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STRENGTHENING THE EFFECTIVENESS AND IMPROVING THE EFFICIENCY OF THE SAFEGUARDS SYSTEM

A report by the Director General

FOREWORD

In resolution GC(XXXVII)/RES/619 the General Conference requested the Director General to inform it at its thirty-eighth regular session of the actions taken to strengthen the effectiveness and improve the cost efficiency of the safeguards system. The actions consist of a continuation of those reported to the thirty-seventh regular session of the General Conference in GC(XXXVII)/1073 and subsequent actions resulting from Board decisions and from initiatives of the Secretariat. This report provides information on the Secretariat's Development Programme for a Strengthened and More Cost-effective Safeguards System ("Programme 93+2").

The process of strengthening and otherwise improving the safeguards system has been underway for some time. Statements made at the 1990 NPT Review Conference and the Director General's statement during the February 1991 Board of Governors' meeting spoke of the need for more effective and "cost-efficient" safeguards and identified specific issues which needed to be addressed. During 1991 the Board considered, and in 1992 confirmed the right of the Agency to use the right of special inspection as provided for in comprehensive safeguards agreements. In 1992 the Board took decisions regarding the early provision and use of design information. Throughout 1992 the Secretariat carried out technical studies to identify specific areas of safeguards application which might be improved and to identify mechanisms for implementing the Board decisions. In February 1993 the Board endorsed a reporting scheme on imports and exports of nuclear material and exports of specified equipment and non-nuclear material.

This process of improving the safeguards system is a continuing one. This document reports on progress to date in the major effort in the process, the Secretariat's programme ("Programme 93+2") for assessment, development and testing of SAGSI's recommendations on improving the implementation of safeguards. This report is part of the continuing dialogue between the Secretariat and Member States which is essential for the successful completion of the programme.

INTRODUCTION

1. In April 1993, the Standing Advisory Group on Safeguards Implementation (SAGSI), acting on a request by the Director General and with the support of the Safeguards Department, reported its recommendations for improving the cost-effectiveness of safeguards to the Director General. The Director General reported to the Board on SAGSI's recommendations in June 1993 (GOV/2657). The Board requested the Director General to submit to the Board in December 1993 concrete proposals for the assessment, development and testing of the measures proposed by SAGSI.

2. At the meetings of the Board in December 1993, the Deputy Director General for Safeguards introduced document GOV/2698 describing the Secretariat's development programme for a strengthened and more cost-effective safeguards system. The programme (called "Programme 93+2") provides for the evaluation of the technical, legal and financial implications of SAGSI's recommendations. It was emphasized that any strengthening measures that go beyond the scope of safeguards agreements can only be implemented with the agreement of the States concerned. The Chairman of the Board, in summing up the Board's December 1993 discussion of the proposed programme, said that "the Board had reiterated its support for strengthening of the Agency's safeguards system and for the Secretariat's efforts and initiatives aimed at increasing the effectiveness and improving the efficiency of that system", and that, "the Board had welcomed the Secretariat's intention to submit regular progress reports to it and provide regular opportunities for it to express its views". Further progress in the programme was reported to the Board in February 1994 (GOV/INF/729) and in June 1994 (GOV/INF/737).

3. The ideas and proposals being considered in "Programme 93+2" are broad in scope and diverse in nature. They cover all of the four areas considered by SAGSI for improving the cost-effectiveness of safeguards. They deal with both declared and undeclared nuclear activities. They include possible new measures for strengthening safeguards; further efficiencies in how current safeguards activities are carried out; alternative procedures and techniques that may be more efficient or effective in carrying out safeguards; and possibilities for replacing some current safeguards procedures by alternative procedures which maintain the effectiveness of safeguards but which can be implemented with less effort and lower cost. The further recommendations of SAGSI at its November 1993 and March 1994 (see GOV/INF/739) meetings are being taken into account.

4. The criterion for inclusion of a measure in "Programme 93+2" was that it be identified as having potential for one or more of the following:

(i) reducing the cost of implementing safeguards while maintaining or improving their effectiveness;

(ii) increasing the capabilities of the Agency to detect undeclared nuclear activities;

(iii) increasing the effectiveness and/or efficiency of safeguards through greater cooperation with State Systems of Accounting and Control (SSACs);

(iv) improving the effectiveness and/or efficiency of the acquisition, processing and analysis of safeguards relevant information; and

(v) improving the capabilities of inspectors, other Agency safeguards staff and SSAC staff to carry out new measures as required for field testing the measures or for their subsequent implementation as may be decided at some future point.

Effectiveness is a measure of the extent to which Agency safeguards are able to achieve the safeguards objectives. Efficiency is a measure of the productivity of Agency safeguards, i.e., how well the available resources (staff, equipment, money) are used to fulfill the Agency's part in the implementation of safeguards.

5. The Secretariat's reports on "Programme 93+2" describe the work of the Programme as organized into six task areas with a seventh task for overall management and integration of the results. These are:

Task 1:	Cost analysis of present safeguards implementation
Task 2:	Assessment of potential cost saving measures
Task 3:	Environmental monitoring techniques for safeguards application
Task 4:	Improving the effectiveness and efficiency of the safeguards system through strengthening measures and increased co-operation with State Systems for Accounting and Control (SSAC)
Task 5:	Improved analysis of information on States' nuclear activities
Task 6:	Enhanced safeguards training
Task 7:	Proposal for strengthening and improving the efficiency of the safeguards system

The core "Programme 93+2" team is comprised of a programme manager, six task officers and representatives from the Legal and External Relations Divisions. The work is being accomplished through a series of internal working groups, drawing from expertise throughout the Secretariat, and extensive support from Member States (Member State Support Programme tasks and technical assistance in connection with field trials).

6. The Secretariat has emphasized the importance of Member State participation in testing measures being investigated under the programme. To date, 20 Member States (Argentina, Australia, Canada, Czech Republic, Finland, France, Germany, Hungary, Indonesia, Japan, Netherlands, Romania, Russia, Slovenia, South Africa, South Korea, Sweden, Switzerland, the United Kingdom, and the United States) have offered their assistance in the conduct of environmental monitoring field trials and related technical areas and in field trials of other strengthening and more cost-effective measures involving alternative safeguards procedures and increased cooperation with SSACs. Additional offers, particularly relating to the application of environmental monitoring techniques in the vicinity of reprocessing operations, uranium enrichment and to the broader field trials, would be welcomed.

