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IAEA SAFEGUARDS AND TECHNICAL SUPPORT PROGRAMS: POTAS IN THE 1990s

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ABSTRACT

The U.S. Program of Technical Assistance to IAEA Safeguards (POTAS) has since 1978 provided technology and technical assistance to the IAEA to support its nuclear safeguards activities. The present level of support, $6.9 million per year, equals 10% of the Department of Safeguards annual budget. During the next decade, the International Atomic Energy Agency (IAEA) will face new technical challenges in carrying out its verification activities. To help the IAEA acquire the technology and other technical support that it will require in the 1990s, POTAS expects to continue its assistance, both in the areas established in the past and in additional areas dictated by newly identified IAEA safeguards requirements. This paper will look at the political and policy context within which the Department of Safeguards, and hence POTAS, operates, and how that context is expected to evolve over the next decade. The roles and functions of POTAS will be identified and discussed in terms of their historical evolution. Lastly, the paper will consider how POTAS is expected to change during the 1990s, both to maintain effectiveness in existing roles and functions, and to meet the challenge of the changing policy context.

INTRODUCTION - THE ENVIRONMENT

The U.S. Program for Technical Assistance to IAEA Safeguards (POTAS) was created during a time of great stress in the International Atomic Energy Agency's safeguards system. At that time IAEA safeguards were barely a decade old, and were focused on research facilities and reactors. The additional responsibility of implementing the Treaty on the Non-Proliferation of Nuclear Weapons meant the IAEA Department of Safeguards faced a new and much greater challenge. Full-scope safeguards meant not only many more facilities and much larger quantities of nuclear material under safeguards, it also meant whole fuel cycles under safeguards. To assist the IAEA in meeting the challenge of this rapidly expanding scope and complexity, the U.S. established POTAS.

IAEA safeguards is now facing another period of great change, and hence stress on the Department and on the structures which support it. While the nuclear industry has not grown nearly as fast as once predicted, the number of facilities and quantities of nuclear material under safeguards have grown dramatically when seen in a 10 - 20 year perspective. Highly automated new plutonium handling facilities have led to highly automated new safeguards approaches. At the same time, the safeguards budget has been constrained by the policy of zero-real growth. These forces have produced considerable interest in seeking new approaches and concepts which will afford comparable levels of verification and assurance with smaller resource requirements.

One important source for such new ideas has been the recent and on-going development of verification regimes under other international agreements. The inspection procedures under the Intermediate-Range Nuclear Forces agreement(1) and the Conference on Security and Cooperation in Europe confidence-building measures agreement(2) have generated new ideas potentially relevant to IAEA safeguards. The current negotiations on a Chemical Weapons Convention(3) have utilized IAEA safeguards as a model for an inspection system on the chemical industry, and have also considered ideas such as "challenge inspections" that are now influencing the discussion of future nuclear safeguards.

As these forces were leading toward formal discussions in the Board of Governors (BOG), another development intervened to further stimulate thinking about fundamental issues. United Nations Security Council Resolution 687(4) defines a new role for the IAEA, an inspection and verification responsibility differing in scope and content from classical IAEA safeguards. At present, this new verification regime applies only to Iraq, a unique case and not a precedent for present international safeguards. However, IAEA implementation of U.N. Security Council Resolution 687 furthers the impetus from the last NPT Review Conference to consider further development in IAEA practice of special inspections.

These factors shape the context within which POTAS and other voluntary safeguards support programs will operate over the next decade. It is not clear just how these forces will evolve, but it is clear that IAEA safeguards are now entering a period which will not simply be the continued gradual refinement of the established system, but rather will be a time of adjustment to a new world order.

DIRECTIONS FOR SAFEGUARDS

The Department of Safeguards has embarked on a major planning effort to define the role of Safeguards in the next decade. While all Departments in the IAEA must respond to a changing political environment, the special mandate of the Department of Safeguards to provide impartial assurance that all States are meeting their safeguards obligations imposes an added technical challenge. Not only must the Department of Safeguards attempt to define possible

scenarios for the future as part of an overall IAEA plan, but they must then take the additional step of planning technical strategies to respond to whatever the future brings.

In order to continue to provide effective safeguards in the 1990s, the Department of Safeguards has implemented a three tier planning approach: development of a strategic plan as part of the IAEA Secretariat Medium Term Plan (1993-1998); definition of a detailed Safeguards R&D plan which is updated every two years; and submission of specific requests to Member State Support Programs (MSSPs) to solve specific problems.

