On-Site Inspections: Experiences from Nuclear Safeguarding

Wolfgang Fischer and Gotthard Stein

On-site inspection (OSI) is a collective term for different forms of inspector access to a state territory under more or less strict and formally agreed rules in order to verify compliance. While OSIs are found in some environmental and human rights agreements, their main area of application is arms control and disarmament.[1]

Many agreements that include provisions for OSIs are the product of the post-Cold War era, and most refer to weapons of mass destruction: the Threshold Test-Ban Treaty, the Intermediate-Range Nuclear Forces Treaty, Strategic Arms Reductions Treaty, the Comprehensive Nuclear-Test-Ban Treaty, and the Chemical Weapons Convention; treaties concerning conventional weapons include the Conventional Armed Forces in Europe Treaty and the Vienna Document of 1994, and many other agreements, especially bilateral United States-Soviet/Russian ones (Peaceful Nuclear Explosions Treaty, Wyoming Memorandum of Understanding, Destruction Co-operation Agreement and Destruction and Non-Production Agreement).[2] A special case worthy of individual study is the UNSCOM OSI experience in Iraq (see article by Graham Pearson in this issue).

Other lesser-known OSI activities are frequently overlooked: such as the successful inspections in Germany within the framework of the Western European Union (WEU) in order to verify the non-production of chemical weapons.[3] Moreover, there is an important body of experience with a particular form of OSIs: the inspections of the International Atomic Energy Agency (IAEA) in non-nuclear-weapon states (NNWS) that are parties to the Non-Proliferation Treaty (NPT)[4] and, for the member states of the European Union (EU), the inspection activities of the European Atomic Energy Community (Euratom).[5] The extent of inspector access and the conditions under which IAEA inspections can take place have been disputed for many years, and there has been a gradual, sometimes pragmatic evolution with respect to inspectors' access to nuclear facilities and other places.

The Role of Inspections in Safeguards

The history of the utilization of nuclear energy is a history of safeguards.[6] Whereas it was rapidly recognized that nuclear energy would have to be safeguarded in order to make its military utilization less probable, the object and extent of safeguards remained controversial for a considerable period. Some of these concerns have become relevant again with the discussion on tightening safeguards after discovery of Iraq's proliferation.

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In the 1950s and 1960s, the United States, and later the Soviet Union, pressed for direct controls of both nuclear material and the nuclear plants and technologies in NNWS. Such controls would have permitted the IAEA extensive insights and rights of intervention in these countries. This included safeguards that would have given IAEA inspectors the opportunity to search for undeclared nuclear activities in NNWS at any time and any place. In the mid-1960s (during negotiation of the NPT) and between 1969 and 1971 when the IAEA Safeguards Framework Agreement (INFCIRC/153) for NNWS[7] was negotiated, the NNWS resisted these concepts. Whereas government and industry in the NNWS considered safeguards a major precondition for the use of nuclear energy, the safeguards suggested would have curtailed their promising — but in comparison to the nuclear-weapon states (NWS) still backward — nuclear development as well as their sovereignty. Such inspection rights would have strengthened the difference in status between NWS and NNWS. Furthermore, these intrusive inspections would have been a clear vote of "no confidence" by the NWS in the politically credible and trustworthy NNWS, most of them members of the NATO, the WEU and the European Community (EC).

The difficult negotiating process resulted in a "historic compromise" — INFCIRC/153 — which expressed the international political and economic balance of power at that point in time and one which was not modified in principle for more than twenty years. Germany and other states succeeded in agreeing upon a safeguards system that combined high efficiency with low costs, thus reducing the disruption of the daily operations of their nuclear industries. As agreed in INFCIRC/153, all nuclear material has to be put under safeguards (therefore, INFCIRC/153 was called the Full-Scope Safeguards or FSS system) but safeguards were restricted to monitoring the flow of nuclear material, the access of IAEA inspectors was limited to particular points in a nuclear facility (strategic and key measuring points), and their task was limited to the verification of this material flow (nuclear material accountancy). These FSS are aimed at the timely detection of diversion of a given amount of nuclear material from declared facilities.

