRTY

The world's forerunner of nuclear-weapon-free zones (NWFZs)—the Treaty for the Prohibition of Nuclear Weapons in Latin America, best known as the Tlatelolco Treaty—marked its thirtieth anniversary in 1997. The Treaty opened for signature in February 1967 in Tlatelolco, Mexico, with the participation of eighteen States in the Latin American region. In commemoration of the occasion, Mr. E. Roman-Morey, who heads the Agency for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (OPANAL), presented an overview of the Treaty's evolution at the IAEA Symposium on International Safeguards. Excerpts follow:

"In October 1962 in the core of the Cold War, the world frightfully awaited the results of 'the Cuban Missile Crisis'. Those thirteen days were enough for Latin America to realize that without being direct actors in the conflict between the two blocks...it could have nonetheless been affected by the destructive consequences of a nuclear confrontation. This luckily never took place.

The ingenious Latin American reaction that came to light is perhaps the greatest contribution of our region to international law: The Treaty of Tlatelolco, the world's first NWFZ in a densely populated area... The Treaty opened for signature on February 14, 1967...

The Treaty was born during the Cold War and in spite of it. As you know we did not invent the wheel but we were the first ones to make it roll. There were previous initiatives, such as the ones in Central and Nordic Europe which were not possible to develop because of the Cold War. Other later NWFZs, like the Treaties of Bangkok and Pelindaba, were possible only because of the end of the Cold War. Tlatelolco is specifically dedicated to nuclear disarmament, but its final goal is "total and complete disarmament". At the same time it has a solid social basis. It states the obligation that its parties should use nuclear installations and nuclear energy exclusively for peaceful purposes, for the benefit of its peoples...

The Treaty of Tlatelolco was one of the very first clear examples that when there is a defined political will and transparency and trust among the parties to a disarmament treaty, it can be considered an important confidence-building measure.

The circumstances in which it was conceived, the way its text was drafted, the participation and non-participation in the Treaty and its later development through three decades are strongly linked to the presence or absence of confidence, trust, and transparency in the region.

...A very important characteristic of Tlatelolco is that it is considered the first international disarmament instrument which involves in its legal framework not only its Member States but the recognized nuclear-weapons States... Additional Protocol II, aimed at nuclear-weapon States, provides for the first time in this type of Treaty so-called "negative security assurances"... All five NWS have signed and ratified this Protocol...

Relations with the IAEA are very clearly defined ... Article 13 is directly engaged with the important issue of safeguards (requiring the negotiation of agreements with the IAEA). Additionally, OPANAL and the IAEA also have a co-operation agreement in force. Within its framework in March 1996, both organizations co-sponsored an international seminar on the IAEA's Safeguards System, held in Kingston Jamaica, for experts of all the Member States of OPANAL. I must underline that this seminar was a great success for the region and was honored by the personal participation of Dr. Hans Blix, Dr. Mohamed ElBaradei and the highest ranking IAEA safeguards officials.

Out of the 33 Latin American and Caribbean States in the region, today all but one have signed and ratified the Treaty. Cuba is the only State which still needs to ratify it. Regarding the safeguards agreements with the IAEA, out of the 33 States, only Haiti needs to finalize its negotiations with the IAEA...

NWFZs should always be accepted as a cornerstone in the international regime of non-proliferation and as an important landmark in the 'step-by-step' process towards total and complete disarmament... After thirty years we have learned that confidence-building measures, and as a consequence NWFZs, are very important tools to help dissipate insecurity and to improve the political environment. Thus they facilitate larger, bigger and stronger agreements related to international security and co-operation."