The Medium Term Plan, which may be given final Board of Governors' approval early in 1992, will provide the broad response of the Board to the political and technical challenges which the IAEA anticipates in the mid-1990s. The Safeguards R&D plan, which is being developed concurrently with the Medium Term Plan, identifies specific technical needs and associated problems that must be addressed to implement effective safeguards. Finally, specific Agency needs for assistance by the member state support programs (both R&D and non-R&D) are approved at the Division level, documented on special forms (SP-1s) and submitted to MSSPs for their consideration.

The planning process outlined above is ongoing and therefore subject to change. The Medium Term Plan is still in draft and being reviewed by the Governors. However, the ideas and insights generated by the ongoing development of the Medium Term Plan and their reflection in the R&D plan and requests to member state support programs can serve as a starting point to examine the shape and character of IAEA safeguards, and so the role of POTAS, in the next decade. The discussion in the rest of the paper is based on this input tempered by the fifteen year experience of providing technical support to the Department of Safeguards through POTAS. The rest of this section will address what the content and magnitude of the future safeguards responsibilities might be in the environment of the 1990s and how member state support programs might assist. The next section will discuss some of the specific problem areas that we expect POTAS to address.

Future Scenarios for Safeguards

What workload can the Department of Safeguards anticipate in the 1990s? The answer lies both in the changeable political environment, as described previously, and in the more predictable patterns of change in technology and the nuclear industry.

Looking first at the nuclear industry, both the quantity of nuclear material and the number and complexity of facilities under safeguards is expected to increase significantly(5). The only question is the magnitude of the increase. In addition, new types of nuclear facilities are anticipated to be developed during the 1990s for commissioning in the next century, thus requiring the IAEA to expend additional resources to develop effective safeguards

approaches and any required new technology. Finally, the IAEA must keep abreast of advances in technology on an ongoing basis so as to continue to enhance the effectiveness and efficiency of safeguards as the environment in which safeguards operates continues to change.

In the political arena, the IAEA and the Department of Safeguards may be asked to increase the scope of their responsibility by the Board of Governors. The recent U.N. Security Council mandate to the IAEA to conduct inspections throughout Iraq to identify all Iraqi nuclear activities may presage a wider scope for IAEA safeguards inspections as well, especially as the IAEA Board of Governors has now found that Iraq violated its safeguards agreement by failing to declare some relevant materials and activities. Concerns about the credibility of IAEA safeguards in the light of these undeclared activities may well lead the Board of Governors to pursue increased use of special inspections as first discussed at the Fourth NPT Review Conference held last year. Also, continued interest in expanding safeguards in nuclear weapons states could lead to substantially increased resource requirements.

Present estimates of additional resources required to provide safeguards in the 1990s using presently defined approaches and existing technology range from a one-third increase under a business as usual scenario, to two-thirds if all non-nuclear weapons states accept full scope safeguards, to triple if all civilian facilities in all nuclear weapons states accept safeguards.

Technical Challenges for Safeguards

Although the policy decisions reached by the Board of Governors in response to the political environment of the 1990s will ultimately determine the nature of the responsibilities that the Department of Safeguards must meet, the magnitude of the safeguards workload will also be strongly influenced by trends in the nuclear industry that are already in place. In addition, new technology can open the door to increased efficiency and effectiveness for the Department of Safeguards, both in the field and at headquarters. It is in this technical arena that the member state support programs can assist the Department of Safeguards.

First, as mentioned above, new and innovative nuclear facilities constructed in the 1990s will be responsible for an increased workload under existing safeguards agreements. These will include both reactors and large high-throughput bulk facilities -- enrichment, fuel fabrication and reprocessing installations. There is also renewed interest in the development of both long term and permanent spent fuel storage, the latter in geologic repositories with associated conditioning facilities in States where reprocessing of spent fuel is no longer envisaged.

These new facilities will require a substantial investment of IAEA resources before they can be safeguarded effectively and

efficiently. The Department of Safeguards staff will have to verify the facility design; develop the safeguards approach (a lengthy process in new types of facilities); prepare technical specifications for the safeguards equipment to implement the approach; develop and/or oversee the development of the required hardware, software, and procedures; and finally test and implement the approach. In addition, for existing facilities the safeguards approaches will need to be reexamined to take advantage of new technology applicable to safeguards appearing in the marketplace, and to apply any new insights on approaches to verification that could reduce inspection time while maintaining or increasing effectiveness.

In parallel with defining and upgrading the technical underpinnings for verification of safeguarded material, the IAEA will need to continue to explore new approaches to streamlining administrative functions, such as information gathering and analysis of information required for the preparation of inspection reports, development and utilization of the specialized management information required within the Department of Safeguards, and efficient procurement and maintenance of safeguards equipment.

