

# AD-A201 841

IEAL-R/86-55

**Energy and  
Environment  
Group**

A SAFEGUARDS PLAN FOR THE 80'S

VOLUME I  
EXECUTIVE SUMMARY

PREPARED FOR:

U. S. ARMS CONTROL AND DISARMAMENT AGENCY  
WASHINGTON, D. C. 20540

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FEBRUARY 24, 1987

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**DISTRIBUTION STATEMENT A**  
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88 11 10 005

<b>REPORT DOCUMENTATION PAGE</b>	<b>1. REPORT NO.</b> IEAL-R/86-55I	<b>2.</b>	<b>3. Recipient's Accession No.</b>
<b>4. Title and Subtitle</b> A Safeguards Plan for the 80's Volume I Executive Summary		<b>5. Report Date</b> February 24, 1987	
<b>7. Author(s)</b>		<b>6.</b>	
<b>9. Performing Organization Name and Address</b> International Energy Associates Limited 3211 Jermantown Road Fairfax, Virginia 22030		<b>8. Performing Organization Rept. No.</b>	
<b>12. Sponsoring Organization Name and Address</b> US Arms Control and Disarmament Agency 320 21st Street, NW Washington, DC 20451		<b>10. Project/Task/Work Unit No.</b>	
<b>15. Supplementary Notes</b>		<b>11. Contract(C) or Grant(G) No.</b> (C) AC4NC104 (G)	
<b>16. Abstract (Limit: 200 words)</b> The report identifies and analyzes concepts for increasing, in an evolutionary rather than revolutionary manner, the effectiveness and efficiency of the application of safeguards by the International Atomic Energy Agency (IAEA) and for strengthening the IAEA as an institution. A quite broad and extensive set of analyses and recommendations on possible means of improvement is included. In general, these are relevant for consideration not only for the remainder of the 80's but also well into the 90's. <i>Key words</i>		<b>13. Type of Report &amp; Period Covered</b> Final	
<b>17. Document Analysis a. Descriptors</b> Inspection, arms control, Nuclear materials management. (SDC)		<b>14.</b>	
<b>18. Availability Statement:</b> Release unlimited		<b>19. Security Class (This Report)</b> UNCLASSIFIED	<b>21. No. of Pages</b> 73
		<b>20. Security Class (This Page)</b> UNCLASSIFIED	<b>22. Price</b>

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TABLE OF CONTENTS

EXECUTIVE SUMMARY AND A SAFEGUARDS PLAN FOR THE 80'S

1.0	EFFECTIVENESS AND EFFICIENCY	1
1.1	Introduction	1
1.2	General Observations	3
1.3	Safeguards Principles and the Nature of Safeguards	5
1.3.1	Proliferation Threats and Scenarios	9
1.3.2	Safeguards Assumptions	9
1.3.3	Safeguards Objectives	10
1.3.4	Safeguards Goals	11
1.3.5	The Materials Accountancy/Containment and Surveillance Balance	14
1.3.6	Safeguards Rights	18
1.3.6.1	General	18
1.3.6.2	Undeclared Material	19
1.3.6.3	Undeclared Activities	20
1.3.6.4	Verification	20
1.3.6.5	The Starting Point of Safeguards	21
1.3.6.6	The Status of Facilities and Strategic Points Under INFCIRC 153	22
1.3.6.7	Use Verification	24
1.3.6.8	Subsidiary Arrangements	25
1.3.6.9	Special and Ad Hoc Inspections	26
1.3.6.10	The Relationship of INFCIRC 153 to INFCIRC 66	28
1.4	Methodology	29
1.4.1	Materials Accountancy and Containment and Surveillance	29
1.4.2	Continuous and Intermittent Inspections	32
1.4.3	Random and Unannounced Inspections	34
1.4.4	Fuel Cycle Oriented Safeguards	36
1.4.5	Material Form: Direct and Indirect-Use Material	38
1.4.6	International Interdependence	40
1.4.7	Fuel Assembly Identification Devices (FAIDS)	41
1.4.8	LEU Fuel Fabrication	42
1.4.9	Light Water Reactors	43
1.4.10	MOX Fuel Fabrication Facilities	45



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TABLE OF CONTENTS (CONT'D)

1.5	Flexibility and Trade-Offs	46
1.5.1	Options	47
1.5.2	Trade-Offs	47
1.5.3	Subsidiary Arrangements and Special Inspections	47
1.6	Cooperations	50
1.7	Safeguards Effectiveness and Findings	50
1.7.1	Anomalies	52
1.7.2	Special Channels	52
1.8	Staffing and Administration	52
1.9	Political Considerations	54
1.9.1	Differentiation	54
1.9.2	Nonsafeguards Information	57
1.9.3	Designation of Inspectors	58
1.10	U. S. Actions	58
1.10.1	The U. S. Voluntary Safeguards Offer	58
1.10.2	U. S. Staffing	59
2.0	DURABILITY	61
3.0	SAFEGUARDS RESOURCES	67

EXECUTIVE SUMMARY  
AND  
A SAFEGUARDS PLAN FOR THE 80'S

1.0 EFFECTIVENESS AND EFFICIENCY

1.1 INTRODUCTION

In this section of the report, conclusions and recommendations drawn from the results of the study reported in the sections that follow are restated and collated in the form of a five year Action Plan that might be followed to further U.S. safeguards objectives. This section, accordingly, also serves as the Executive Summary of the Report. As in the case of the analytical sections of the study, principal emphasis is placed on the results of Tasks I and II, Improvements to Safeguards Effectiveness and Efficiency.

It should be stressed that this Plan is not intended as an overall program for U.S. activities in support of international safeguards. These activities are of an ongoing nature and are formulated through the customary procedures for the development of U.S. government programs and budgets. Rather, this Plan seeks to identify substantive policy points which, if adopted, could affect the manner in which IAEA safeguards are implemented or U.S. policy in respect to these safeguards.

Since these recommendations relate in the most part to IAEA safeguards policies and procedures, they cannot, of course, be implemented unilaterally by the U.S. but can only be advocated and promoted by the U.S. through the customary means available to it. These mechanisms are well understood and the study did not address the specific means by which acceptance of those recommendations that are deemed desirable might best be accomplished.

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No claim is made that the suggestions offered in this report are novel, nor was an effort at novelty a guiding principle of the review. On the contrary, given the intensive consideration given over many years by safeguards experts in both the IAEA and its member states as to how safeguards might be improved, it is to be expected that most if not all of the concepts recommended in this report will have been previously identified and evaluated. It is also recognized that many of the recommendations of this report depend on judgements that are controversial and on which opinions can legitimately differ, while the adoption of others may be impractical or undesirable for reasons that are not fully accessible to those outside the day-to-day conduct of safeguards. Nevertheless, the authors believe that the recommendations taken as a whole can make a useful contribution to the further improvement of the already impressive system of international safeguards.

The Plan follows the structure of the analytical portion of the study. As in the report, it was found to be impractical to distinguish explicitly between possible means for improving the effectiveness (Task I) and the efficiency (Task II) of safeguards and these tasks have, accordingly, been consolidated in this section of the report (Task V) as well. It should also be noted that the Plan includes a large number of individual items, many of them relatively detailed in nature. This is indicative not of a conclusion that there are numerous deficiencies in current safeguards practices but, on the contrary, that the system is a fundamentally effective and efficient one that could, as would be anticipated, benefit from "fine-tuning". Moreover, while numerous, many of the individual items, which should be viewed primarily as illustrative rather than exclusive, fall into several general categories and are so grouped in the Plan.