The IAEA inspection system consisted of routine inspections, ad hoc inspections and special inspections. Most IAEA inspections were routine inspections in nuclear facilities with a facility attachment agreement between the state and the IAEA, which lays down the rights and obligations of each side in detail for each facility under safeguards. In nuclear facilities without such an attachment these inspections were called ad hoc inspections. Due to the lack of detailed agreed rights and obligations, the inspector access was not that limited in principle. But in reality most ad hoc inspections were conducted in a way similar to routine inspections, partly due to the fact that a facility operator must restrict inspector access to some areas due to safety reasons (e.g. protection from radiation). The third type of inspections, special inspections, remained dormant until the early 1990s, when they were briefly resuscitated in a failed attempt to use them under non-cooperative conditions in North Korea.[8]

Based on INFCIRC/153 the IAEA devoted itself in a routine, politically unspectacular and successful manner to safeguarding declared nuclear material, as confirmed by its annual internal Safeguards Implementation Report. The safeguards system worked well. But INFCIRC/153 had a particular implication: because of the "apolitical" allocation of safeguards resources according to the size of the fuel cycle (i.e. the amount and quality of nuclear materials), the safeguards effort was concentrated on the highly developed industrial countries with large fuel cycles, in particular Germany, Japan and Canada. About 75% of routine and ad hoc inspections were conducted in these countries, whereas few efforts were concentrated on unpredictable countries with a small declared fuel cycle — such as Iraq. The consequences became

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The official, narrow interpretation of safeguards and INFCIRC/153 (i.e., solely the numerical verification of the flow of nuclear material) has, however, never been shared by all those involved. In the United States, but also within the IAEA, there have been demands that when applying safeguards, the existence of undeclared materials and activities in NNWS should be assumed. This attempt to change some fundamentals of safeguarding was rejected, amongst others, by Germany and Japan with the argument that if the assumption of undeclared material were introduced in the safeguards concept then material accountancy could no longer be maintained as a closed material balance. Its confidence-building function would therefore be lost and in particular those NNWS with large fuel cycles would no longer be able to demonstrate their compliance. What would be the value of being a party to the NPT if parties to the treaty are treated with the same lack of confidence as non-parties? Nevertheless, a pragmatic solution had to be found to address the problem of undeclared activities and materials for the commercial enrichment facility of Uranium Enrichment Co. (Urenco).

The Hexapartite Safeguards Project

When it was decided in the 1970s to build multilateral enrichment facilities with centrifuge technology in Europe and to develop safeguards concepts for them, it was claimed that safeguards would also have to be capable of monitoring the process of enriching uranium itself. Although the assumption of undeclared activities was not strictly covered by the NPT or INFCIRC/153, states that carried a major safeguards burden found a practical solution to this problem.

It seemed at an early stage that nuclear material accountancy and its verification in such enrichment facilities could be solved in a relatively simple manner: the enrichment process is characterized by very good possibilities for measuring the hexafluoride, assaying the isotopes and carrying out mass determination by very precise weighing since the uranium hexafluoride must be kept in closed tube systems and process units. This would permit simple and transparent nuclear material safeguards procedures for which the enrichment facility can be divided into material balance areas with fixed key measurement points. However, the sensitivity of centrifuge technology put this simple solution into question since it had not been finally clarified whether the safeguards should be carried out with or without inspector access to the cascade hall. The operators of the plant feared for the protection of their know-how, the IAEA worried about its safeguards capability. The situation was further complicated since a contracting party can establish areas in facilities pursuant to INFCIRC/153 which are not accessible to IAEA inspectors. The situation in Western Europe was also characterized by the fact that inspectors from Euratom are not subject to such restrictions. They have access to all points of a facility but, if the IAEA inspectors' access is restricted, they cannot always be accompanied by these inspectors during their verification activities.

In order to solve these problems by consensus, the Hexapartite Safeguards Project (HSP) was started in 1980, comprising Germany, The Netherlands and Great Britain cooperating within the framework of Urenco, as well as Japan, Australia, the United States, the IAEA and Euratom.[9]

Essential concerns addressed by the working groups of the HSP were:

- The structural features of the facilities, which had to be "safeguards friendly";
- Nuclear material accountancy. It was found that the material balance of a facility can be adequately verified by IAEA and Euratom if the facility has a capacity of less than 2,000 tonnes of uranium separation per year;

- Processes and techniques for containment and surveillance without an inspector being granted access to the cascade hall. If inspections were dispensed with, suitable instruments and measures would have to be found to ensure that undeclared activities and materials would be detected in the cascade hall area. A working group was set up to investigate the possibility of "inspection-free" safeguards for the cascade hall;
- The opposite approach was pursued by another group — the development of safeguards strategies including access to the cascade hall. In this approach, models with different access rights were considered, ranging from completely unlimited access up to access limited with respect to frequency, time and scope. After in-depth analysis and considering various criteria, including the technology holders' interest in secrecy, the working group selected a model providing for a limited number of unannounced inspections in the hall (Limited Frequency Unannounced Access, LFUA). Special significance was attached to the element of the inspector's unannounced access due to its deterrent effect.