7. At this stage there is an advantage in discussing the various proposals side by side in one document, showing the work done in each of them. It allows overview and an assessment of possible trade-offs and synergies. Nevertheless, in the past few years, measures for the strengthening of safeguards have been advanced to the Board as and when they were ready. To the extent that measures now contemplated are not organically linked with others, there is no reason why they should have to await presentation to the Board until a whole package becomes ready. As before, they may be advanced when they are adequately explored and developed. When they require commitments by governments going beyond existing safeguards agreements, they clearly must be subject to the agreement of the States concerned. Not all proposals, however, are of this kind. For instance, the creation of additional regional safeguards offices would not require modification of safeguards agreements.

8. The timing and content of field trials are decisive for developing the specificity of many of the proposals. These trials are resource intensive both for the Secretariat and for the Member States participating in the trials. Scarcity of Secretariat staff is one factor in scheduling the trials. Whenever possible, Support Division personnel are used. However, some field trial activities are much more efficiently and effectively carried out by experienced inspectors knowledgeable about the facilities involved. The scheduling of field trials that makes effective use of experienced staff is complicated by the requirement that "Programme 93+2" development activities not interfere with routine implementation of safeguards.

9. Although the presentation in this status report follows the seven tasks in which the work has been divided, it is also possible to view new proposals together with measures already adopted in clusters that relate to main areas of reform.

A. One major area concerns measures to strengthen the Agency's access to information, which could contribute to making safeguards more effective. Measures already taken in this area are:

a) early provision of design information,

b) greater use of data that are available publicly, in-house or otherwise and

c) the reporting scheme on export and import of nuclear material, non-nuclear material and specified equipment.

The major additional elements contemplated for this area are:

d) broader information on States' nuclear activities, resulting in greater nuclear transparency and

e) environmental monitoring.

B. Another major area of measures relates to access to sites and the effectiveness of the access. Measures already taken in this area are:

a) the Board's expressed positions regarding special inspections, both in general terms and in a concrete case and

b) voluntary offers by some governments to accept Agency visits "any time, any place".

Development of this very important area may comprise proposals regarding:

c) routine access to nuclear-related sites beyond "strategic points",

d) "managed access" to sensitive sites under a scheme of "any time, any place" and

e) expanded right to prompt access on short notice or no notice.

C. A third area of measures might be termed administrative streamlining and rationalization. Measures already taken are inter alia:

a) the expanded regional use of the two safeguards offices in Toronto and Tokyo,

b) the partnership agreement with Euratom,

c) the proposal for simplified designation procedures for inspectors and

d) the computerised log sheets.

Further measures in this area might be:

e) reduction in the inspection frequency to LWRs,

f) greater use of unattended, remote readout equipment in lieu of some inspections,

g) additional regional safeguards offices to save travel costs and facilitate short notice/no notice safeguards,

h) multiple-entry visas for inspectors, reducing red tape and administrative burden,

i) expanded capability for inspectors to freely communicate with headquarters,

j) retraining of inspectors and

k) joint use by SSACs and the Agency of equipment and laboratories.

10. The aim of "Programme 93+2" is to develop proposals for a strengthened and cost-effective safeguards system, together with an accompanying evaluation of the technical, legal and financial implications, for presentation to the Board of Governors. The progress summaries for each of the tasks are given below, including an assessment of the progress expected by the end of 1994.

Progress Report on "Programme 93+2" Tasks

TASK 1: Cost analysis of present safeguards implementation

11. The SAGSI report suggests that if some of the strengthening measures are proven effective, then trade-offs could ultimately be possible between those measures and certain elements of the current safeguards system. An important factor in evaluating the merits of any possible trade-offs is relative costs. The primary objective of Task 1 is the assessment of costs of implementing safeguards as a function of the magnitude of the various technical safeguards parameters (e.g., timeliness, significant quantities (SQ), probabilities of detection). The specific implementation costs associated with current values of these parameters and the cost sensitivity to changes in the values are not sufficiently well known. A reasonable range in the value of each parameter has been defined for this cost assessment. In parallel to these studies the technical cases are being considered for changes to the SQ for plutonium, for changing the timeliness goal for metallic Pu/HEU and for changing the conversion time/timeliness goal for depleted, natural and low-enriched uranium. The financial aspects, as well as the inherent technical merits, of the strengthening measures are being addressed under other tasks.

12. The budgeting and cost management system associated with the implementation of safeguards is based on expenditure items. Thus, experience based estimates of the cost to carry out a particular kind of inspection (e.g., physical inventory verification or interim inspection) at a specific facility or the cost to implement safeguards for a year at a specific facility are available. However, even for these cases, assumptions are needed for dealing with the distribution of indirect costs, the amortization of equipment costs, etc. From the standpoint of cost sensitivity, when a change in the magnitude of a technical implementation parameter (e.g. timeliness) results in more or fewer interim inspections, the estimation of the increase or decrease in associated costs is straightforward. When changes in the technical implementation parameters (e.g., significant quantity or probability of detection) result in changes in the level of specific activities integral to an inspection as a whole, the associated changes in cost are difficult to estimate because the costs of a number of unit activities (e.g., an NDA measurement) are facility-specific.

13. Facility-specific cost data have been collected for:

- travel and subsistence costs;
- costs for the destructive analyses (DA) of safeguards samples (transport and analysis);

- costs (time) for the various kinds of non-destructive analysis (NDA) including equipment procurement and maintenance costs;

- average strata-by-strata material inventories (interim and PIV) and the costs (time) to establish the population of items, select the items for verification and perform the verification measurements;

- average cost per surveillance unit by type - Minolta, MIVS, MUX, etc. (procurement, installation, servicing, review); and

- average costs for seals check, replacement and verification.

Similar data will be collected for:

- average costs (time) for records audit and review; and

- costs (time) related to any design information verification.

14. These cost figures relate primarily to activities carried out in the field, which are most directly affected by changes in the assigned values of the technical implementation parameters. However, these figures do not include the costs of the myriad of activities such as the analysis and reporting of inspection data and conclusions, follow-up on discrepant results, maintenance of inspection records and other data bases, quality assurance, training, development of improved equipment and safeguards approaches and the negotiation of subsidiary arrangements that directly or indirectly support the implementation of safeguards. The sensitivity analysis identifies and quantifies those costs that are affected by a change in the values of the technical implementation parameters.