## 1.2 GENERAL OBSERVATIONS

1. The development, in the short span of 25 years since the first IAEA safeguards system (INFCIRC 26) was adopted, of a large, complex, and generally effective and efficient system for the verification of international undertakings of a highly sensitive nature is an impressive achievement. The dominant fact of IAEA safeguards is not what is wrong with them, but how much is right. It is essential, therefore, that suggestions for improvement be seen in this perspective and pursued in a manner that does not undermine confidence in the system as a whole. Even if fundamental problems and dramatic means for overcoming them had been identified-- which is not the case--the politically sensitive nature of safeguards makes it essential that major changes and reversals be avoided and that improvements be of an evolutionary nature. The suggestions put forward in this Plan are, accordingly, in the nature of "fine-tuning," involving principally the balance among existing elements of the system, rather than major departures from current practice. To a large degree, they involve attitudinal changes on the part of the Agency and member states, rather than explicit procedural modifications.
  
2. Safeguards coverage, that is, whether safeguards apply to all of a state's nuclear activities or only to selected ones such as those provided by external suppliers, is a nonproliferation issue of the greatest significance, but it is not a safeguards issue and is not dealt with in this study. Continuing misunderstanding on this point on the part of policy-makers is injurious to safeguards and should be dispelled insofar as possible.

3. Similarly, the sanctions or penalties that are or might be applied to a state that violates safeguards or any peaceful use commitment are not per se a safeguards issue and were not considered in this study. Misunderstanding on the relationship between safeguards and the penalties applicable to their violation is also injurious and should be dispelled.
  
4. Although the terms of reference for the study imposed no explicit boundary conditions on the types of changes that could be considered, it was concluded at an early stage that changes that would require amendment of the Agency Statute, which is an international treaty, were unrealistic and should be ruled out. Similarly, changes that involve the amendment of the Agency's two safeguards documents, INFCIRC/66 and INFCIRC/153, are regarded as unrealistic, particularly since such changes would be effective only to the extent that individual safeguards agreement could be modified to incorporate them. However, current interpretations of these documents as well as of the Agency Statute should not be regarded as a constraint, especially when, as in some instances, these interpretations or perceptions are inconsistent with the original intent of the documents. Moreover, safeguards agreements concluded under the general authority of INFCIRC/66 are not uniform and have evolved considerably. This process of evolution should continue. Consideration should be given to the preparation of versions of IEAL-R/84-19 and IEAL-275, the negotiating histories of INFCIRC/66 and INFCIRC/153, respectively, that are suitable for public release, as well as of other documents or papers that would serve to develop a better understanding of the intent of these documents.

5. While substantial difficulties could be expected in amending subsidiary arrangements, these arrangements were not intended to be immutable and should not be regarded as a bar to otherwise desirable changes in safeguards approaches or procedures. The amendability of subsidiary arrangements should, therefore, be encouraged. One means of doing so which should be employed to the extent possible is to couple any changes which involve increased obligations on states with others which improve efficiency or reduce obligations.
6. Measures which can improve effectiveness and those which can improve efficiency are generally indistinguishable, although the emphasis in their application may differ. Accordingly, Task I (Improved Efficiency) and Task II (Improved Efficiency) of this study were consolidated in this report.

### 1.3 SAFEGUARDS PRINCIPLES AND THE NATURE OF SAFEGUARDS

1. Safeguards principles include basic features of the system which have a fundamental impact on the nature and intensity of the system and the manner in which the resources available to it should be allocated. These features include the identification of the threats to which safeguards must respond; the assumptions made, if any, as to the capabilities and motivation of states to divert material; the objectives of safeguards; and the performance goals to be achieved or approached, whether quantitative or qualitative.
2. Safeguards objectives have frequently been described as comprising verification of compliance with nonproliferation

undertakings; deterrence of violations through the risk of early detection; and detection of violations should any occur. It would be preferable, however, to redesignate the second objective as that of ensuring a risk of detection through the capability to detect diversion, since the extent to which a state may be deterred from any violation is dependent on a number of external factors, in addition to its perception of the risk of detection.

3. The continuing dialogue on the objectives and goals of safeguards, while susceptible to being overdone, is generally beneficial in improving understanding of the safeguards system, and should not be discouraged. Additionally, the relative weight given the three safeguards objectives has implications for the kind and degree of safeguards measures to be employed. For example, increasing the risk of detection through the collection of additional or improved optical surveillance could reduce the need for inventory or flow verification.
4. In this regard, verification of compliance is the objective that most frequently will be achieved since the vast majority of states will be in compliance with their nonproliferation undertakings. The detection of diversion, should any occur, is, however, the ultimate test which safeguards must meet, since the failure to do so in even a single instance would not be excused by the fact that, in many more instances, compliance had been correctly verified.
5. The current emphasis on the verification of compliance as the most important safeguards objective could also lead to

reduced effectiveness and efficiency by encouraging efforts to achieve unnecessarily high detection probabilities. In contrast, emphasis on ensuring a reasonable risk of detection, even though this risk is not required in order to deter most states from diverting, can lead to improved effectiveness and efficiency in accomplishing both verification and detection. The risk of detection should be viewed not principally as a deterrent, but as the most efficient tool to achieve verification or detection.

6. The current emphasis on safeguards as a "service" is useful in underscoring that it is in states' self-interest to demonstrate through safeguards that they are in compliance with their nonproliferation undertakings. However, undue emphasis on this point, and on such related points as the voluntary nature of safeguards, tends to obscure the equally valid and important point that in voluntarily accepting safeguards, states assume binding international obligations, noncompliance with which can properly be taken into account in reaching safeguards and nonproliferation conclusions. Such overemphasis, thus, tends to promote attitudes on the part of both member states and safeguards personnel which make it more difficult for the Agency to employ its safeguards rights in meeting its safeguards responsibilities.
7. Another truism on which undue emphasis should be avoided is that safeguards can only disclose what is taking place at present and are incapable of shedding light on future diversion. While this is correct in a narrow sense, and it is clearly true that safeguards cannot foresee a change in

intentions, diversion may well be preceded by current actions which, while not themselves contrary to a state's nonproliferation undertaking, give legitimate cause for concern. Rather than emphasizing such limitations, inspectors should be encouraged to develop a sense of inquiry which would help ensure early recognition of potential difficulties.

8. The single most important quality of effective safeguards is "independent verification," which means simply that safeguards findings must, in the final analysis, be based on information obtained by or subject to verification by the Agency. Independent verification also requires that safeguards be complete; that is, that there be some risk of detection for all credible diversion pathways.
9. In striving for independent verification, it is important that achieving goals and requirements in form not be allowed to substitute for the achievement of independent verification in substance. In this regard, while quantitative detection goals and materials accountancy are not intrinsically inconsistent with independent verification, undue emphasis on them can divert attention from such verification.
10. While safeguards findings must be based on independent verification, it is appropriate in making final judgments as to compliance with nonproliferation undertakings to take into account not only these findings but all relevant circumstances and information, including the voluntary nature of the acceptance of safeguards, the degree and quality of cooperation between the state and the Agency, and the

state's motivation and opportunity to acquire a nuclear explosive capability. The integration of these considerations with the findings of the safeguards system per se is a function which should be performed only by the most senior officials of the Agency and its Board of Governors.

11. It is not an objective of international safeguards to establish the quantity of nuclear material possessed by states or facilities, but only to determine whether any of it has been diverted. Misunderstanding of this point contributes to the current overemphasis on materials accountancy.

#### 1.3.1 Proliferation Threats and Scenarios

Although the safeguards system is designed to detect the protracted diversion of small quantities of nuclear material, this is not a credible proliferation strategy for large industrialized countries. More broadly, the diversion strategies most likely to be employed by a given country, if any, will be dependent on the country's capabilities, and opportunities, as well as its motivations. Thus, the Agency should be encouraged to make country-specific analyses of likely diversion scenarios, as an aid to the effective use of safeguards resources both within a state and among states.

#### 1.3.2 Safeguards Assumptions

1. No feature of the safeguards system has a more direct and fundamental impact on the nature of the system and the allocation of its resources than the safeguards assumptions;

in particular, the assumption that clandestine enrichment or reprocessing facilities for converting indirect-use material to direct use material cannot be ruled out either in states that have no such facilities or in states having known facilities of this type. This assumption, however, should not be eliminated, although the country-specific diversion scenarios recommended above would allow some moderation of the impact of this and similar assumptions, with consequent benefits to the allocation of safeguards resources.