An evaluation group compared the results of the working groups and, after having compared the safeguards models without and with inspector access, chose the LFUA concept as the optimum solution provided that three conditions were fulfilled. Firstly, the LFUA model must be accepted and applied by all those involved, i.e. also by the NWS. In this way, equal treatment was claimed in principle for the first time for NNWS and NWS. Secondly, the individual verification activities must be clearly defined and described in advance. Thirdly, the secrecy problems resulting from inspector access to the cascade hall must be solved satisfactorily. These conditions were fulfilled.[10]

The HSP was able to solve the difficult question of IAEA inspectors' access to the sensitive cascade hall, to ensure the verification of material accountancy and invalidate the concerns about enrichment offering opportunities for undeclared activities, because the technically sophisticated modification of the cascade sequences required for illicit activities could not remain undetected. A substantial contribution to this effect would be the inspections in the cascade hall, which could include visual inspections and technical measures. In the case of visual observation, the inspector compares what has been declared with what is actually observed, for example, the presence of equipment, the features of the facility and the configuration of the enrichment process. Pictures of the design of the facility and other photographs may help. Furthermore, the inspector verifies the entire tube system for the nuclear material, both inside the cascade hall and at the wall breakthroughs up to the end points outside the cascade area. The frequency of routine inspections inside and outside the cascade hall is twelve times per year with the LFUA safeguards concept for facilities with up to 1,000 tonnes of uranium separation. The frequency of LFUA inspections inside the cascade hall is facility specific, between four and twelve times per year. The duration of the LFUA inspections in the hall is between one and eight hours, depending on whether the inspector only makes visual inspections or also performs measurements.

The LFUA model permits the inspector unannounced access to the cascade hall, specified in terms of time and space. It succeeds without any sophisticated safeguards apparatus and makes the inspector's permanent presence in the plant superfluous. This is equally true in reprocessing plants. Of political significance is the equal treatment of NWS and NNWS realized for the first time in the safeguards domain by the HSP. In this way, a model was created for later verification agreements that go beyond the narrower safeguards domain.

The Iraq Experience and its Consequences

Despite the HSP, the central issue of whether the existence of an undeclared parallel nuclear programme in NNWS may be officially assumed and whether safeguards should be oriented towards

the detection of such a programme had not been seriously discussed at the working level of the IAEA and not at all in the political body of the Board of Governors. And when such discussions have taken place in the media, some Western democracies with expanding fuel cycles were scrutinized and had to ward off assumptions about their credibility, while states with a probably high motivation for proliferation but with few declared nuclear activities received less attention. Even rumours that some NNWS, in particular Iraq, had a nuclear weapons programme, did not and could not change this situation. This was, firstly, due to the "apolitical" allocation of safeguards resources, partly an expression of an "apolitical" IAEA; and, secondly, to the fact that at the time of the East-West conflict a special inspection in sensitive cases or general modifications of the safeguards concept would not have found a consensus in either the Eastern or Western camp. The traditional low profile safeguards policy went smoothly as long as there were no serious disturbances in the safeguards routine.

But everything changed in 1991 with the detection of the Iraqi nuclear weapons programme.[11] For the first time, a party to the NPT, which had committed itself not to acquire nuclear weapons and was subject to FSS, had been caught in the act of clandestinely constructing nuclear weapons. The embarrassing aspect was that the extensive programme was not unmasked by IAEA safeguards[12] but only as part of the unique inspection rights of the United Nations Special Commission (UNSCOM) which Iraq had to accept after its defeat in the Gulf War.

However, if safeguards cannot detect clandestine parallel nuclear programmes, a central pillar of the non-proliferation regime will collapse. When this danger became apparent after the Iraqi case, discussions and activities were started to strengthen safeguards, re-establish their credibility and close this detection gap. In addition to increasing the effectiveness of safeguards, attention was directed towards raising their efficiency in order to make them more cost-effective, and release funds for monitoring other arms control agreements (for example, the proposed fissile materials agreement between the NWS).