15. Other work included in Task 1 is well underway. Papers have been prepared on termination, exemption and substitution of safeguards on nuclear material. The policy for the termination of safeguards on nuclear material in waste has been completed. The remaining papers are under consideration by the Secretariat. The costs of activities deriving from these papers will be assessed. An evaluation of a change in the starting of safeguards to an earlier point in the uranium purification process has been carried out. A concept paper has been prepared by the Secretariat, and a legal opinion on the issue is being prepared. At the Board Meeting in February 1992, a decision was made on the early provision of design information and the continuity of this knowledge through the lifetime of the plant to its shutdown condition. Procedures are being prepared for reviewing and verifying the declared design information throughout the facility life cycle. Criteria for accepting final

decommissioning are also being developed. The costs of introducing these measures will be assessed.

16. Task 1 will be completed by the end of 1994.

Task 2: Assessment of potential cost saving measures

17. Task 2 has as its objective the identification and evaluation of a number of technical and administrative measures that have the potential to reduce costs associated with the current implementation of safeguards. The development work associated with these measures is being performed either within the Secretariat or through Member State Support Programmes. This task was added to "Programme 93+2" following the December 1993 Board of Governors Meeting (see GOV/INF/729). This gives greater visibility to these efforts and increases the synergy with related development work within the "Programme 93+2" framework.

18. Major cost sectors associated with the implementation of safeguards, and thus the areas targeted for potential cost savings, are staff costs (60%), equipment (13%) and travel (13%). As the number of facilities and the quantities of nuclear material under IAEA safeguards continue to increase, reduction in trained staff is not realistic. However, staff utilization efficiencies may be improved and travel costs reduced through use of modern technology, through economies in safeguards operational modes, by enlarging existing or establishing new field offices and through efficient use of office automation equipment. Cost savings in the equipment sector may be achieved through greater standardization and the sharing of equipment and analytical services costs with the operator.

19. The measures so far identified for their potential to improve utilization of staff and reduction in travel and equipment costs are described below. The work breakdown structure is provided for sub-task 2.1 to indicate the level and direction of the evaluation. A similar structure is in place for the other sub-tasks.

Sub-task 2.1 Use of equipment capable of functioning in an unattended mode.

To meet increased inspection needs with increasingly limited resources, use of enhanced technology such as assay and monitoring equipment capable of operation in an unattended mode offers the possibility of reducing the physical presence of inspectors in the facilities which means savings in inspection effort and reductions in radiation exposure. Existing cases include Bundle Counters, Core Discharge Monitors, video surveillance, CONSULHA (containment and surveillance for La

Hague), NDA measurements at MOX fuel fabrication facilities, etc. Other cases where similar measures might be applied include the verification of inter-bay transfers of spent fuel in OLR's, transfers of spent fuel to canisters for dry storage, transfers of spent fuel between reactors and reprocessing plants and spent fuel storages and shipments of finished fuel from fuel fabrication plants to reactors, tank monitoring and sampling at reprocessing plants. Provisional estimates have been made of inspection effort savings if all of the applications were to be implemented.

The work breakdown structure includes the following elements:

(a) Identify all situations where NDA measurements are required to verify inventory/inventory flow, inventory changes or the unreported production of high enriched uranium that are potential candidates for the use of equipment functioning in an unattended mode.

(b) Estimate the inspection effort currently used to fulfill the relevant Safeguards Criteria requirements (PDI's/year).

(c) Identify NDA systems or combinations of NDA and C/S systems that could be installed to do the verification activity in an unattended mode.

(d) Evaluate for each such system:

i) technical feasibility including authentication requirements,

ii) safeguards effectiveness,

iii) the costs for equipment, its installation, maintenance and how the costs are amortized, and

iv) resources needed for data review and analysis at site and at headquarters (equipment and effort).

(e) List all assumptions and difficulties (technical, legal and financial) in realizing the unattended system.

(f) Estimate the time schedule for implementation of such systems.

(g) Estimate annual savings in inspection effort and inspection travel and determine the cumulative net costs.

(h) Reporting of the results and recommendations.

Sub-task 2.2 Mail-in of data collected through equipment functioning in an unattended mode

The Agency, in 1992-93, successfully conducted field tests for mail-in by the SSAC of the surveillance video tapes (STR-297). The broad application and associated cost implications are being evaluated. Provisional estimates have been made of potential savings in inspection effort for the cases where such measures are applicable.

Sub-task 2.3 Remote interrogation of NDA and C/S equipment

The present safeguards criteria requires periodic verification of inventories of, inter alia, spent fuel at reactor installations or at away from reactor installations. In the majority of cases the nuclear material is kept under C/S measures. Routine inspections for timeliness are made to service the cameras or replace/verify seals. With the development of enhanced technologies, remote interrogation or transmission of C/S data to Agency headquarters or a field office for review and analysis offers savings in inspection effort. Other examples include the Bundle Counters and Core Discharge Monitors at Candu Stations and NDA (with C/S) measures operating in an unattended mode. Preliminary estimates have been made of potential inspection effort savings from these applications and of the equipment costs for remote transmission of surveillance data.

Sub-task 2.4 Use of commercially available (standard) equipment

The current practice of relying on equipment with unique or specialized configuration requires the maintenance of more than 100 types of instruments. This entails extensive and costly support services. Use of standard off-the-shelf equipment in modular form may permit rapid assembly of the equipment needed to meet the ever changing demands and at a lower cost (with assurance of sufficient support for maintenance/upgrading). The cost saving potential of a program designed to consolidate and optimize the use of instrument development and support resources with an emphasis on commercially available equipment is being evaluated.

Sub-task 2.5 Sharing equipment and installation costs with the operator

There are increasing instances where the State System of Accounting and Control (SSAC) and the nuclear plant operator have an interest - beyond the mutual interest in the assurance regarding the non-diversion of nuclear material - in Secretariat owned and installed equipment (e.g., for resolving facility accountancy problems or for plant operation reasons). The objective of this sub-task is to identify the specific instances (existing and planned) where the Secretariat and operator/State have agreed on the joint use of safeguards equipment and to do a cost-benefit analysis of a programme where the equipment, installation and maintenance costs are shared. Information on such existing equipment and costs has been collected for all facilities.