2. Another important assumption which should be retained and which is not being given full weight in the formulation of safeguards approaches and procedures is that collusion between states to violate nonproliferation undertakings is highly improbable. According appropriate weight to this assumption could yield savings in safeguards by reducing the need for measurements of nuclear materials transferred internationally.

### 1.3.3 Safeguards Objectives

1. As observed in 1.3.1, the relative weight given the three objectives of verification, risk of detection, and detection has implications for the kind and degrees of safeguards measures to be employed. While verification may be the politically most acceptable objective given the commitment of virtually all states to compliance with their nonproliferation undertakings, it can lead to unnecessary safeguards effort, since it requires either complete and precise accounting of all safeguarded material or the capability to detect diversion with a high degree of certainty.

2. In contrast, achieving a significant risk of detection could result in savings in safeguards efforts and reduced intrusiveness and should be given increased emphasis. States in compliance with their nonproliferation undertakings can be expected to recognize that the safeguards system must assume the possibility of diversion in order to demonstrate that it is not taking place.

#### 1.3.4 Safeguards Goals

1. The omission of quantitative goals for the detection of diversion from INFCIRC/66 and INFCIRC/153 was not inadvertent, and the adoption of such goals in the mid 1970's has contributed to the current emphasis on materials accountancy, since it is difficult to assign quantitative values to the effectiveness of containment and surveillance. The fact that the quantitative detection goals cannot be achieved through materials accountancy at large bulk handling facilities and must be replaced by less strict "verification" goals also leads to misunderstanding and has a potential for the misallocation of safeguards resources for both implementation and research and development by stimulating efforts to more closely approach the detection goals. Additionally, uniform quantitative goals make it difficult to take into account in allocating safeguards resources the likelihood that the diversion goals of different states would, in the unlikely event that they would decide to divert, vary greatly depending on their national security circumstances.

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2. Notwithstanding their shortcomings, uniform, quantitative safeguards goals offer benefits, including the avoidance of capricious implementation of safeguards, and there is no consensus either as to the desirability of change or as to any new values that might be adopted. On balance, therefore, it is undesirable to seek any formal change in the current goals.
  
3. While the quantitative detection goals should remain unchanged, priorities should be assigned to the goals for the purpose of allocating safeguards effort among them in circumstances where the goals cannot be fully achieved either because of inadequate resources or technical infeasibility. The detection goal to which a lower priority can most appropriately be assigned is the probability of detection, since the current goal of 90-95% probability is unnecessarily high. A probability of detection of 50% is adequate to ensure the desired perception of a high risk of detection and the priority of achieving the 90-95% goal can appropriately be lowered as long as a 50% probability is achieved in practice.
  
4. Of particular importance, the detection probability goal should call for the introduction of a significant risk of detection for all realistic diversion pathways in preference to achieving the full probability goal for a limited number of pathways. Undue emphasis on the attainment of the quantitative detection probability goal in respect to some diversion pathways runs the risk that even though the "easy" diversion scenarios may become hard, the "hard" scenarios may become easy.

5. Although the timeliness values of the current detection goals are unrealistically short for most materials under most circumstances, no explicit reduction in the priority of their attainment is recommended, in part because attainment of the timeliness goal has already been deemphasized on a de facto basis through the Agency's practice of reporting goal attainment on both a timely and non-timely basis. Additionally, for direct-use material in large bulk-handling facilities, the impact of the timeliness goal on inspection frequency will ordinarily be limited, since frequent or continuous inspection is required in any case for flow verification.

6. Safeguards detection goals can be judged as having been attained only to the extent that verification has been independent; that is, that it rests in the final analysis on facts which do not depend on unsupported assertions of the state. Independence of verification, however, is not a "yes-no" criterion, but one which must be assessed against particular diversion pathways and concealment strategies.

In principle, materials accountancy achieves independent verification without regard to the diversion pathway assumed. In practice, however, the assurance obtained through materials accountancy, like that for containment and surveillance, is heavily dependent on diversion pathways and concealment strategies. Additional emphasis should be placed on achieving independence of verification in respect to a continually increasing number of diversion pathways, even at the expense of a reduced probability of detection for some selected pathways.

1.3.5 The Materials Accountancy/Containment and Surveillance Balance

1. The frequent contention that Paragraph 29 of INFCIRC/153 was intended to limit the use of or reliance on containment and surveillance is a misinterpretation which disregards the negotiating history of INFCIRC/153. Contrary to this contention, Paragraph 29 was adopted not to limit but to open the door to containment and surveillance, of which there is no mention in INFCIRC/66. While Paragraph 29 identifies material accountancy as a safeguards measure of fundamental importance, it does not mandate the relative effort to be placed on the two categories of safeguards measures or the relative weight to be given their results in reaching overall safeguards findings. A reasonable interpretation to be accorded Paragraph 29 is that materials accountancy is required in all situations, while containment and surveillance are optional, but that in situations where containment and surveillance are of value there is no constraint on the relative effort or weight that may be given accountancy and containment and surveillance. The contention that the role of containment and surveillance is limited by safeguards agreements is one of the factors contributing to the strong emphasis placed on the formal accomplishment of materials accountancy, which can detract from a more balanced use of safeguards resources in maximizing the capability to detect diversion by all appropriate means.
  
2. The need for materials accountancy as a safeguards measure cannot be justified on the grounds that knowledge of a state's nuclear materials flows and inventory is of impor

tance to an assessment of its proliferation potential, since the role of safeguards is not to ascertain how much safeguarded nuclear material is present but whether any such material has been diverted.

3. The distinction between containment and surveillance as a measure to ensure the completeness of materials accountancy and as a measure to detect directly diversion or indications thereof is a spurious one, since containment and surveillance can accomplish the first task only to the extent that it also accomplishes the second.
4. Either materials accountancy alone or containment and surveillance alone, if infallible, is capable of providing assurance that no diversion of nuclear material from authorized locations has occurred. It is because neither is infallible that both are needed. However, accountancy alone may not be capable in all situations of determining whether safeguarded nuclear material at authorized locations is being put to unauthorized use. Detection of such "in-situ" diversion in some circumstances; for example, the use of research reactors to perform military experiments, would require surveillance measures capable of establishing the use being made of safeguarded nuclear material.
5. The conclusion that Agency safeguards currently place undue emphasis on materials accountancy at the expense of making the most effective use of containment and surveillance and with some prejudice to independent verification is admittedly a value judgment of the authors of this study with which a number of highly qualified safeguards professionals

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are in disagreement. As a value judgment, it cannot be quantified or demonstrated on an entirely analytical basis, and is based instead on a number of observations and considerations, derived in large measure from discussions with a number of safeguards personnel as well as those of states and facilities where safeguards are conducted.

These observations and considerations include the frequent characterization of the Agency safeguards system by senior Agency officials as one of accountancy; the demonstrated failure of accountancy in more than one important U.S. bulk-handling facility to conclusively establish non-diversion; and the fact that containment and surveillance, since their effectiveness cannot be quantified, tend to be given little weight in formal judgments of the effectiveness of detection goal attainment, despite the perception of inspected parties that, where applicable, they are the most effective element of the system. Considerable weight was also given to the observations of senior Agency safeguards officials that feel strongly constrained in implementing safeguards by Paragraph 90 of INFCIRC/153, which calls for periodically informing states of the results of materials balances, despite the fact that this provision was never intended as a statement of principle as to how safeguards should be implemented.

To some extent, as described more fully in the body of this report, the term materials accountancy is used here to refer to a complex of related features of the Agency safeguards system, including the rigidity and quantitative emphasis of the Agency's inspection goal attainment criteria and the current emphasis on verification rather than detection,

which, taken together, tend, in the author's judgment, to focus the attention of safeguards personnel, including inspectors, on the making of measurements and materials balances, in a manner and degree that could detract from independent verification and the observation of qualitative indications of unauthorized use or activities that, in the final analysis, might be the most important contribution of safeguards to providing warning of potential proliferation.