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The Short Revival of Special Inspections

In principle, the IAEA could use special inspections pursuant to INFCIRC/153 as a "fall back" instrument to eliminate any inconsistencies arising within the FSS framework. INFCIRC/153 (§73) states that the IAEA may make special inspections in order to verify special reports[13] or if the information available is not adequate for the IAEA to fulfil its responsibilities. A special inspection is either additional to routine inspection efforts or involves access to information or locations in addition to the access specified for ad hoc and routine inspections, or both. Therefore, special inspections have the potential to unveil undeclared activities and nuclear materials if the IAEA knows where it has to go to and if access is granted by the state. In practice, however, special inspections did not have any significance since neither the IAEA nor the states on the Board of Governors wanted to raise any politically delicate doubts about the reliability of FSS and of the honesty of some NPT parties. This attitude changed when experiences with Iraq and North Korea made it very clear that the risk of nuclear proliferation within a NNWS is a function of its political system and not per se a function of the size of its (declared) nuclear fuel cycle, as implied in the safeguards concept. Many safeguards experts had long emphasized that an INFCIRC/153 state intending to acquire nuclear weapons would not divert nuclear material from its effectively safeguarded declared nuclear activities but instead create a clandestine weapons programme.

The Iraqi case brought about a brief revival of this forgotten type of inspection. Whereas there was broad agreement to "awaken" special inspections, there was also from the very beginning a lack of unanimity about some important questions. The United States demanded that special inspections should refer to all declared and undeclared activities by a NNWS in the sense of the 1960s — that meant investigating suspicions without any restriction (any time, any place) — an interpretation that was not acceptable to other countries. Another question was whether or not there should be fixed rules about the implementation of special inspections. However, as an instrument for specific situations it had to be individually tailored to each case. Therefore, flexibility seems to be one condition for the success of a special inspection — but at the cost of the state's sovereignty and the economic interests and legal rights of the concerned industries. Again, consent failed. Therefore, the Board of Governors merely confirmed the admissibility of special inspections in February 1992 with reference to the pertinent paragraphs in INFCIRC/153. But after only a few months disenchantment prevailed about the applicability of special inspections. Because the IAEA knew where it wanted to inspect, in February 1993 North Korea refused to accept a special inspection[14] and the IAEA's subsequent appeal to the Security Council did not lead to unanimous support on compulsory measures to force the inspection.

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In order to escape from this dangerous dead end, the United States and North Korea agreed in bilateral negotiations on a controversial treaty in October 1994 (US-North Korea Agreed Framework and the Korean Peninsula Energy and Development Organization, KEDO), which intended to freeze and then dismantle the nuclear weapons programme in return for a reward (fuel oil and — under particular preconditions — new reactors that produce less plutonium).[15] Although the IAEA is still demanding a special inspection in North Korea, prospects for its realization are, at least for the time being, poor. Since the North Korean case, the usefulness of special inspections has been seen in a rather subdued light.[16] Consent emerged that instead of applying special inspections, the problem of unmasking undeclared activities should be solved by less politically sensitive means. The safeguards reform entered a new phase.

The Strengthened Safeguards System

The failed revival of special inspections was followed by lengthy and controversial discussions. This negotiation process[17] led to a broadening of the safeguards system through an additional safeguards framework agreement (INFCIRC/540),[18] known as the Strengthened Safeguards System. (See contribution by Rich Hooper to this issue.)

The IAEA's safeguards reform programme, called the "Programme to Strengthen the Effectiveness and Improve the Efficiency of Safeguards" (93+2) was initiated in 1993 by the Board of Governors and was based on a recommendation by the IAEA's Standing Advisory Group on Safeguards Implementation (SAGSI). In April 1993 SAGSI proposed that safeguards should provide confidence that there are no undeclared nuclear activities. It was the first time that an IAEA body went beyond the previous safeguards concept and emphasized the possibility that a NNWS could have an undeclared nuclear programme. Whereas INFCIRC/153 only verified the correctness of the nuclear declaration, the new challenge was how to verify the completeness of a state's declaration. Such a task was a challenge both for the IAEA and those states interested in effective safeguards, because many problems had to be solved — in particular with respect to inspector access.