Sub-task 2.6 Sharing State's chemical analytical services

The high throughput of existing and future bulk handling facilities requires that the Secretariat increase its capability to carry out highly accurate chemical analysis (DA) at the Safeguards Analytical Laboratories at Seibersdorf (SAL). Data on SAL analyses and sample shipment, which are only a fraction of analysis costs, have been collected. The possible savings in the analytical costs and the sample shipment costs in the event that the operator owned and run analytical services can be authenticated and used, are being evaluated.

Sub-task 2.7 Expanded application of certain current safeguarding schemes

The Agency has experience in the application of safeguards schemes such as the zone approach, dual containment and surveillance (C/S) and NRTA (near-real-time accountancy) to increase the effectiveness of safeguards and to optimize Secretariat resources, and substantial savings in inspection effort have resulted, while fulfilling the requirements of the safeguards criteria. The cost saving potential of a broader application of the zone approach and dual C/S, given that certain technical problems are solved, is being evaluated. The examination of NRTA shows that its implementation would contribute primarily to safeguards effectiveness, but is not expected to lead to significant cost savings.

Sub-task 2.8 Enlargement of the Regional Offices and the establishment of new offices

The safeguards operations in States/Regions far away from Vienna and with large inspection effort requirements imply heavy travel costs. The Agency has established a Regional Office at Tokyo and at Toronto in order to make inspections

in Japan and North America more cost effective. In addition, the regional offices offer better possibilities for performing inspections at short notice. The increasing inspection work in South America, and CIS due to new safeguards agreements and in Far East and USA due to additional facilities/nuclear material under safeguards will result in substantial financial commitments on the part of the Secretariat. A draft cost-benefit analysis of establishing a field office in South America has been prepared and possible expansion of the existing regional offices and/or establishment of a new field office in the USA is being investigated.

In addition to sub-task 2.8, a number of other administrative measures are being reviewed where changes have the potential to reduce the costs of safeguards implementation. Examples include streamlining of procedures for States' radiation protection requirements for inspectors in the field, the possible move of the radiation monitoring facility from Seibersdorf to the VIC, the incorporation of Chemical Weapons Convention provisions such as the right to use Agency means of communication in the field, multiple entry visas and universal designations in the safeguards system and the expanded use of electronic data processing (at Headquarters and in the field) and local area networks.

20. Task 2 is scheduled to be complete by the end of 1994.

Task 3: Environmental monitoring techniques for safeguards application

21. Task 3 evaluates the use of environmental monitoring techniques to enhance the Secretariat's ability to detect undeclared nuclear activities. The further development, assessment and use of environmental monitoring as a strengthening measure was one of SAGSI's principal recommendations. The task which involves a number of field trials, is focused on:

(i) evaluating the practicality, effectiveness and cost of the use of environmental monitoring under a range of conditions;

(ii) establishing and documenting environmental signatures associated with a variety of nuclear activities (with an emphasis on uranium enrichment, reactor and reprocessing operations) at both long and short range;

(iii) establishing and documenting sample collection and analytical procedures and quality control requirements; and

(iv) establishing a "clean room" sample handling and screening capability at Seibersdorf (see paragraph 29), extending the existing network of analytical laboratories to include the capabilities for the analysis of environmental samples and establishing certification requirements for laboratories added to the network.

Substantive progress has been made in all areas.

22. Any production or manufacturing process loses some small fraction of the process materials to the immediate environment. The extent of the losses depends on a wide variety of things including the nature of the process, the material, the control measures to limit losses and the migration of losses beyond the immediate environment. Control measures depend primarily on the value of the material and the risk losses represent to human health and the environment. The processing of nuclear materials is no exception, and even though great care is taken to limit losses, they inevitably occur and migrate beyond the immediate environment where the loss took place. Further, nuclear materials have specific physical properties (e.g., radioactivity) that make it possible to detect and characterize losses that may be present in the environment in only very small quantities. This capability together with the possibility that specific signatures can be unambiguously correlated with specific nuclear processes is why environmental monitoring is seen as having promise with respect to the detection of undeclared activities. The goal of the environmental monitoring field trials is to demonstrate and, where possible, calibrate the utilization of these methods for safeguards application.

23. Since the start of "Programme 93+2" a number of Member States have responded to the Secretariat's request for help with offers to host field trials and provide other related technical assistance. Consultations with the Member States have identified potential sites and detailed planning meetings have been held to schedule the sample planning and collections.

The field trials and their schedules are as follows:

COUNTRY	FACILITY TYPE	SCHEDULE
Sweden	reactors, research center	13-27 Sep 1993
Hungary	reactor	27-29 Oct 1993
USA	enrichment	22-25 Mar 1994
Japan	reprocessing	11-15 Apr 1994
South Africa	enrichment	11-19 Apr 1994
Australia	research center	26-29 Apr 1994
Argentina	enrichment	06-13 May 1994
Indonesia	research center	17-20 May 1994
South Korea	research center	20-24 Jun 1994
UK	reprocessing	26-30 Sep 1994
Germany	enrichment	to be scheduled

24. Additional environmental samples will be collected in connection with the broader field trials being planned under Task 4. Decisions have not yet been made regarding the location and schedule for field trials in the Czech Republic and the Netherlands. The sample analysis capacity of the expanded network of laboratories in combination with reporting requirements of "Programme 93+2" dictated that the sample collections be organized and carried out as quickly as possible. The number of samples collected in each field trial varies considerably depending on the sample medium being examined and the type of facility. The overall sample volume is high. For example, in the South African field trial nearly 600 samples (smears, vegetation, soil and water) were collected at 57 sampling points.

25. The emphasis in these field trials is on short range monitoring in that all planned sample collections are in the vicinity of nuclear facilities. The sample collection plans are being constructed in a manner to provide information on the distances away from facilities that various signatures can still be detected. This will allow some inferences regarding the long range detection problem, however, currently planned field trials do not include the evaluation of long range monitoring through the collection of high volume air samples or the sampling for gaseous effluents.