6. It goes without saying that the appropriate balance between materials accountancy and containment and surveillance will vary among facility types and even on a facility-to-facility basis among those of the same type or function. Light water reactors provide one example of a facility where the safeguards approach is formally directed toward establishing a materials balance, but where, in reality, the principal means for establishing non-diversion with respect to virtually every diversion pathway is provided by optical surveillance. It is a conclusion of this study, detailed later, that the emphasis on materials accountancy tends to distract attention from the possibility of making the LWR safeguards approach both more effective and more efficient through improvements in surveillance. Another key example where the accountancy emphasis has been effectively subdued by a safeguards approach which emphasizes not whether an acceptably low value of material unaccounted-for can be established, but whether an unauthorized activity is taking place is the approach for centrifuge enrichment plants, which emphasizes measures which could detect HEU production. The role of containment and surveillance in safeguarding large bulkhandling facilities such as MOX fabrication or

spent fuel reprocessing plants is not entirely clear, but it is a conclusion of this study that an appropriate role and balance can be achieved only if the preoccupation with materials accountancy that currently characterizes the safeguards system is tempered and a more open-minded approach taken, as was done in the case of centrifuge enrichment plants.

### 1.3.6 Safeguards Rights

#### 1.3.6.1 General

1. Although insistence on the Agency's rights as set forth in safeguards agreements cannot resolve all issues that arise in the course of safeguards implementation, establishing the purpose and intent of these rights is of value if only to help ensure that safeguards implementation is not hampered by unwarranted interpretations. While it is a truism that the Agency can do no more than it is allowed to do by the sovereign states in which safeguards are applied, it is equally true that these states have agreed in their respective safeguards agreements to accord the Agency a variety of rights, and that other member states of the Agency are as entitled to the observation of these rights by a safeguarded state as that state is entitled to ensure that the Agency does not overstep them.
  
2. While there is validity in both the view that states tend to place narrow, legalistic interpretation on the Agency's rights and that the Agency sometimes oversteps the bounds of what is reasonable and necessary, the Agency, on balance,

has tended to acquiesce in challenges to its rights to the detriment of effective safeguards. While the Agency should not assert rights whose exercise is not necessary to effective safeguards simply to display its resolve, it should make use of appropriate opportunities to invoke infrequently used rights, such as those of special inspections, when legitimate safeguards circumstances warrant their use.

#### 1.3.6.2 Undeclared Material

1. Safeguards agreements concluded under INFCIRC/153 give the Agency both the right and the obligation to apply its safeguards to all nuclear material in all peaceful nuclear activities in the state, and the negotiating history makes it clear that this right is not limited to "declared" material, a term which is not found in INFCIRC/153. Safeguards agreements concluded under INFCIRC/66 generally give the Agency a comparable right and obligation to apply safeguards to all nuclear material used or produced in facilities listed in the inventories of such agreements, regardless of whether such material is declared or reported.
  
2. The Agency should continue to actively implement its right to apply safeguards to undeclared or unreported material in circumstances where it is particularly relevant, such as the possible insertion of undeclared fertile material in high power research reactors. In the more general case, specific implementing measures may be unnecessary, but inspectors should adopt the attitude that they are expected to be observant of and to report the presence of any undeclared nuclear material. Toward this end, the performance and

results of this observation should be included in the Agency's inspection goal attainment criteria.

#### 1.3.6.3 Undeclared Activities

Although agreements concluded under INFCIRC 153 are also unambiguous in establishing the Agency's right to apply safeguards to nuclear material in "undeclared" activities, the underlying rights of search and access that would be required to give effect to this right are generally absent from such agreements, as are the practical capabilities to implement such a right. However, there is implicit authority under such agreements for the adoption of the concept of "challenge", such as incorporated explicitly in the Treaty of Tlatelolco. While there is no need to seek a consensus on the use of this right in the absence of any practical case, the possibility of doing so if and when such a case arises should be preserved. In this regard, such a "challenge" could be brought to the Board of Governors either by the Secretariat itself or by one or more member states. An analogous possibility of "challenging" particular activities is available under INFCIRC 66 agreements in respect to activities which appear to be covered by such agreements but have not been so declared.

#### 1.3.6.4 Verification

The term "verification" is employed in several different contexts in INFCIRC/153, ranging from verification of compliance with a state's nonproliferation obligation to verification of information on the flow or inventory of

nuclear material reported by a state to the Agency. The position is apparently taken by some states that the term "verification" in the latter context means only that the Agency may establish that at least the amount of nuclear material reported to be present. Analysis of the provisions of INFCIRC/153 as a whole clearly establish, however, that the term "verification" throughout this document has the conventional meaning of "establishing the truth," and that this requires the Agency to satisfy itself not only that all reported material subject to safeguards is present, but also that no unreported material required to be safeguarded is present. The acceptance of this interpretation of "verification" is fundamental to the effective implementation of safeguards agreements and it should be adopted by the Agency in practice and in attitude.

#### 1.3.6.5 The Starting Point of Safeguards

1. The provisions of INFCIRC/153 defining the starting point of safeguards do not materially lessen the effectiveness of safeguards in comparison with other realistic options that might have been adopted. In this regard, it is unavoidable in a full-scope safeguards system that safeguards must begin at some stage on the basis of a state's unverified declaration as to the amounts of material and the activities present in the state. Acceptance of this declaration as the starting point for purposes of routine safeguards implementation does not, however, mean that the state is excused from its safeguards and nonproliferation obligations if its declaration is found to be incorrect, or that the Agency should not be alert to any indication of omission.

2. There is a tendency in the Agency to discount the usefulness of the requirement of Paragraph 34 of INFCIRC/153 for reporting of imports and exports of material which has not yet reached the stage of "nuclear material suitable for fuel fabrication or enrichment", on the grounds that such reporting is not subject to verification. This reporting requirement could provide information of considerable importance in certain circumstances since it provides "programmatic" information of value in assessing a state's nuclear program and in guiding Agency efforts in regard to what activities of potential safeguards importance may be present in the state. The adoption of this reporting requirement in INFCIRC/153 also illustrates that information of a "programmatic" nature, even though not subject to materials balance verification, was expected to be useful to the achievement of safeguards objectives.

#### 1.3.6.6 The Status of Facilities and Strategic Points Under INFCIRC/153

1. Contrary to some contentions, the safeguards status of facilities does not differ substantially under INFCIRC/153 and INFCIRC/66. In both cases, safeguards procedures are directed at detecting the diversion of safeguarded nuclear material. Although safeguards are made specifically applicable to facilities under a number of INFCIRC/66 agreements, this requirement signifies principally that safeguards are to be applied at these facilities regardless of whether the nuclear material delivered to them is otherwise subject to safeguards, a requirements which is unnecessary under INFCIRC/153 agreements, since all peaceful nuclear material in a state is subject to safeguards under these agreements.

The contention that INFCIRC/153 treats facilities in a different and more limited way than does INFCIRC/66 tends unjustifiably to limit the Agency in the exercise of its safeguards rights and should be dispelled. As a specific example, the Agency may visit facilities under INFCIRC/153 agreements to verify design information, a right which is functionally equivalent to the right of design verification inspections under INFCIRC/66 agreements, despite the omission of the word "inspection" in INFCIRC/153.

2. The explicit requirement under INFCIRC/153 agreements that states submit design information "as early as possible before nuclear material is introduced into a new facility" provides the Agency with a potentially valuable means of reaching an early finding of non-compliance when circumstances justify, and this opportunity should not be prejudiced by the contention that the requirement lacks specificity as to the time when design information must be submitted. Given this requirement, unwarranted delay in the submission of design information should be regarded as an important, and conceivably determinative, departure from a state's safeguards obligations.
3. There is no support in INFCIRC/153 agreements for suggestions that the Agency's right to apply safeguards, including its inspection rights, are terminated or suspended when all nuclear material is removed from a facility at which safeguards have been applied. While the intensity of safeguards at such facilities should of course be reduced, the Agency has and should employ as appropriate the right to verify the continued absence of nuclear material and consequent non-operation of such facilities.