It soon became clear that the legal basis of INFCIRC/153 was only sufficient to implement the so-called 93+2 Part I measures (environmental sampling in declared facilities), which were accepted by the Board of Governors in June 1995. In order to tailor safeguards to undeclared activities (the Part II measures), a new agreement would have to be negotiated. To this end, a panel was established by the Board in 1996 with the task of strengthening the effectiveness and improving the efficiency of safeguards (Committee 24). After contentious discussions it agreed upon the draft of the new Model Protocol agreement in May 1997 (INFCIRC/540), which was adopted by the Board in May 1997. The Strengthened Safeguards System is intended to close the gap in IAEA safeguards.[19]

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According to INFCIRC/540, the state has to declare its past, present and intended nuclear activities.[20] This includes, among others: the description of all relevant facilities, sites, the status and activities of the entire nuclear fuel cycle, including R&D activities relevant to the fuel cycle; as well as other activities related to nuclear facilities, including the development and fabrication of components for these facilities, information on nuclear source material to which no safeguards have been previously applied, and, upon request by the Agency, information on facilities and activities outside the nuclear facility site. Together with other information obtained from open sources and from intelligence, the IAEA expects to develop a clearer understanding of all relevant nuclear activities within a state and to derive indications of undeclared activities, should they exist.

To this end, the IAEA created a "Physical Model" detailing a nuclear fuel cycle. The Physical Model simulates successive steps to be followed in the course of the production of weapons-grade material and the construction of nuclear explosive devices. The first level contains the key activities, e.g. reprocessing, enrichment as well as accompanying weaponization. At the second level each of these key activities is broken down into specific routes or processes, for example, enrichment is represented by nine different processes. At the next level down, indicators are attached to the specific processes and their development, i.e. materials to be used, equipment, tools and training activities. The information available from a state's Expanded Declarations and from other sources will then be projected on the physical model and will assist the IAEA in identifying inconsistencies in declarations and in pointing to information gaps and suspicious items. Upon request by the IAEA, inspectors will have access to any place mentioned in the Expanded Declaration and on a selective basis to any place on a site where nuclear material is or was customarily used, including closed down facilities. When exercising its access rights, the IAEA may make use, as required, of visual inspections, examination of operating records, environmental samples and allowed measurement techniques. The new access rights are also extended to facilities, companies, sites and research institutions that do not use or possess any nuclear material, but which are related in some way to the nuclear fuel cycle and its technologies. This implies that safeguards are no longer related merely to the presence of nuclear material. But these new "complementary access"[21] rights of IAEA inspectors are not unlimited and unconditional: the concept of "managed access" was introduced.

Managed Access

From the very beginning of Committee 24 discussions, the Director General of the IAEA postulated that strengthening safeguards depends on enlarging the IAEA's verification rights and therefore its right to go to more locations and beyond the strategic and key measurement points of INFCIRC/153. Whereas most countries agreed in principle with this new complementary access, it

was disputed to what extent, under what conditions and according to what modalities such access should be granted.[22] When the IAEA demanded more or less unlimited and unconditional access to nuclear and non-nuclear proliferation-relevant sites, facilities and locations, both public and private, the states refused to accept this — from their perspective — absoluteness of complementary access.

After lengthy and difficult discussions an agreement was reached on both substance and procedures. First of all, it was agreed in a vague general clause (Article 4a, INFCIRC/540) that the IAEA "shall not mechanistically or systematically seek to verify the information referred to in Article 2", which regulates the information a state provides the IAEA. Furthermore, it was agreed that complementary access is broad but not unlimited, and has to follow procedures and be managed (Art. 7, INFCIRC/540). In this case the IAEA must give the state concerned advance written notice, and must specify the reasons for access and the activities to be carried out during access. Furthermore, the IAEA shall provide a state with an opportunity to clarify and facilitate the resolution of the question or inconsistency for which complementary access is sought — an important rule to avoid confrontations between a state and the verification agency over problems that are easy to solve with both sides' goodwill. Therefore, some form of "political" managed access has been agreed, offering a state the opportunity to solve a safeguards problem in advance of an inspection. Additionally, the inspected state has the right to have its own representatives accompany the IAEA inspectors. It was agreed that a request by the IAEA for complementary access shall not be denied by a state for lack of substantive justification, and that the purpose of such access may not be disrupted or held back by delaying actions on the part of the state.[23]