26. Some results from the field trial in Sweden carried out in mid September 1993 were reported (IAEA-SM-333/69) on during the March 1994 Safeguards Symposium in Vienna. Water, sediment and biota samples were collected in coastal waters in the vicinity of five nuclear facilities. A total of 30 locations were selected for sampling. The sampling locations were chosen to extend from the outfall of each facility to 20-30 kilometers in each direction along the coast. Results from the trial show that nuclear operations in coastal areas can be detected in water and sediment samples up to 20 kilometers from the facility depending on local transport and mixing conditions. Nuclear reactor operations can be detected by the presence of activation products. A minute quantity of plutonium ($\sim 10^{-15}$ grams/liter) isolated from a high volume water sample taken near a research facility showed high burn-up isotopics consistent with spent fuel characterization studies being conducted there. Sediment samples, taken in the same area, show the presence of lower burn-up Pu which represent an integrated history of the activities at this facility. Sediments from other locations showed only fallout plutonium and were clearly distinct from those collected in the vicinity of the facility. Preliminary results from the Hungarian field trial show the presence of Cs-isotope signature in sediments taken at and downstream (40 kilometers) of the reactor site. No such signature was observed upstream from the site.

27. Technical assistance being provided by Member States in support of the evaluation of the applicability of environmental monitoring to safeguards includes the analysis of environmental samples, the use of advanced analytical methods and sample collection technologies, training in sample collection techniques and detailed literature reviews.

28. The United States has nominated five laboratories for inclusion in the expanded network of laboratories to assist the Secretariat in the measurement of environmental samples. Specialized laboratories in other Member States (e.g., France, Russian Federation, UK, and in the European Union) have also been used for the analysis of environmental samples. A sample distribution and reporting protocol that protects the identity of the samples is in place. Member States hosting environmental monitoring field trials under Task 3 have been invited to participate in the analysis of parallel samples. Laboratories in these Member States will be considered for inclusion in the Secretariat's expanded network. An Agency procedure has been developed for auditing the quality assurance programmes of candidate laboratories before accepting their participation in the expanded network.

29. The clean laboratory for safeguards is being handled as a separate Agency project by a Management Overview Committee and a Task Force with established terms of reference. The Agency has solicited and received a quotation for the planning and design of the clean laboratory from the Austrian Research Centre in Seibersdorf. A cost-free expert from a

Member State is assisting in the design and installation of the clean laboratory and in the transfer of sample handling and measurement techniques.

30. The results from the currently scheduled field trials will provide a basis for at least an initial evaluation of the applicability of environmental monitoring to safeguards. The field trials have been scheduled such that most of the evaluation, together with the identification of any open questions, will be complete by the end of 1994. Cost information necessary to support a cost-benefit analysis will also be available. The clean laboratory is expected to be in operation before the end of 1995.

Task 4: Improving the Effectiveness and Efficiency of the Safeguards System through Strengthening Measures and Increased Co-operation with State Systems for Accounting and Control (SSAC)

31. Task 4 has three objectives:

(i) to assess measures other than environmental monitoring to strengthen safeguards by providing an increased assurance of the absence of undeclared nuclear activities in a State;

(ii) to assess how, and under what conditions, increased co-operation with SSACs could be achieved and what savings could result; and

(iii) to assess the possibilities for cost savings in traditional safeguards activities resulting from the strengthening of the safeguards system.

Progress is reported below for each of the three objectives.

Strengthening measures

32. The strengthening measures being assessed in Task 4 are based primarily on increased transparency which involves two complementary features - increased physical access (openness) and increased access to information (broader declaration). Current requirements regarding a State's declaration to the Secretariat are limited to nuclear material (from the starting point of safeguards), associated processes (to the extent the process related information is needed to safeguard the nuclear material), and nuclear facilities and design information (for facilities containing or expected to contain declared nuclear material) within a State's territory or under its control. Board of Governors decisions regarding the early provision of design information and the voluntary reporting scheme have strengthened the

declaration process. The broader declaration being considered in this task, in combination with certain verification activities, is intended to make a State's nuclear fuel cycle and associated activities as "transparent" as possible. Current thinking regarding the contents of this broader or expanded declaration is that it should include, in addition to all nuclear material, a description and the location of all nuclear related processes, production, research and development and training. A model expanded declaration was developed as a programme working paper and used by the Secretariat in preparatory consultations with Member States hosting field trials. It has been further developed following these consultations, and a detailed questionnaire is being developed to assist States in preparing the declaration.

33. Inspector access has been a key issue since the beginning of safeguards. Access for routine inspections, under a comprehensive safeguards agreement, is limited to specific points (called "strategic points") deemed necessary for the Secretariat to meet its safeguards obligations. Wider access will be tested in the course of the field trials, defined in terms of:

(i) access at any time and without advance notice, and

(ii) "managed" access for the purpose of protecting sensitive information.

This will include access based on specific information or the need to implement a technical measure (e.g., environmental monitoring). The level of access may vary from one field trial to the next. However, a number of access related elements have been identified which provide the Secretariat with a consistent position in the preparatory consultations with Member States. The access requirements do not involve, literally, "any time, any place", without notice, but they do involve very broad access both within and outside facilities containing nuclear material subject to safeguards and other locations identified in the expanded declaration - and at short or no notice. "No notice" is taken to mean no advance notification regarding the timing, activities or location of an inspection. The access arrangements are intended to permit the Agency to be able to gain the necessary access and carry out the necessary activities while recognizing the State's right to protect non-relevant sensitive information.

34. Access is absolutely key. Even without a high quality expanded declaration, wider access would still represent an improvement over the current system with respect to increased assurance regarding the absence of undeclared activities. "Transparency" is an acquired state achieved through a high level of cooperation between the Member State and the Secretariat involving access - access to information and physical access. The field trials in Australia, Canada, Finland and Sweden are being defined and carried out in this spirit. Field trials in

three of the four States are under way. The role of the SSAC in facilitating the strengthening measures and the costs of implementing them are being assessed as part of the programme.

Increased co-operation with SSACs

35. Co-operation between a State System of Accountancy for and Control of nuclear material (SSAC) and the Secretariat is a necessary condition for achieving effectiveness of safeguards implementation. In most cases the SSAC's role in such co-operation has involved the provision of information required under the safeguards agreement with regard to inventories of nuclear material and their changes, the securing of access to facilities and to nuclear material and the establishment of an accountancy system at facility and State levels. The approach under Task 4 is to evaluate the possible degree of increased co-operation, commensurate with SSACs resources and capabilities and with the Secretariat's need to maintain effectiveness and draw its own independent conclusions. The experience gained in developing the New Partnership Approach with Euratom has been used in developing the approach under Task 4. Some technical elements from the New Partnership Approach are to be tested in the field trials in Sweden and Finland.

