

IAEA Safeguards – Where Do We Stand Today?

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The political history of nuclear energy has been characterized by two parallel aims which have sometimes been in conflict: the development of the peaceful uses of atomic energy, in respect of which a large measure of success can be claimed; and attempts, which have been increasingly successful only in recent years to stop at least the spread of nuclear weapons throughout the world. The status and prospects of the IAEA's safeguards system can be evaluated only within the total context of these attempts

The efforts against the proliferation of nuclear weapons were based on changing strategies. Immediately following the end of World War II there was a hope that proliferation could be prevented by means of a monopolistic international institution exercising total control over all nuclear activities (Baruch Plan, 1946). This restrictive attempt failed and by 1952 three Nuclear Weapon States had emerged. By means of a fundamental change of strategy, Eisenhower's "Atoms for Peace" programme of 1953 vigorously tried to promote the peaceful utilization of nuclear energy all over the world, at the same time linking this promotion to agreements and controls aimed at preventing any military use of nuclear energy. In the course of implementing this policy the IAEA was created in 1957 and entrusted with the international promotion and control of the peaceful uses of nuclear energy.

The general policy of promotion proved to be exceedingly successful, stimulating an almost exponential growth of nuclear energy, that has led to the operation of more than 220 nuclear power plants in 21 countries. It was only during the last several years that constraints on this development could be felt due to economic recessions and increasing opposition from public groups which typically, and almost exclusively, directed their efforts against the peaceful uses of nuclear energy.

Independently of the peaceful development mentioned above, "horizontal proliferation" occurred, with two further States developing nuclear weapons (France 1960, China 1964). In the same period the two big nuclear powers enlarged their atomic arsenals and developed war-heads and carrier systems to qualitative extremes ("vertical proliferation"). Finally, in 1974 India triggered a test explosion.

This proliferation and its potential extension are conceived as an extreme threat to world peace because the sensitive "balance of horror" could be destabilized by even an "outsider detonation" of limited strategic value. Therefore in the mid sixties, intensified efforts were made to prevent further proliferation, culminating in the Treaty on the Non-proliferation

of Nuclear Weapons (NPT) of 1970. The IAEA was entrusted with ensuring that Non-Nuclear Weapon States party to NPT adhered to their undertakings.

The NPT as well as the safeguards system of the IAEA, being the most important and effective instruments of non-proliferation, were, nevertheless, seen by some critics as not being sufficiently comprehensive and effective. There is no doubt that the Indian explosion contributed to this opinion, though it was carried out by the use of nuclear facilities and material that had never been placed under IAEA safeguards. This point bears repeating since the explosion is often cited as indicating a weakness of the safeguards system. The diminished confidence in the safeguards system contributed to a resurgence of restrictive approaches in non-proliferation politics. On the one hand, forgetting the spirit of the era of the Geneva Conferences, unilateral restrictions on the transfer of sensitive information, materials and equipment were considered. On the other hand, the development and introduction of "technical fixes" was recommended to inhibit military uses of new facilities and processes.

The first approach was pursued by the "London Suppliers Club" (1976), by important uranium suppliers (Australia, Canada) and in the US Non-Proliferation Act of 1978. The second approach was promoted by the USA, by attempting to motivate all States to dispense with the separation and use of plutonium and by stimulating the development of proliferation resistant fuel cycles. All these efforts are indeed well intended but a positive outcome seems doubtful. Moreover there is a feeling of apprehension that the renewal of restrictive policies could have unforeseen detrimental effects.

For technical reasons a satisfactory outcome of these policies seems doubtful as too much nuclear knowledge and know-how is already too widely spread and can be acquired without help in the case of firm political determination. The technique for enriching uranium by diffusion, for instance, is today still highly classified. This did not prevent several countries from developing the centrifuge enrichment method, a process which is economically attractive but which also poses some proliferation problems. The already mentioned restrictions focus mainly on the fuel cycle of commercial nuclear power plants. However, using this cycle to acquire nuclear weapons would involve an expensive, difficult and uncertain approach. With good reason this approach has therefore not been used by any of the Nuclear Weapon States nor by India. The most practicable option — to use simple reactors and small reprocessing plants — cannot be closed by technical restrictions but only by political means. When thinking of the newly developed proliferation-resistant fuel cycles, even if they are technically feasible, account must still be taken of the existence of the 400 nuclear power plants which will shortly be in operation and cannot be converted to new fuel without nearly insurmountable difficulties.

The new restrictive policy that has so far been implemented unilaterally has, furthermore, scarred the self-esteem of several nations and undermined the confidence of others in the validity of previously concluded supply agreements. As a result, a number of countries feel with increasing urgency a need to create an independent fuel cycle by constructing sensitive facilities even in those cases where a small nuclear power programme does not justify such decisions economically. Additionally, a certain hardening in the negotiation of safeguards agreements can be observed.