4. Unlike the semantic distinctions between the status of facilities under INFCIRC/153 and INFCIRC/66, the provisions of INFCIRC/153 restricting access during routine inspections to "strategic points" is a substantive difference of some importance. The "strategic points" restrictions of INFCIRC/153 were adopted in the context of a carefully framed compromise under which strategic points are defined as those which are necessary and sufficient to allow the Agency to meet its safeguards responsibilities and which allows access beyond strategic points in the course of special inspections. The Agency's practices in regard to the designation of strategic points in subsidiary arrangements is not known in detail due to the confidential nature of these documents, but it should be encouraged to give full effect to the compromise approach referred to above.

#### 1.3.6.7 Use Verification

1. INFCIRC/153 leaves no room for doubt that the objective of safeguards is to detect the diversion of safeguarded nuclear material from authorized activities, not simply from authorized locations. INFCIRC/66 safeguards agreements contain a similar prohibition against use for particular purposes. Consequently, the Agency may determine that a safeguards agreement has been violated or that it is no longer able to verify compliance even if all safeguarded material can be accounted for, if such material is found to be used for nuclear weapons or purposes unknown. While unlikely, such diversion of safeguarded nuclear material from authorized to unauthorized uses, without physical removal of such material

from locations in which it can be accounted for (which can be referred to as in-situ diversion) cannot be excluded, and safeguards measures designed to detect and observe such diversion are authorized and are appropriate in some circumstances.

2. Although special measures designed to detect in situ diversions are ordinarily unnecessary, inspectors should be encouraged to approach their tasks with the attitude that the use being made of safeguarded material is a legitimate matter of safeguards interest and that irregularities are to be reported. Inspectors should also be given orientation as to the type of activities involving safeguarded material that might be inappropriate. The contention that the Agency lacks authority to treat improper use of safeguarded material as an anomaly, which is often supported with the hypothetical example of an inspector lacking authority to report that he has observed plutonium fabricated into hemispheres, is another example of uniformed and incorrect interpretations of safeguards agreements that tend to narrow the Agency's rights unnecessarily and to discourage an appropriate attitude of inquiry on the part of inspectors and other safeguards personnel. The Agency's inspection goal attainment criteria should include any evidence of in situ diversion as an explicit item.

#### 1.3.6.8 Subsidiary Arrangements

1. Subsidiary arrangements serve a number of important purposes, including that of giving states an indication of how the Agency will implement its safeguards rights. However,

such information should be provided in the form of "indications", without narrowing the rights incorporated into safeguards agreements approved by the Board of Governors. The language found in model facility attachments generally follows this approach, but it is not known whether actual facility attachments employ comparable language, in view of their confidentiality.

2. Although subsidiary arrangements are not referred to in INFCIRC/66, they are generally provided for in INFCIRC/66 agreements. Since INFCIRC/66 agreements contain no requirements for either a maximum or actual level of inspection effort, subsidiary arrangements concluded under these agreements should avoid establishing or indicating such limits.

#### 1.3.6.9 Special and Ad Hoc Inspections

1. Special inspections are provided for in both INFCIRC/66 and INFCIRC/153 because the opportunities for routine inspections under these documents are subject to certain limitations. The right of special inspections is especially important under INFCIRC/153 because of the limits placed by this document on routine inspection effort and access, and special inspections are accordingly provided for whenever the Agency is unable to fulfill its safeguards responsibilities on the basis of routine inspections. Thus, the Agency's right to conduct special inspections was an essential element in securing agreement on the concept of limited routine inspections, and this right should not be foreclosed, even on a de facto basis, by disuse or the adoption of the attitude that its use is infeasible.

2. Special inspections need not be confrontational or even adversary in character in any greater degree than is inherent in the inspection process. The basic purpose of special inspections is to allow the Agency to meet a need for more information than can be obtained through routine inspections, a requirement which is not necessarily indicative of a suspicion of diversion. The Agency should, accordingly, review its practices in regard to designating inspections as special and should consider the conduct of special inspections when safeguard circumstances make this appropriate in view of the collated advantage of establishing the availability and reasonableness of its right to conduct special inspections.
3. The provisions of INFCIRC/153 for the conduct of ad hoc inspections are designed to remove any incentive for states to delay inspections by prolonging the negotiation of subsidiary arrangements. The Agency should make appropriate use of ad hoc inspections for this purpose as well as to verify a state's initial inventory and any changes in it pending the conclusion of the relevant facility attachments.
4. By specifying that ad hoc inspections are to identify and verify "changes in the situation" occurring since submission of an initial report, and by providing for access to any locations where an initial report or inspections carried out in connection with it indicate that nuclear material is present, the provisions for ad hoc inspections make it clear that verification is not confined to establishing that all reported material is present in a state but extends to the presence of unreported material as well.

## 1.3.6.10 The Relationship of INFCIRC/153 to INFCIRC/66

1. INFCIRC/153 is a more detailed, complete and specific document than INFCIRC/66, and includes some areas in which the Agency's rights and opportunities are enlarged in relation to those of INFCIRC/66. Nevertheless, INFCIRC/153 contains major restrictions on the Agency's rights not found in INFCIRC/66, which were adopted in recognition of the safeguards and nonproliferation value of the de jure full-scope safeguards accepted by NPT parties. Thus, the safeguards system prescribed by INFCIRC/153 is not applicable as a matter of right to activities safeguarded under INFCIRC/66 agreements. The tendency of the Agency, based on the perception that INFCIRC/153 is a "better" document, to implement safeguards uniformly under both INFCIRC/153 and INFCIRC/66 agreements is, thus, inadvisable, since INFCIRC/66 provides the Agency with important safeguards rights and opportunities that should not be relinquished in the interest of uniformity or of following the "better" system.
  
2. The Agency should adopt as a basic presumption that INFCIRC/66 agreements will be implemented in accordance with their own terms and that any concessions to uniformity must be technically justified and matched, when relevant and necessary, by acceptance by the state involved of relevant features of INFCIRC/153. For example, the inspection effort at reactors safeguarded under INFCIRC/66 agreements should not be reduced to the levels customarily applied under INFCIRC/153, unless the state accepts and cooperates with the containment and surveillance measures which make these reduced levels possible.

## 1.4 METHODOLOGY

Matters such as safeguards assumptions, objectives, goals and rights are important in determining and conditioning how safeguards are implemented. However, safeguards methodology--the measures actually employed to verify compliance or detect diversion--are the principal determinant of safeguards effectiveness and efficiency. In this study, safeguards methodology was examined primarily in terms of several broad categories of measures and the issues they present. However, the methodology employed in safeguarding a few specific types of facilities was also examined.

### 1.4.1 Materials Accountancy and Containment and Surveillance

1. Because materials accountancy and containment and surveillance each have significant but different drawbacks, a rational and effective safeguards system requires both categories of measures.
2. As observed previously, the intent of Paragraph 29 of INFCIRC/153 was not to limit, but to open the door to greater use of and reliance on containment and surveillance. Containment and surveillance help both to ensure the validity and completeness of materials accountancy and to provide information of significance to the direct detection of possible diversion. The view that the role of containment and surveillance is confined to establishing and maintaining the validity of materials accountancy by ensuring that all flows or inventory are measured once and only once, tends to encourage undue emphasis on materials accountancy and to

detract from taking full advantage of containment and surveillance.