36. The first step was to devise a questionnaire, to be completed by SSACs, to establish the technical and manpower resources, operational capability, legal powers, information holdings and administrative structure of the SSAC. The questionnaire has been completed and sent out to a few SSACs on a trial basis and some revisions made on the basis of comments received.

37. The next step was to devise a model pattern of increased co-operation by listing all of the candidate activities, largely, but not entirely, related to inspections, which a SSAC could perform, either by itself or jointly with the Agency, in order to increase the efficiency of Agency verification activities, and hence reduce the Agency's costs, or to reduce the extent of Agency activities. The critical requirement against which all of the candidate SSAC activities are tested is that safeguards effectiveness and the Agency's ability to draw independent conclusions are maintained. A subdivision into three levels of cooperation, as identified by SAGSI, is being used. These levels include forms of cooperation for which no decision has been taken.

enabling activities

- greater involvement of the SSAC as foreseen within the existing terms of safeguards agreements, in pre-inspection arrangements and other preparatory activities, such as

the provision of material declarations in an automated form and standardized format to increase the efficiency of Agency inspections;

joint or shared activities

- shared activities and equipment that could incorporate such things as

  (i) joint research and/or development projects and training programmes,

  (ii) shared laboratory and other measurement equipment,

  (iii) commonly developed and implemented safeguards approaches, sampling plans, calibration and measurement procedures,

  (iv) expanded use of containment and surveillance measures,

  (v) common evaluation of the performance of measurement systems (using data identified by the Secretariat), and

  (vi) joint efforts to identify and solve problems; and

SSAC inspection activities

- the taking into account by the Secretariat, under specified conditions, of results of SSAC inspection activities with the intent of reducing the extent of Secretariat inspections while maintaining effectiveness and the need for the Secretariat to reach its own independent conclusions.

Co-operation arrangements, and the conditions needed to ensure the Agency's effectiveness and independence, are being tested in field trials mentioned above.

38. Based on the revised questionnaire, the structure, capabilities and resources of the SSACs for all non-nuclear weapon States having a comprehensive safeguards agreement and a significant nuclear fuel cycle will be evaluated. Each SSAC will be fitted into the model described above, according to its capabilities, and an estimate made of the cost savings that would arise if the increased cooperation were implemented. Finally, the issue of regional systems (RSACs) is being addressed. The features which might be characteristic of a regional system, along with some initial criteria and possible levels of additional co-operation, are being examined.

Cost-savings in traditional safeguards activities

39. An increased assurance in the absence of undeclared activities, advances in technology and new approaches could lead to the possibility of reducing the present costs of safeguards aimed at detecting the diversion of declared nuclear material. Task 4 will assess the effectiveness of the strengthening measures in increasing the assurance of the absence of undeclared activities. In the context of this increased assurance, elements of the present safeguards system, e.g., timeliness inspection activities for irradiated fuel, will be assessed to see if they can be done differently (possibly with the aid, also, of advanced technology), or less often, or not at all. The cost savings and impact on effectiveness of such approaches can then be assessed.

40. Wherever possible, approaches will be designed to be equally applicable in all States with comprehensive safeguards agreements, i.e., to generic facility types or broad categories of nuclear material, but it should be noted that the effort required to produce the same level of assurance of the absence of the undeclared nuclear activities, particular with respect to using environmental monitoring techniques, may vary among States depending, for example, on the extent of their nuclear activities. It is planned to test approaches at light water reactors, on-load reactors, fuel fabrication plants, irradiated fuel storage facilities and research reactors in field trials in the States mentioned above.

41. By the end of 1994, all of the elements described above will have been tested under field trial conditions. This should provide sufficient data to give an initial indication of the costs and effectiveness of strengthening measures and of the cost savings, and any impact on effectiveness, achievable through increased co-operation with SSAC or through new approaches. It is likely that further trials continuing well into 1995 will be required to refine the approaches tested.

Task 5: Improved analysis of information on States' nuclear activities

42. Task 5 focuses on the analysis of information available to the Agency about a State's nuclear activities. The objective of the task is to ensure the development and establishment of a coherent and comprehensive approach to the acquisition, management and analysis of information from open sources, safeguards inspection data (including results from environmental monitoring), the reporting scheme on imports and exports of nuclear material and exports of specified equipment and non-nuclear material, design information and the expanded declarations referred to in Task 4. A highly disciplined and phased approach is being taken to ensure that the resulting information system will use Secretariat resources

effectively to identify at an early stage any instance in which the available information about a State's nuclear activities appears to be inconsistent with its declaration to the Secretariat.

43. Work underway in this task is focused on three areas:

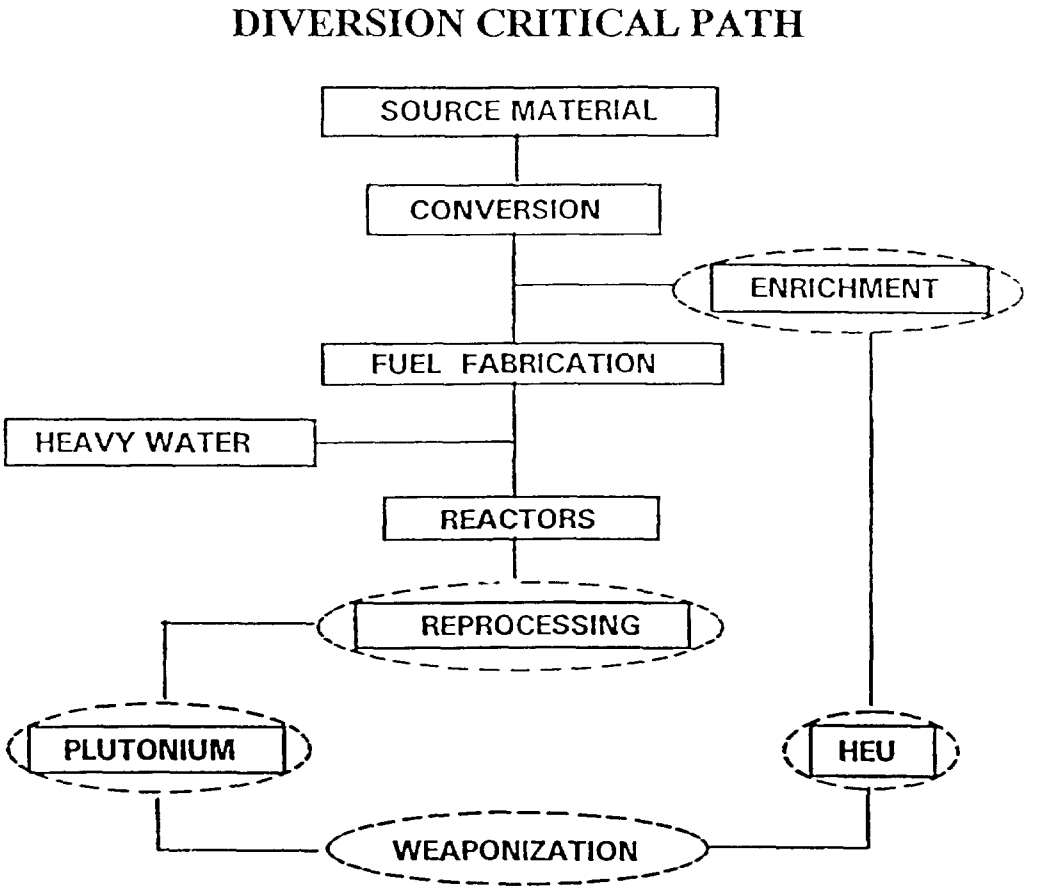
(i) development of a diversion critical path structure,