It is to be expected that the very valuable International Nuclear Fuel Cycle Evaluation (INFCE), presently formulating its conclusions, will reveal the very limited scope of technical fixes and lead back to the realization that proliferation is in the first instance a political problem, the solution of which lies in appropriate policies of consensus and co-operation, based on the good-will and determination of all sides to maintain peace. These policies should take into account the motivations leading to proliferation: striving for military power, feelings of insecurity and conceptions of prestige. Unreliability of supplies or offended self-esteem may lead to thoughts of the prestige conferred by the possession of nuclear weapons or at least of facilities and materials that can be utilized for their production. Several possibilities are at hand to discourage or limit such tendencies:

- In the first instance, world public opinion as voiced by the UN;
- All policies leading to détente and to the removal of discrimination;
- Limitation and reversal of vertical proliferation (for example through SALT);
- A global nuclear test ban;
- Extended technical support for developing countries;
- Multilaterally agreed limitations or conditions on the transfer of sensitive know-how and equipment;
- Supply guarantees for nuclear fuel and equipment under full-scope safeguards.

All these instrument of non-proliferation policies would not work without the effective operation of comprehensive non-proliferation agreements, from regional weapon-free zones to the NPT-System. The strengthening and extension of these instruments is of fundamental importance. Here the IAEA plays a decisive role as an international trustee charged with verifying that the parties to non-proliferation agreements have complied with their undertakings.

Where does this system stand today? As of end 1978, 106 States (including 3 Nuclear-Weapon States) have become parties to the NPT, of which 61 Non-Nuclear-Weapon States have concluded with the IAEA the required safeguards agreements which have entered into force. Some of these States do not, as yet, have any significant nuclear activity. The States of importance to the application of safeguards are, of course, those 53 which operate nuclear facilities. An analysis shows the following picture: 5 of the 53 States are Nuclear Weapon States; thirty-one of the other 48 are subject to IAEA safeguards under NPT Agreements in force. That leaves 17 States; 16 of these are under safeguards based on a pre-NPT safeguards agreement. Finally, it should be mentioned that Egypt is operating a research reactor without safeguards.

By and large this is an encouraging and self-explanatory picture. In most of the Non-Nuclear Weapon States all nuclear facilities are under IAEA safeguards; there remain only a few States for which this cannot be said. Moreover, 3 of the Nuclear Weapon States have voluntarily made to the IAEA an offer for the implementation of Agency safeguards in non-military facilities to be selected. This will allay the concern of other industrialized States in respect of the possible distortion of international competition if safeguards are confined only to their facilities. The corresponding agreement with the UK is already in force, enabling the IAEA among other things to gain valuable experience in the inspection of a fast-breeder plant and related reprocessing facility. The agreement with the USA is at present being dealt with in Congress. The outcome is of course of the greatest interest to Non-Nuclear Weapon States party to the NPT.

The extent to which nuclear activities are currently safeguarded can be clarified by considering the tasks still to be performed in extending and consolidating the system of non-proliferation agreements. In the first instance, the few special cases already mentioned should be encouraged to submit all their nuclear installations at least to a pre-NPT-agreement. This is the concept of full-scope safeguards on which the London Suppliers Club was not able to reach complete agreement but, which is, on the other hand, a fundamental requirement of the new Non-Proliferation Act of the USA. Resistance against this concept is significant, as the Indian example shows.

Further advances could be made if the pre-NPT-agreements (16 States) were converted into NPT-type agreements; these latter are preferable from the points of view of standardization and more efficient safeguards. This conversion concept also meets with considerable difficulties. The main argument against the NPT is that it is an "unequal treaty", giving privileges to States that developed the atomic bomb before 1 January 1967, and discriminating against all others. Furthermore, there is another argument stating that the Non-Nuclear Weapon States honoured their obligation — non-proliferation — whereas slow progress has been recorded in the discharge of the obligations of the Nuclear Weapon States.

Concluding this review of the status of Non-Proliferation agreements it can be said that impressive progress has been achieved and that the few remaining gaps have been identified although much has still to be done to close these gaps. However, agreements are only one pillar of the non-proliferation system. While the breach of a firm international obligation occurs rather seldom nowadays, conventional agreements are not a sufficient barrier against the global menace of the further proliferation of nuclear weapons. This novel type of threat had to be answered by the novel system of verifying compliance with the agreements through international inspections of nuclear facilities on national territory by the IAEA. Another important question arises now: Where do we stand today with regard to the inspection system — what is it able to detect and how reliable is it?

Perfectionist specifications for ideal international inspection systems have been delineated in some reports and compared with the actual system of the IAEA which, as all real things, is not perfect and moreover is greatly limited by budgetary considerations, amongst others. The comparisons aimed at emphasizing the need to replace safeguards by drastic technical and administrative measures. What if such measures prove to be technically ineffective and impossible to enforce internationally? Mankind will be left in despair. Is it really wise to abolish the police because it is not perfect?