3. Anomalies arising out of containment and surveillance should be given full weight and should not be regarded as resolved until additional information provides a satisfactory, independently verifiable explanation for the specific anomaly observed or follow-up materials accountancy is sufficiently complete to rule out diversion.
4. Another misperception that tends to drive the safeguards system toward excessive reliance on materials accountancy is the requirement of Paragraph 90 of INFCIRC/153 to inform states periodically of the results of inspections and the conclusions the Agency has reached, in particular, upon completion of a physical inventory and materials balance. As is apparent from its position in INFCIRC/153, Paragraph 90 was not intended as a fundamental principle that would influence how safeguards are implemented. It was adopted without debate in response to members requests to be informed of the results of inspections, and means no more than it says; that members are to be informed of the results and conclusions of safeguards, however they may have been obtained. Similarly, Paragraph 30 refers only to the "technical conclusion" of safeguards, and is clearly subordinate to Paragraph 28, which defines the objective of safeguards. Thus, Paragraph 30, as well, was not intended to drive the safeguards system.
5. Both materials accountancy and containment and surveillance must be independent if the safeguards conclusions drawn from them are to be valid. While both classes of measures can

provide independent information, containment and surveillance tend inherently to provide independent information; in contrast, materials accountancy, due to its use of operators' or states' data, measurements, and samples, can lead to verification in form without achieving independence in substance. It is especially important, therefore, to emphasize the need for independent verification in relation to materials accountancy measures.

6. The safeguards approach developed by the Hexapartite Safeguards Project Group, which emphasizes random unannounced access to the centrifuge hall to verify that there is no production of highly enriched uranium, is an important and innovative example of the use of surveillance not merely in support of materials accountancy, but for direct observation of a condition that would be indicative of diversion. It should help stimulate consideration of the expanded use of surveillance, and specifically of the monitoring of process variables as a safeguards tool.
7. On balance, it appears that undue emphasis has been placed on materials accountancy and the achievement of materials balances in form, with a consequent underemphasis on containment and surveillance and independent verification in substance. This, in turn, tends to foster attitudes on the part of safeguards personnel that may limit their incentive and readiness to observe and report anomalies that could be indicative of diversion or misuse.
8. The development of optical surveillance technology has concentrated on the development of improved hardware, in the

form of both film camera and TV systems. While this emphasis has been appropriate to date, it is now timely to devote specific effort to the more effective utilization of this technology, including such matters as the most effective number and locations of cameras, the interpretation of results, the training of film reviewers, and similar matters.

#### 1.4.2 Continuous and Intermittent Inspections

1. A distinction has traditionally been drawn between continuous and intermittent inspection, both in terms of their capabilities and their presumed acceptability. The term "inspection mode" in Paragraph 81 of INFCIRC/153 refers to these two types of inspections.
2. Continuity of knowledge, whether achieved through continuous inspection or otherwise, is essential for flow verification at some types of installations, such as large bulk handling facilities, since substantial receipts and transfers of safeguarded materials would normally occur at these facilities between even very frequent intermittent inspections. Unless verified as they occur (for example, each time a spent fuel batch is dissolved in a reprocessing plant dissolver), the opportunity to verify that value is a lost permanently. Since at the present there are no remote, instrumental means for achieving this continuity of knowledge in a number of situations, continuous inspection remains essential for several important types of facilities.
3. In addition to being essential for verification of flow measurements, continuous inspection can make a major

contribution at bulk handling facilities by affording the opportunity for continuous, or frequent and announced surveillance of [sensitive] operations, for example, the transfer of plutonium from the product end of reprocessing plants. Continuous inspection can also increase the effectiveness of optical surveillance and other containment and surveillance devices by providing the opportunity for realtime or near real-time review of their observations and quick follow-up of any anomalies.

4. Despite early opposition to the concept of continuous inspection on grounds of intrusiveness, but in keeping with U.S. beliefs, facility operators are showing increased receptivity and even preference for continuous inspection. Advantage should be taken of this attitude to establish continuous inspection in a number of installations. The Agency's concerns over the cost of continuous inspection, while understandable, should not stand in the way of its implementation under current conditions.
5. A major element in determining the effectiveness of continuous inspection is detailed familiarity of the inspectors not only with the facility as such, but with its operating status. The current means of implementing continuous inspection through frequent, short, overlapping visits is not conducive to attaining and maintaining this state of knowledge. Additionally, frequent rotation of inspectors on short term visits is costly and cost savings might be possible through the long-term assignment of resident inspectors in at least some circumstances. The Agency has established regional offices in two locations, Japan and Canada, to which inspectors are assigned on a long-term basis, but these inspectors have not so far been resident at a

facility where continuous inspection is applied. Serious consideration should accordingly be given to at least a trial resident inspection arrangement.

#### 1.4.3 Random and Unannounced Inspections

1. Although the concept of random and unannounced, or surprise, inspections has a strong appeal to safeguards critics and proponents, such inspections offer only limited advantages in a limited range of circumstances. Even if the problem of assuring the element of surprise could be overcome, which is improbable given the immigration procedures of most states, random, unannounced inspection visits do not offer safeguards benefits in most cases since:
  - o At reactors, continuous optical surveillance provides continuity of knowledge which makes any incremental gain in effectiveness from random unannounced visits small or non-existent, except for detecting possible unreported irradiation in cases, such as research and test reactors, where containment and surveillance are impractical.
  - o At bulk handling facilities where direct use material is present, continuous inspection makes random, unannounced visits irrelevant. Additionally, the nature of the diversion strategies available at bulk handling facilities would make discovery in the course of an inspection visit very unlikely.
2. One special circumstance in which random inspection visits could be useful is in regard to the detection of "borrowing" or "shuffling" diversion strategies; that is, the movement

of material from a facility not scheduled for an inspection to another facility at which an inspection is scheduled to make up a deficiency at the latter. The practice of conducting random, unannounced inspections at like facilities in a state while one of them is undergoing a scheduled physical inventory verification could provide a significant risk of detection in respect to such strategies, and should be undertaken at least to a limited degree.

3. Consideration has been given to the use of random non-performance of announced inspection, particularly at LWRs, as a means of reducing inspection effort without significant loss of effectiveness. This approach, however, would be less efficient and less effective than the alternate concept of allowing reactor operators to change and "mail in" optical surveillance records rather than having this done by inspectors conducting quarterly visits. A similar conclusion can be reached in regard to the value of random, unannounced inspections for reactors.
4. Another special circumstance where unannounced inspection is both effective and efficient is, as observed earlier, at centrifuge enrichment plants, where surprise visits could detect and thereby deter alterations in plant or operations designed to produce HEU. To be effective for this purpose, the lead-time between the time when the operator becomes aware of the pending inspection and actual plant entry must be no longer than the time required to conceal HEU production, if it had been in progress. This condition can apparently be met at centrifuge enrichment plants.

5. In contrast to random unannounced inspection visits, the random application of inspection activities in the course of scheduled inspections has considerable merit. While this approach is undoubtedly used to some extent, it is not clear that it has been adopted as a deliberate policy. The systematic use of a random approach to the conduct of inspection activities in the course of both intermittent and continuous inspections should be considered.

#### 1.4.4 Fuel Cycle Oriented Safeguards

1. In a very real sense, safeguards undertaken pursuant to INFCIRC/153 are inherently "fuel-cycle oriented", in that substantial constraints were placed on Agency safeguards rights in recognition of the value of the de jure full-scope safeguards required by INFCIRC/153. This fact must be taken into account in any consideration of further steps that might be taken to make safeguards more fuel-cycle dependent.
2. INFCIRC/153 makes no reference to "fuel-cycle oriented" safeguards and clearly contemplates a single system of safeguards in which safeguards are conducted and safeguards conclusions drawn on a facility-by-facility basis; indeed, on an MBA-by-MBA basis. The adoption of an approach in which generalized, country-wide conclusions would somehow be drawn on the basis of generalized data and information would represent a major departure for which there is no technical basis or political justification.
3. Nevertheless, INFCIRC/153 contains provisions, notably in Paragraph 81(c), which indicate that specific verification activities at each facility may and should be influenced by the place of that facility in the fuel cycle as a whole.

These provisions, however, represent only a few of some twenty criteria specified in Paragraph 81 for determining the actual inspection regime, and the negotiating history of INFCIRC/153 sheds very little light as to how the fuel-cycle-dependent criteria are to be applied.