(ii) the identification and evaluation of potential information sources, and

(iii) the identification and development of computer hardware and software for information management and analysis.

Diversion critical path

44. With expert assistance from Member States, a diversion critical path is being developed as a means to structure both the information and analysis requirements. A highly simplified representation of the diversion critical path is depicted below:



The objective is to define all known pathways for the production of weapons usable material and subsequent weaponization. For example, the conversion block would include all known processes for the conversion of ore concentrates to the chemical forms required for feed to the various enrichment processes, for the fabrication of reactor fuels and the production of metal and all intermediate conversion steps. Each process is identified as a node in the pathway and any combination of nodes that could result in weapons usable material is a viable part of a critical path. Each node, in addition to the process description, is characterized by any special equipment, infrastructure and non-nuclear material requirements and the potential environmental signatures (e.g., from the detailed literature reviews carried out under Task 3). The weaponization block will be largely comprised of equipment and material signatures. The process identification and descriptors for this block will be limited to such things as the production of tritium, enriched lithium and alpha-emitting radionuclides.

45. The diversion critical path will provide a structure for the analysis of environmental monitoring results, import-export data, design information, etc. and give a basis for the evolution of the model expanded declaration (Task 4) in terms of process details and associated equipment. The critical path structure also provides a template for the expanded declaration to guide the inspection process. It will take into account the possibilities for shortening any of the paths to weaponization at each of the fuel-cycle steps through external procurement and assistance. The activities declared by a State as constituting their nuclear related research and development programme will be placed in this same critical path structure. A first such critical path structure has been drafted.

Potential information sources

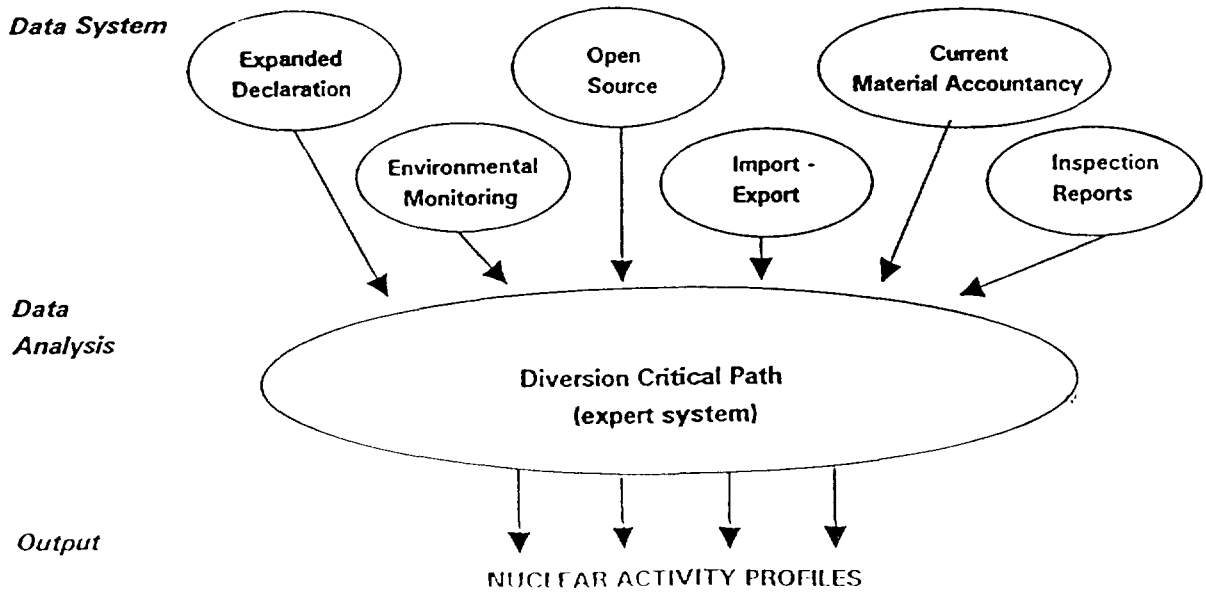
46. This task element has thus far identified, evaluated and attempted to utilize information from Secretariat data bases and from certain open sources. A computerized system for storage and retrieval of safeguards-relevant information derived from open sources (e.g., public media, scientific publications) has been established and periodically updated. The system incorporates safeguards-relevant information from existing Secretariat databases on power (PRIS) and research reactors (RRDB) and nuclear fuel cycle facilities (NFCIS). It also contains a broad spectrum of information on State's nuclear regulations, energy requirements, production and resources, nuclear and nuclear-related programmes, States' international cooperation, companies, firms and organizations working in nuclear field. The system also includes openly published information on exports and imports of nuclear material, technologies, facilities, equipment, including dual use items, that complement the corresponding information provided to the Agency by the State officially (e.g., the reporting scheme and the expanded declaration). The transfer of information to the relevant users in the Department of Safeguards is already being improved. The analysis of collected

information is being used for further assessment of the expanded declarations provided by the States participating in field trials of measures to strengthen the safeguards system.