Doubts about the effectiveness of the Agency's Inspectorate obviously arise from a misunderstanding created by the ambiguous use of the word "safeguards". Sometimes the term "safeguards" is taken to mean an action which is necessary and within the responsibility of the State, namely the protection of nuclear materials and facilities against acts by unauthorized persons or groups, for example theft, blackmail, terrorism, sabotage and vandalism. This public function directed against subnational activities should consistently be called "physical protection". The term "safeguards" applied to nuclear activities should be restricted to international measures aimed at detecting the diversion of nuclear material to unauthorized purposes and the deterrence of such diversion by the risk of early detection. This function is directed against proliferation by States, in the first instance. It is obvious

that the objectives as well as the technical means and criteria for the success of those two activities should be quite different

One of the fundamental differences between physical protection at the national level and international safeguards is to be found in the instruments of power available. On the territory of a particular State, the Agency only has the right, conceded by the State agreeing to certain limitations of its national sovereignty, to collect specified information, to “export” and evaluate it and to pass the results to the Board of Governors of the IAEA in summary form only, except in cases of suspected diversion. On the other hand, the State is able to use its powers to protect facilities and material physically and to recover diverted material should the need arise. The existence of this real power is in itself a preventive factor and awareness of its existence constitutes a real deterrent. The international safeguards system of the Agency is not able to **prevent** diversion but its main objective is to **detect** discrepancies, to **trigger** international reaction and thereby **deter** diversion. This objective is clearly defined in the safeguards agreements at the “timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection”.

The deterrent effect of the safeguards system must be taken into account by a State which, motivated by whatever reason, starts to consider the production of nuclear weapons. It must be aware of the risk of discovery and indictment at the bar of international opinion for the breach of an important international obligation. It is, however, impossible to quantify the detection probability necessary to deter a given State in a given situation. Only experience would be able to teach us *a posteriori* that the risk of detection was not sufficient to deter the State. The detection probability should however suffice to make the misuse of existing nuclear activities unlikely and, in case of an irrevocable decision, to make it more advantageous on balancing costs and benefits, for a State either to withdraw legally from NPT according to Article X (bearing in mind all international consequences) or to establish a clandestine fuel cycle additional to the existing one (not forgetting all the difficulties, risks and consequences).

As already said, it is not possible to quantify the preparedness of States under safeguards to run the risk of being detected. Neither is it easy — for the moment, at least — to quantify the overall detection capability of the Agency’s safeguards system. For the planning of specific actions, such as taking of statistical samples, a 90–95% detection probability is used. The overall capability depends however *inter alia* on the size of the staff of the Inspectorate, its efficiency, the standard of its technical equipment, the types of facilities to be safeguarded and the effectiveness of the States’ systems of accountancy and control foreseen in the NPT-safeguards agreement. Safeguards agreements also place limitations on inspection activities. Considering the possible catastrophic consequences of further proliferation of nuclear weapons, the Agency has, in any case, the obligation to strive in its planning and activities towards as high a detection capability as possible. However, external limits are set by economic and political considerations of the Member States — the IAEA can at best be as good as its Members permit.

The objectives of the Agency’s safeguards system contain two quantitative expressions: “significant quantities of nuclear material” and “timely detection”. Here again mis-

understandings can arise if the difference between national physical protection and international safeguards is not kept in mind. Physical protection may often have to be designed in a way to achieve a detection time of the order of minutes or hours and rather small amounts of material can be significant. The problem is not the proverbial student of physics fumbling in a garage to construct a bomb out of reactor plutonium. Even the diversion of 100 grams of plutonium could result in political disaster because of hysterical reactions from a misinformed general public. The detection of such small target amounts in such short times cannot be reasonably required of the international safeguards system and the inability of this system to comply with such a requirement is no argument against the system, but rather against the requirement. Significant quantities to be detected by the international safeguards system are, for example, of the order of 8 kg plutonium, the amount necessary to build an explosive device, inclusive of losses.

The alarm bell triggered by unauthorized entry into a nuclear facility should bring armed guards to the scene within minutes. The international inspector, on the other hand, does not have the task of prevention; his objective is to detect anomalies indicating diversion by whomsoever and for whatever purpose. Generally speaking, it is, of course, desirable that international safeguards should be able to detect a diversion before the diverted material is converted into a nuclear explosive and detonated. Depending upon the kind of material, the target for detection times taking into account the time needed for evaluation, analyses and so on may thus be a matter of weeks or months rather than the minutes or hours needed to counter a criminal or terrorist attempt to seize the material.