As just described, the Department of Safeguards is faced with an increased workload, though of varying magnitude, under all credible scenarios. When this prospect is combined with the prospect for continued zero-real growth in the overall IAEA budget and the need to maintain the other programs of the IAEA, it is clear that the Department of Safeguards must continue to find new means to accomplish more with the limited resources available. POTAS and the other member state support programs will continue to represent the only major source of assistance in achieving this.

DIRECTIONS FOR POTAS

The previous section sought to describe what IAEA needs over the next decade might be; clearly that is an exceedingly difficult task, and involves a great deal of ambiguity. This section will nonetheless seek to identify some of the ways in which POTAS, and by extension other member state safeguards support programs, can respond to the IAEA's needs.

It is important in this context to recall that POTAS and many other safeguards support programs provide several different kinds of assistance to the Department of Safeguards. Research, development, and demonstration (RD&D) of new safeguards instruments and techniques is the most recognized area of assistance, and the original objective of many support programs, including POTAS. A second area might be described as routine support and maintenance functions, such as inspector training and provision of cost-free experts to perform tasks for which regular staff are not available. The third area is infrastructure development, such as installation of PC local-area networks or development of the Safeguards Management Information System.

Safeguards RD&D

It is quite clear that POTAS will continue to play a major role in RD&D for the IAEA. The new complex facilities noted previously will require the development of innovative ideas and equipment to effectively implement safeguards. Some ongoing POTAS supported projects of this type are concerned with unattended acquisition of data, integration of C/S and NDA measurement techniques, authentication of data from operators equipment, and development of near real-time-accounting principles. Significant support for these projects and other R&D projects not yet defined is expected to continue.

One new and interesting question for POTAS is the degree to which future RD&D activities will be performed as they have been in the past -- through Agency requests to governments which respond by funding work at national nuclear laboratories -- and the degree to which commercial firms will play an increasing role in this area.

Commercial firms are already performing important work for the IAEA in several technical areas, including surveillance equipment (for example, the Sony Corporation work on COSMOS and the Aquila Technologies Group work on MIVS), advanced seals (for example, Dornier development of VACOSS) and local area networks (Aquila Technologies Group implementation of a LAN). However, there is a growing view, within the U.S. and the Secretariat, that a number of problems faced by the Department of Safeguards are not unique. In important respects the problems are the same as those faced in other arenas, where they are addressed by commercial firms. For example, pattern recognition is a regular need in endeavors as far apart as medical interpretation of x-rays and other types of "pictures", such as spectral analysis of many kinds. The adaptation of magneto-optical mass storage devices, including their associated software, from existing commercial applications to a variety of safeguards uses is another area to examine. The analytical tools developed and marketed for other fields may prove appropriate and powerful for safeguards applications as well.

We expect that POTAS will increasingly look for commercial off-the-shelf products which can satisfy IAEA safeguards needs, and look to commercial firms to integrate those products into tools tailored to address IAEA's safeguards needs. Nonetheless, it is clear that a great deal of RD&D on new safeguards instruments and techniques will continue to be performed at the U.S. DOE national laboratories and their counter-parts in other countries.

Safeguards Support and Maintenance

The second area of interest is assistance in performing routine support and maintenance functions. In the support area at the present time, POTAS and other member state support programs supply much, if not most, of the training provided to safeguards inspectors over the course of their careers in the IAEA. POTAS and other programs also provide cost-free experts to work in the

Safeguards Training Section. Another example is the long-term assistance by POTAS in the strengthening of quality assurance activities in the Department of Safeguards, notably the development and application of a quality plan for use in the design, development, testing, procurement and implementation of safeguards equipment. Preparation of standard procedures for measurement of nuclear materials and presentation of seminars for Department of Safeguards staff on subjects such as project management, team development and quality assurance are continuing activities.

Such support activities could be included in the regular IAEA budget and funded through assessed contributions, or can continue to be supported largely through voluntary national safeguards support programs. This question is now being considered within the Secretariat in the context of the Medium Term Plan. So long as most Member States continue to adhere to a zero-real growth policy with respect to the IAEA budget, the role of POTAS in safeguards training and other support areas through the provision of cost-free experts will continue. The only real issue will be what portion of POTAS funds should be allocated to these activities. We cannot foresee any substantial decrease as we cannot expect any significant real increase in the safeguards budget for such activities. Nor can we foresee any substantial increase in this area unless POTAS funding increases substantially, as other kinds of needs will continue to compete for POTAS funding.