47. A number of other open information sources have been identified and are being evaluated. Examples include the International Nuclear Information Systems (INIS) - this is a Secretariat data base containing approximately 1.5 million documents covering a broad spectrum of nuclear related subjects, and the information published as part of the Emerging Nuclear Suppliers Project (ENSP). Assessment of the potential contribution of the various types and sources of information is part of Task 5. Information from exporting States on actions on export license applications (e.g., denials) for dual-use commodities has been identified as a potentially valuable addition to the information provided under the reporting scheme.

Identification and development of computer hardware/software capabilities

48. The work in this area has been to identify commercially available software necessary to meet the information management and analysis needs being identified in Tasks 3, 4 and other parts of Task 5. Examples include a geo-referenced data management system for the environmental monitoring data and parts of the expanded declaration and text processing capability for the open source data base. The intent is to maintain a high level of flexibility through a modular structure such as that depicted below.



The work in this task element, as in others in Task 5, is being heavily supported by Member State Support Programmes.

49. The work on the diversion critical path and the procedures for evaluation of open source information are expected to be complete by the end of 1994. Organizational elements and work on computerization, together with estimates of the resources necessary to fully implement the system, will continue well past that time.

Task 6: Enhanced safeguards training

50. Task 6 of the programme is concerned with the identification, development and implementation of training programmes required to ensure that the staff of the Secretariat have the necessary skills to carry out the new measures to strengthen and improve the cost effectiveness of safeguards and, in general, with training to deal with expanded safeguards requirements. Completion of the task will ensure that a training base has been established should decisions be made in the future to proceed with routine implementation of some or all of the measures being tested.

51. Training, either as elements added to existing training courses or as new training courses, dealing with design information review, increased co-operation with SSACs, and environmental monitoring has been incorporated in the Secretariat's overall training programme. Training on measures to strengthen safeguards and on the analysis of information on State's nuclear activities is being planned.

52. Training on design information review, with an emphasis on reprocessing and enrichment facilities, for operating, shut down and permanently closed facilities has been prepared and incorporated in training courses ("Safeguards at Reprocessing Facilities" and "Placement of New Facilities under IAEA Safeguards"). Special exercises and workshops on design information review are being held at Member States' facilities. Several Member States (Belgium, Germany, the USA) have been requested to identify some permanently closed down facilities to be available for the IAEA training exercise on design information review activities. Positive response was received from Belgium, and a technical visit was made in June 1994.

53. In addition to traditional IAEA training courses for State systems organized at different levels, a new training course, "IAEA safeguards for SSAC personnel", is being developed which will emphasize different aspects of the IAEA activities in the field of international safeguards directly related to co-operation with State Systems. The new course will be given for the first time in November 1994 at Headquarters, Vienna. The part of the completed questionnaires on SSACs, prepared within Task 4, that deals with training activities or training needs of State systems is being analyzed to identify other opportunities for co-operative or joint training programmes. As an example of increased co-operation

between EURATOM and the IAEA, a joint training programme based on the New Partnership Approach is now being developed. The training programme will be implemented by both organizations on an annual basis.

54. The environmental monitoring field trial carried out in the vicinity of an enrichment facility in the U.S. during March 1994 was organized as a joint sample collection and training exercise. Eleven Secretariat staff were trained in effective sample collection planning, sample media and sample collection and handling techniques. Emphasis was placed on methods to avoid cross-contamination. Procedures that incorporate the elements of this training exercise have been developed and are being utilized in the on-going field trials. The staffing of the field trials is being organized in a way to expand the base of trained personnel (i.e., on-the-job training). The Secretariat, with the help of two Member State Support Programmes, is developing a more formal and extensive training course to support environmental monitoring.

55. Other training being planned in support of "Programme 93+2" must necessarily await developments elsewhere in the Programme. A training exercise that generally supports the strengthening measures of Task 4 through a broadening of inspector observational skills is being developed through a Member State Support Programme. As part of this work, a number of Agency staff (mostly inspectors) were interviewed with a view toward identifying skills that might be useful in detecting undeclared nuclear activities. Other, more specific training needs will be identified in the course of the Task 4 field trials. A similar situation exists with respect to the information analysis task. Training on a multi-media geo-referenced information storage and retrieval system is underway, and training on other commercially available software has been requested. The training necessary to implement the systematic analysis of information on State's nuclear activities has yet to be identified.

56. In addition to the training described above, the work of Task 4 and 5 will be far enough along by the end of 1994 that the training elements necessary to implement the proposed measures can be identified. The costs associated with training support for the proposed measures will be assessed.

Task 7: Proposal for strengthening and improving the efficiency of the safeguards system

57. The integration of the results of Tasks 1 to 6 into proposals for more effective and efficient safeguards will be the final part of the programme and will be dealt with in Task 7. The proposals will be assessed for effectiveness, cost and the possible trade-offs among the strengthening measures and certain elements of the current system. The relative merits of

the proposals will be fully explored and presented. Task 7 will also incorporate a description of any legal implications of the proposals. Furthermore, new administrative and legal measures will be addressed aimed at facilitating safeguards implementation regarding such issues as designation of inspectors and visa requirements. From this analysis the Secretariat will be in a position to make a detailed proposal to the Board on a strengthened and more cost-effective system which will cover both the safeguarding of declared material and facilities and the detection of undeclared activities.

58. An element of each of the tasks is the assessment of the legal issues associated with the measures under consideration. This analysis

(i) addresses the scope of the IAEA's existing authority within the terms of current safeguards agreements to carry out the measures considered by the various task groups,

(ii) identifies the extent to which additional authority is necessary to permit the IAEA to implement such measures, and

(iii) describes, where necessary, legal arrangements or instruments for securing the Agency's right to do so.

59. It is possible even at this stage to identify a number of basic issues related to the Agency's right of access to various categories of locations, the purposes or activities for which such access may be requested and the role of the Board of Governors and of individual Member States party to safeguards agreements in effectuating the various proposals. Apart from ascertaining the Agency's right to carry out activities as they are developed in the course of "Programme 93+2", and proposing mechanisms for securing, where necessary, additional legal authority, it is anticipated that other corollary legal issues might arise, for example, in the context of contractual matters, administration (e.g., travel arrangements, regional offices), health and safety, and liability. These issues will also be addressed.