4. One step that could result in some savings in safeguards effort, which is contemplated by INFCIRC/153 and which may not be currently practiced as widely as possible, is eliminating any redundancy of flow verification for interfacility transfers. Additionally, eliminating flow measurements entirely for some or all international transfers by relying instead on the safeguards assumption that there is no collusion between states in respect to their safeguards commitments, could result in improved efficiency. While the overall savings in inspection effort resulting from these simplifications would not be dramatic, the impact on specific facilities could be substantial. This approach should be employed to a greater degree than at present.
  
5. Among a number of approaches that have been proposed for achieving greater fuel cycle dependency of safeguards implementation are increased use of randomness and the "zone approach", which involves the grouping of several facilities into a single materials balance area, so as to reduce the need for interfacility flow verification. For reasons explained earlier, randomness of inspection visits appears to have only a limited potential for safeguards simplification in comparison with other techniques likely to be available, and a substantial adverse impact on effectiveness. The zone approach is in some respects an extension of the concept referred to above of eliminating redundancy in interfacility flow verification.

6. In summary, dramatic gains in efficiency cannot be achieved from any acceptable "fuel-cycle oriented" safeguards approach. However, modest gains can be realized from further applications of the criteria of Paragraph 81 of INFCIRC/153 that affect the inspection regime in multi-facility fuel cycles. Several of these criteria can and should be given more weight than at present.

#### 1.4.5 Material Form: Direct and Indirect-Use Material

1. The division of nuclear materials into "direct-use" and "indirect-use" for safeguards purposes is an oversimplified and artificial distinction, since all nuclear material beyond the stage of naturally-occurring ore has been taken some distance along the pathway to nuclear explosive usability and can be taken the remaining distance by nations or subnational groups possessing the necessary capabilities. The rationale for safeguarding indirect-use material, particularly that which is relatively far removed from nuclear explosive usability is threefold:
  - o Knowledge of the input flow of indirect-use material to facilities which produce direct-use material assists in verification of the product flow, although such knowledge is not essential to the effective safeguarding of the direct-use product.
  - o Under INFCIRC/66 agreements, where some facilities and activities may not be safeguarded unless safeguarded material is introduced into them, it is desirable that safeguards apply to as many materials as possible, since such materials might be introduced into otherwise unsafeguarded facilities where direct-use material is

produced. Under INFCIRC/153, where all activities are safeguarded, this reason for safeguarding indirect-use material is inapplicable.

- o Most importantly, under either INFCIRC/66 or INFCIRC/153 agreements, safeguarded indirect-use material may be diverted to undeclared and clandestine facilities for transformation into direct-use material. Thus, the safeguarding of indirect-use material may detect their diversion and may provide indications of the existence of clandestine facilities where such materials are further processed.

This rationale is as valid today as in the past and the safeguarding of indirect-use material should therefore be maintained at an appropriate level.

2. The increasing capabilities of states to build indigenous and potentially clandestine enrichment facilities has increased the importance of safeguarding uranium of less than nuclear explosive enrichment. Additionally, the timeliness goal for unirradiated low enriched uranium (LEU) of one year, which presumes its use only in reactors, does not reflect the relatively short time in which such material could be enriched to the level of nuclear explosive usability. Accordingly, where unsafeguarded enrichment facilities are known or suspected to exist, inspection frequencies at facilities handling unirradiated LEU should be increased and the safeguards procedures employed should take due account of the potential attractiveness of LEU as a feed to unsafeguarded enrichment facilities.

1.4.6 International Interdependence

1. Under the provision of Paragraph 81(d) which makes "international interdependence" a criterion for determining the inspection regime, verification of international transfers can be eliminated provided three conditions are met:

- o Shipper-receiver measurement and agreement on the amounts transferred.
- o Reporting of the shipment by both transferor and transferee.
- o The absence of any reason to suspend the customary assumption that collusion is not present between the shipping and receiving state.

More extensive use of this simplification is appropriate and desirable.

2. Transfers between Euratom states are properly regarded as international transfers insofar as Paragraph 81(d) is concerned (but not Paragraphs 91-96), and were so contemplated by INFCIRC/153, notwithstanding the fact that these states are covered by a single safeguards agreement with the IAEA.

3. The criterion of "international interdependence" goes beyond the case of international transfers and includes "the extent to which the states' nuclear activities are interrelated with those of other states". Under this criterion, significant relationships, in particular, those in which the nuclear facilities in one state are open to nationals of

another state or states, are entitled to consideration in determining the inspection regime. Although there is no indication that the Agency has taken this criterion into account so far, it should be given weight in determining the inspection regime at facilities having a significant level of international staffing adequate to make possible diversion scenarios transparent to the foreign nationals present. Any adjustment in the inspection arrangements on the basis of this criterion should be limited to the measures that are relevant to diversion scenarios whose use would become known to the foreign personnel.

#### 1.4.7 Fuel Assembly Identification Devices (FAIDS)

1. FAIDS may offer substantial potential benefits in terms of improved safeguards effectiveness and efficiency for a major segment of the LWR fuel cycle, provided a variety of technical, economic, and operational problems can be overcome. However, these benefits would be substantially reduced by the lengthy, and in some cases, indefinite, transition period occasioned by the retention at reactors of large inventories of spent fuel on which such devices have not been installed, by the introduction of spent fuel disassembly as a widespread practice. For these reasons, FAIDS are unlikely to be adopted for general LWR use in the foreseeable future.
  
2. An attractive special application for FAIDS is MOX fuel assemblies, especially the more easily disassembled BWR type. The benefits of FAIDS in this application are primarily related to the high strategic value of unirradiated MOX fuel and would not be significantly reduced by the presence at the reactor of large inventories of LEU spent fuel

not equipped with FAIDs. Accordingly, this application merits at least a substantial field trial and demonstration.

#### 1.4.8 LEU Fuel Fabrication

1. Substantial savings in safeguards effort without material impact on the already limited effectiveness are possible through the elimination of monthly interim inspections at LEU fabrication plants manufacturing fuel assemblies for LWR's, while retaining the physical inventory verification on the schedule dictated by the facility physical inventory taking. This regime is appropriate because:
  - o Given the high frequency of feed receipts and product shipments at LEU fabrication plants, monthly inspections as in present practice are in any case insufficient for flow verification at the fabrication facility. Additionally, the one-year timeliness goal for LEU does not require the current monthly inspections.
  - o The feed for many LEU fabrication plants is received through international transfer and, thus, subject to verification through shipper-receiver measurements. Where feed is received from an enrichment facility in the same state, it can be more efficiently and effectively verified at the enrichment plant where continuous or high frequency inspection will in any case be required.
  - o Product transfers can be verified more effectively and efficiently at the reactors to which fuel is delivered than at the fabrication facility, since inspection at

such reactors is in any event required at the time of refuelling.

- o while simultaneous physical inventories are required to protect against "borrowing" diversion strategies, this requirement is no more applicable to the suggested regime than to that now in use.
2. Although the approach suggested above is similar in its results of the "zone-approach", verification of interfacility flows is not dispensed with under this approach, but simply shifted away from the fabrication plant, where it is not now being adequately accomplished.
  3. The modified LEU fabrication plant inspection regime proposed herein merits an extended field trial at an early date.

#### 1.4.9 Light Water Reactors

1. Although the current approach to safeguarding LWRs is relatively effective and efficient, meaningful improvement in both effectiveness and efficiency appear possible through a modified inspection regime with the following elements:
  - o Elimination or substantial reduction in the current quarterly interim inspection through use of the "mail-in" concept of replacing the surveillance camera recording medium and returning it to the Agency.
  - o A strengthened optical surveillance regime, including coverage of all penetrations through which spent fuel

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can be removed from the spent fuel or reactor halls, and improved coverage of the reactor hall during outages to ensure detection of any change in core configuration after core physical inventory verification, and continuous surveillance coverage of the reactor hall to ensure detection of unauthorized reactor head removal.