In order to solve the infamous problem of protecting sensitive information, a dual route was taken. Firstly, Article 7a on managed access states: "Upon request by [name of state], the Agency and [name of state] shall make arrangements for managed access under this Protocol in order to prevent the dissemination of proliferation sensitive information, to meet safety or physical protection requirements, or to protect proprietary or commercially sensitive information. Such arrangements shall not preclude the Agency from conducting activities necessary to provide credible assurance of the absence of undeclared nuclear material and activities at the location in question, including the resolution of a question relating to the correctness and completeness of the information referred to in Article 2 or of an inconsistency relating to that information."[24] Which practical effects the managed access has for such IAEA inspections remains to be seen. Managed access must find middle ground: too much "management" could protect commercial interests at the cost of safeguarding, whereas too much openness could contribute to a loss of secrecy and — a considerable risk — the proliferation of sensitive, weapons-relevant information. Secondly, Article 15 says that the IAEA "shall maintain a stringent regime to ensure effective protection against disclosure of commercial, technological and industrial secrets and other confidential information coming to its knowledge" in the implementation of INFCIRC/540. The details of this regime (principles, conditions of staff employment, procedures in cases of breaches of confidentiality) still have to be developed, approved and agreed upon by the Board of Governors. Again, many questions have been left for future negotiation and practical implementation.

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Implications for a Fissile Material Treaty

All verification systems must have the potential to discern undeclared activities. One lesson of the IAEA safeguards system is that in order to be successful, a verification agency must have (in

principle) the right to go to any place in a country under suspicion. But to find political agreement for such OSIs, a form of managed access has to be agreed upon. As noted above, such "management" must find a middle course between the protection of commercial interests and effective verification. Management depends on the political correlation of forces at a given moment and the peculiarities of the verification problem (e.g. chemical, nuclear, biological). But no one should overestimate OSIs, which are only one instrument of verification and, as a rule, are confidence-building measures. In order to be a strict instrument of verification, OSIs depend on accurate information and the political support of the international community and the Security Council when there is resistance by the state under scrutiny. The latter is the weakness of any verification system.

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Taking this into account, what could we learn from nuclear safeguards for a future Fissile Materials Treaty (FMT)? Firstly, in order to be effective, verification of a FMT would require a comprehensive declaration, even in the military domain. Any credible verification scheme would therefore require a declaration by the state of all nuclear material and of all existing fuel cycle related facilities and activities, including those facilities and activities where nuclear material has been produced before the entry into force of a FMT.

Secondly, effective verification and assurance of the completeness and correctness of the declaration can only be achieved by granting inspectors access to the declared facilities and, if necessary, to other places. Some form of managed access seems to be unavoidable, due to political, economic, safety and legal reasons.

Thirdly, a certain level of transparency, even of the military fuel cycle, is a primary requirement for the effective verification of a FMT. Arguments against transparency might be put forward with reference to national security.

Therefore, fourthly, the need to protect such sensitive weapons-related technology against the risk of proliferation by inspection activities points to an instrument of managed access in order to protect sensitive information. In general, the increased flexibility of the Strengthened Safeguards System will allow safeguards to be more easily adapted to special fuel cycles as compared to the rigid system based INFCIRC/153 measures alone. The Strengthened Safeguards System would therefore also be readily adaptable to the requirements of verifying a FMT in NWS and in the states not belonging to the NPT.

In order to verify a FMT effectively, the treaty needs to be comprehensive in scope.[25] With respect to the organization charged with the task of verification, presumably the IAEA, the verification of a FMT would require appreciably increased resources. The new Strengthened Safeguards System would appear to be most appropriate for verifying a FMT, because its adaptability to the special characteristics of certain fuel cycles contains the potential for increased effectiveness as well as cost efficiency.

As the new safeguards system evolves, the mechanistic criteria applied in the past with respect to timeliness and material categories should be subject to revision. The extent to which such payoffs will be possible will depend on the extent to which measures included in the Model Protocol provide confidence that no undeclared activities and facilities exist.

The future application of the Strengthened Safeguards System to all nuclear material and to all fuel cycle activities in NWS and non-NPT states, with the exemption of nuclear weapons, and to activities which would explicitly not be prohibited by a comprehensive FMT would strongly support

both the disarmament and the non-proliferation regime and would be a decisive step towards a highly efficient and cost-effective universal safeguards system. This would eliminate the necessity for development of an alternative to the new safeguards approach for the FMT.