An important maintenance function where we expect significant change concerns safeguards equipment. In the past almost all routine maintenance and repair of this equipment has been performed by Department of Safeguards personnel. There are several trends which mitigate against continuing this practice. First, increasingly the Department of Safeguards is deploying many units of a standardized design and construction (this has long been true for surveillance equipment, but is increasingly common for seals verification equipment and non-destructive equipment as well). Second, more and more safeguards equipment is micro-processor controlled. The commercial maintenance philosophy for such equipment is to replace components rather than to repair them. The skills required to repair many different kinds of micro-processors and to maintain effective quality control/quality assurance quickly outpaces the cost of replacing parts. And whole modules can often be replaced in the field, reducing down time for the instrument and therefore reducing overall cost further. A third development, related to the second, is that more and more safeguards equipment is being procured in relatively large orders from a single commercial supplier rather than in small orders from a commercial job shop. These commercial suppliers provide warranties for their products, but these warranties often mean that maintenance of that equipment is the responsibility of the supplier.

We foresee an increasing role for commercial firms in maintenance, and perhaps logistics activities, for safeguards equipment. While such a development does not necessarily imply any change in the role of POTAS and other support programs, it may.

For example, support program coordinators could function as facilitators between the IAEA and commercial suppliers.

The possibility of a facilitator role for POTAS was strengthened recently when the United States Department of Energy (DOE) adopted a policy of actively transferring technology developed in its national laboratories to commercial firms in the U.S. This DOE policy stems from the passage by the U.S. Congress in 1989 of the National Competitiveness Technology Transfer Act, explicitly written to provide incentives to the private sector to commercialize technology derived from federally funded R&D. The Act authorizes government-owned and contractor-operated Department of Energy laboratories to engage in cooperative research and development agreements (CRADAs) with private industry under conditions expressly designed to encourage such technology transfer. All DOE laboratories now have or soon will have their contracts modified to include the possibility of engaging in CRADAs.

Both the Modular Integrated Video System (MIVS) developed through POTAS and the COBRA seal developed by DOE have already been successfully transferred from the developer (Sandia National Laboratories) to a commercial firm (Aquila Technologies Group, Inc.). POTAS has continued to support the IAEA during acquisition and deployment of MIVS, and is supporting IAEA evaluation of the COBRA seal system manufactured by Aquila.

While MIVS and the COBRA seal involve equipment developed with public funds, POTAS can and may in the future provide similar assistance to firms which have developed their own products. Searching out and locating such products and firms may be an increasingly important activity in POTAS. In this context, POTAS' technical management arm, the International Safeguards Project Office (ISPO), represents a body of experience in U.S. procurement and export practices which is valuable to the IAEA, and in IAEA procedures and requirements which is valuable to industry.

Infrastructure Development

The third area of POTAS effort identified above is infrastructure development. This has traditionally been a major area of POTAS activity. Many of the cost-free experts provided to the Department of Safeguards over the years have been charged with developing new infrastructure within the Department, which is then to be taken over by the regular staff of the Department. (In practice, CFEs have often taken over the support and maintenance of the new infrastructure as well). Needs in this area will continue, although it is hard to predict the specific requirements for infrastructure over the next decade.

There is growing interest in examining the basic concepts underpinning IAEA safeguards and what the international community expects by way of IAEA verification. Zero-real growth in the IAEA budget and continued growth in safeguards responsibilities provided

the original motivation for such interest for several years. However, recent and ongoing events in Iraq have created new questions, and heightened interest.

Addressing the technical aspects of the many questions arising over changes in verification philosophy and safeguards principles will require considerable analytical work. Although in recent years systems studies have entailed decreasing portions of POTAS funding; we can expect a significant increase in systems studies in the near term. As the Board of Governors and Member States determine the course of safeguards, whether continuation of the current course or some significant change in direction, the requirements for additional infrastructure building and technical support will become clear, and will point the way to POTAS involvement and assistance in the 1990s.

SUMMARY

IAEA safeguards is entering an important period of re-evaluation and transition. While the question of greater efficiencies in safeguards implementation has been an important issue in recent years, the larger issue now involves the continued relevance and credibility of IAEA safeguards. The Iraqi situation is generating a more fundamental re-examination of the international nuclear non-proliferation system, and future IAEA safeguards will be shaped by how this larger re-examination evolves.

However, one can make several predictions concerning the evolution of POTAS, and perhaps other member state support programs, over the next decade. First, POTAS will continue to perform the same functions that it has for the last decade, and for the most part to the same or somewhat increasing degree relative to the overall IAEA safeguards program. Second, the IAEA and POTAS will look more frequently to commercial suppliers for off-the-shelf technology to address safeguards needs, and to commercial firms for support of safeguards instruments and technology. Third, in the near-term POTAS may well perform more system studies to provide technical evaluation of new concepts and approaches being considered for safeguards. We expect important changes in the face of international safeguards, and important changes in the substance of POTAS work, but little change in the structure and operation of POTAS.

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