A technical peculiarity of the international safeguards system arises from the fact that until now there has not been any diversion of nuclear material under its safeguards and, as I have said, the probability of future diversions will remain small, at least partly because of the operation of the system itself. Therefore the main conclusion from inspections is usually the statement that a certain event did not occur. Similarly in mathematics it is difficult to prove the non-existence of an ideal object. Therefore it is a fundamental duty of the Agency and of its control system to remain credible in its assurance and to promote confidence by invalidating, through careful and objective examination, the suspicion that the "malevolent neighbour" strives for something one is oneself prepared to forego. We shall not forget that it was such a suspicion that provided the decisive motivation for the US Manhattan Project, namely that Germany was about to construct an atom bomb. As we know this suspicion was wrong.

The periodic statement of the IAEA that no diversion occurred has an air of assurance similar to that of days gone by when people would shake hands or doff their hats to indicate, in meeting others, that nothing has to be hidden. Nowadays airport control authorities verify this assertion in a more scientific manner.

The Inspectorate of the IAEA operates according to the objective described. It has considerably extended its activities during the last decade to cover the growing number of States coming under safeguards and the fast growing number of nuclear facilities within these States. The staff of the Department of Safeguards rose from 79 to 213 between 1970 and 1978; the number of facilities inspected from 90 to 322; the number of annual inspections from 172 to 762. The amount of nuclear material under safeguards may also be of interest. By the end of 1978 about 66 tons of plutonium, over 10 000 tons of enriched uranium and about 30 000 tons of natural uranium were recorded. To date, all

nuclear power stations operating in Non-Nuclear Weapon States, with one exception (the Spanish-French Vandellós plant) are under IAEA safeguards.

These figures sound impressive and it is impressive too that all these activities of a world-wide control system can be put into operation at a negligible cost. If one divides the annual budget of the Agency's Department of Safeguards — about the cost of a single military aircraft — by the number of kilowatt-hours produced annually in all nuclear power plants, one finds that a substantial contribution to peace has been obtained for not more than \$0.00002 per kilowatt-hour.

Having explained the status of the IAEA's safeguards system it might be of interest to give a condensed view of its future. One requirement has already been dealt with, the universalization and standardization of the NPT-system, so that at least in Non-Nuclear Weapon States all nuclear activities will come under effective safeguards. Furthermore, various attempts to strengthen the system are underway. Concerning operational and technical questions, the internal efficiency of the Agency's Inspectorate is to be improved continually, techniques of measurement and surveillance are being developed on the basis of generous support programmes of Member States, and modifications of the safeguards approach have to be developed to cope well in advance with specific problems of the large reprocessing and other bulk handling facilities of the future

Additionally, international consultations have been proceeding within the Agency for some years in relation to new institutional arrangements for the fuel cycle. Extensive studies were devoted, e.g., to Regional Fuel Cycle Centres. The creation of such centres could demotivate tendencies mentioned above to build, in various countries, independent sensitive facilities not based on sound economic assessments. Apart from greater economy, these centres could contribute to an improved reliability of fuel supplies. Co-location of reprocessing and fabrication would make the fuel cycle less vulnerable to diversion attempts from outside and facilitate safeguarding. Last but not least, the credibility of safeguards would be improved.

Another institutional arrangement to be considered is the creation of an International Fuel Authority with responsibility for providing fuel services and allocating fuel resources, as recommended in the US Non-Proliferation Act. The authority to act as a fuel bank is already contained in the Agency's Statute. Practical consideration is, however, still at the preliminary stage.

A further important function of the IAEA already foreseen in the Statute is to maintain International Plutonium Storage Centres. This scheme gained particular importance during the last years and detailed studies by an international expert group of the IAEA are underway. At the moment, control of the ever growing amounts of separated plutonium is assured. By 1990, however, 150 tons and by 2000 more than 260 tons of separated plutonium are predicted to accumulate from civil nuclear fuel cycles. The storage of plutonium not immediately needed to fuel reactors, or for peaceful research purposes, in storage centres under the control of the IAEA would facilitate not only safeguards, but would also enhance the general confidence in the exclusively peaceful utilization of this potentially dangerous material. Present studies focus on criteria for siting of storage centres, management problems and criteria for the storage of plutonium and for its release.

Returning to the question "IAEA Safeguards – Where do we stand today?" – it should be emphasised that in the decade from 1945–54 three Nuclear Weapon States came into being, and only one nuclear power plant started operating. In the decade 1955–64 two further States acquired nuclear weapons, whereas 24 nuclear power plants went into operation. In the decade 1965–74 only the Indian test explosion occurred, and 131 new nuclear power plants started operating. Finally, from 1975 up to the present the proliferation rate remained zero and the number of nuclear power stations rose to more than 220, again indicating that there is no direct relation between the peaceful and military utilization of nuclear fission. The specific goal of Agency safeguards is to give further effective support to all non-proliferation efforts throughout the world in maintaining a proliferation rate of zero now and in the future.

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