Notes

1 See Wolfgang Fischer, Learning From Other Regimes: "Social Monitoring" As A Contribution To Effective Safeguards?, in: Seminar on Modern Verification Regimes: Similarities, Synergies and Challenges, pp. 103–110, Ispra, EU document EU18681EN. Proceedings from the 20th ESARDA Annual Meeting, Helsinki, May 1998.

2 See the homepage of the Defence Threat Reduction Agency (www.dtra.mil), formerly the On-Site Inspection Agency.

3 See Thilo Marauhn, Der deutsche Chemiewaffen-Verzicht. Rechtsentwicklungen seit 1945, Berlin, 1994.

4 There are IAEA inspections in some facilities of non-NPT states, and NWS have voluntarily offered some facilities for verification activities.

5 The rights of Euratom inspectors are considerably more extensive than those of the IAEA. Because the EU safeguards system is multilateral, proliferation resistant, effective and has an enforcement (sanction) component, the EU and the IAEA agreed on the "partnership approach": the IAEA recognizes the effectiveness and reliability of the EU system and therefore permits Euratom to function as the IAEA's "representative", thereby considerably reducing its own inspection efforts and only intervening as a quality controller for Euratom. Euratom and the IAEA implement joint inspections teams, or the IAEA applies the observation principle and verifies the results of Euratom safeguards.

6 See Lawrence Scheinman, The International Atomic Energy Agency and World Nuclear Order, Washington, DC, 1988; U.S. Congress, Office of Technology Assessment, Nuclear Safeguards and the International Atomic Energy Agency, OTA-Iss-615. Washington, DC, U.S. Government Printing Office, June 1995.

7 IAEA, The Structure And Content Of Agreements Between The Agency And States Required In Connection With The Treaty On The Non-Proliferation Of Nuclear Weapons, INFCIRC/153, Austria, June 1972.

8 Germany volunteered in 1989 for a special inspection in connection with the so-called Nukem scandal as a confidence-building measure. Nukem did not prove to be a safeguards problem.

9 See R. Gerstler et al., Das Hexapartite Safeguards-Projekt, Atomwirtschaft, January 1994, pp. 32–36.

10 Equal treatment was ensured by an exchange of notes by the governments involved and safeguards were agreed upon for the facilities in Almelo (The Netherlands), Capenhurst (United Kingdom) and Portsmouth (United States).

11 See the homepage of the Center for Nonproliferation Studies at the Monterey Institute of International Studies (www.cns.miis.edu) and its links to other sources.

12 The twice-yearly routine inspections failed to discover any indications of a nuclear weapons programme that had no discernible relation to the declared activities.

13 A state shall make such reports if there could be a loss or removal of nuclear material under safeguards.

14 The IAEA became aware of the weapons programme because there were some contradictions in the country's initial nuclear inventory. (This event confirmed the worth of the safeguards methodologies.) The United States contributed satellite images indicating an undeclared reprocessing site. It was the first time the IAEA accepted intelligence support.

15 For further information, see the homepage of the Nautilus Institute (www.nautilus.org).

16 In the early 1980s the Iranian government opened the country twice for some special inspections as a confidence-building measure which elicited no information about secret activities.

17 See Erwin Häckel and Gotthard Stein, eds., Tightening the Reign. Problems and Prospects of a Strengthened Nuclear Safeguards System, Heidelberg, Springer Publications, in print.

18 IAEA, Model Protocol Additional To The Agreements Between State(s) And The International Atomic Energy Agency For The Application Of Safeguards, INFCIRC/540, Austria, September 1997.

19 INFCIRC/540 is additional to INFCIRC/153. Nevertheless, there is a necessity to integrate both in order to make safeguards not only effective but also efficient. This work of integration has still to be done.

20 See W.-D. Lauppe and G. Stein, Possible Implications of the IAEA Strengthened Safeguards System on Future Cutoff Verification, in: 20th ESARDA Annual Meeting, op. cit., pp. 35–41.

21 Complementary means additional to the access rights according to INFCIRC/153.

22 See Reinhard Loosch, The History of the IAEA's Programme 93 + 2, in: Häckel and Stein, eds., Tightening the Reign, op. cit.

23 Ibid.

24 Article 2 of INFCIRC/540 concerns provision of information.

25 See Lauppe and Stein, Possible Implications, op. cit.