- o As a corollary, the reactor head seal would be eliminated or deemphasized and inspection visits to emplace or remove the seal would be eliminated, resulting in some sacrifice of redundancy.
- o Elimination of the requirement or practice that physical inventory verification coincide with the operator's core mapping, and conduct of this verification at the time fresh fuel is loaded into the core. Used fuel, whether loaded at this time or not, would also be verified on this occasion.
- o Verification of fresh fuel by neutron collar NDA immediately before its loading into the core, with an inspector remaining at the facility until fresh fuel loading is accomplished. For LWRs employing plutonium recycle, continuity of knowledge with respect to the integrity of MOX fuel from the time of its receipt at the reactor until core loading and start-up is desirable. This could best be achieved through FAIDs, but continuous inspection or some other form of strengthened surveillance during these periods should be considered if FAIDs are unavailable. This step is desirable regardless of whether the modified inspection regime outlined above is adopted.

2. Even though LWR inspections consume a relatively small portion of overall safeguards resources, they represent an important area for improvement both because they impact on more states, facilities, and organizations than any other Agency safeguards activity and because for a number of states, including some that are viewed as of proliferation concern, they represent the only known source of weapons-usable material. The improved efficiency of the approach suggested above would, thus, have a favorable impact on a number of states and entities. The impact of this approach on inspection effort is not entirely predictable, since the increased effort involved in achieving greater continuity during refuelling outages might or might not be fully offset by the savings in effort resulting from the elimination of inspections.
3. The approach suggested above is not intended to constitute a complete and detailed specification for a new LWR safeguards regime. It should, however, be carefully assessed and field tested or adopted to the extent its potential benefits can be confirmed.

#### 1.4.10 MOX Fuel Fabrication Facilities

1. The inspection of MOX fabrication facilities presents one of the most difficult challenges to safeguards effectiveness and efficiency, due to the accessibility of the direct-use material present and the limitations on measurement accuracy for the flows and inventories of the heterogeneous and fabricated material. The safeguarding of HEU fabrication plants present similar problems.

2. Points which should be considered in regard to the safeguarding of MOX fabrication plants include:

- o The requirement for plant shutdowns for routine physical inventory verification by the IAEA in excess of those that would otherwise be scheduled by the operator is inconsistent with the general principle of noninterference with plant operations. Since the timeliness goal for separated plutonium is well below even six months, semi-annual physical inventory verification, as has been required in at least some past instances, cannot be justified in the basis of timeliness alone. Instead the Agency should seek to rely on complete physical inventories coinciding with the operator's schedule, coupled with more frequent partial inventories which do not require plant shutdown, taking advantage of any detailed, near-real-time book inventories of material in-process which such plants maintain.
  
- o Continuous inspection of such facilities is likely to be a more effective and less intrusive means of safeguarding than are frequent intermittent inspections. In this regard, consideration should be given to accomplishing such continuous inspection, on at least a trial basis, through resident inspectors rather than frequent rotation of short-time inspection visits.

1.5 FLEXIBILITY AND TRADE-OFFS

Agency safeguards implementation has become more rigid than anticipated in both INFCIRC/66 and INFCIRC/153, and increased flexibility is desirable both in order to ensure effectiveness when current procedures are incapable of doing so and to

accommodate facility and state preferences where this can be done without loss of effectiveness or undue expense. The term "options" is employed in this study to refer to modifications made primarily for the latter reason; while "trade-offs" is employed for changes made primarily at Agency initiative to ensure effectiveness.

#### 1.5.1 Options

The Agency should be prepared to modify its safeguards practices, particularly in respect to inspection, at the request of an operator or state, when this can be done without compromising effectiveness and at comparable costs to the Agency. Changes made on this basis should be available to comparable facilities in the same or other states. Neither INFCIRC/66 nor INFCIRC/153 require uniformity of implementation that would exclude flexibility under the conditions just cited.

#### 1.5.2 Trade-Offs

Additional or alternative safeguards measures or approaches should be undertaken at the Agency's initiative when constraints imposed by states or operators make implementation in the customary or preferred manner infeasible. This concept was explicitly incorporated in a number of provisions of INFCIRC/153 and is implicit in INFCIRC/66. One example is the conduct of ad hoc inspections when conclusion of a facility attachment is delayed.

#### 1.5.3 Innovation

1. It is a basic conclusion of this study that current safeguards technology is adequate to allow the Agency to meet its objectives effectively and efficiently, and that the

major opportunities for improvements in both of these respects lies more in procedural, institutional and attitudinal modifications than in new technology. However, improved technology, much of which has been developed in the U.S. Program of Technical Assistance to Safeguards (POTAS) has made an important contribution to safeguards improvement over the past several years and can continue to do so.

2. One area of new technology that has been explored by ACDA is that of remote transmission of safeguards data, by satellite or other electronic means. Automatic data transmission is now commonplace not only in sophisticated scientific and defense applications, but in many commercial activities as well and its application to safeguards, as a major innovation in international relations, cannot properly be viewed as unrealistic. A major motivation for automatic data transmission to safeguards is its potential for minimizing the need for the presence of inspectors, as foreseen by the NPT principle of "the use of instruments and other techniques to the extent that present or future technology permits".
  
3. One way in which a transition to long-range automatic data transmission might be facilitated is by the development of local facility systems in which Agency inspectors can monitor selected activities or process information at an on-site inspectors' office. Conversion of such systems to longer range transmission to remote regional or international safeguards offices would not require a major step.

1.5.4 Subsidiary Arrangements and Special Inspections

1. INFCIRC/153 contemplated a system in which subsidiary arrangements would be modified when necessary with comparative ease. This situation has, however, not materialized and subsidiary arrangements, once concluded, have tended to become virtually immutable.
2. In addition to the unavoidable need to modify a facility attachment in the event of significant changes in facility design or operation conditions, such arrangements can and should be modified either to take into account improved safeguards technology or to provide for a modified safeguards approach to ensure effectiveness, even in the absence of a change in design or operation. Although a facility attachment is subject to agreement by the state, it was the intent of the relevant provisions of INFCIRC/153 agreements that the Agency have considerable authority to establish and change the terms of these arrangements.
3. To avoid the de facto erosion of the opportunity to change subsidiary arrangements, the Agency should consider identifying situations where change is desirable and appropriate. An approach to encourage change which might be applicable in some circumstances is to couple desirable modifications of benefit to the state and operator with changes primarily helpful to the Agency.
4. The right to conduct special inspections may also be subject to de facto erosion through long disuse. Accordingly, the Agency should consider undertaking special inspections where these are clearly justified, on a non confrontational basis.

1.6 COOPERATION

1. Although difficult to define and quantify, cooperation by the state in the implementation of safeguards is an important factor in assuring both the effectiveness and efficiency of safeguards. To the extent that the Agency customarily experiences responsiveness on the part of the state to reasonable requests for additional information or other safeguards needs, the Agency's requirements can be reduced and the quality of its findings improved. Cooperation by the state is especially important in relation to resolving discrepancies and anomalies but its importance is not confined to these situations.
  
2. Cooperation can have a favorable impact on both safeguards implementation and safeguards findings and conclusions. While the problems of defining and measuring cooperation objectively make it difficult to establish a basis on which implementation and findings should respond to the degree and quality of cooperation, a first step, which merits at least a reasonable trial, is to include an assessment of cooperation in inspection reports, in order to gain experience in whether this factor can be assessed and with the consistency of assessment over time and among individual inspectors.

1.7 SAFEGUARDS EFFECTIVENESS AND FINDINGS

1. The development over the past several years of the Safeguards Implementation Report and the Inspection Goal Attainment Criteria is an impressive achievement which has made an important contribution to the standardization, objectivity and overall quality of inspections and to the assessment of

their results. To a large degree, the inspection goal attainment criteria, as the only objective measure of inspection performance, currently drive the inspection process and content and are imposing a much needed discipline on the process.

2. Despite this, the criteria in their present form have disadvantages, including promoting excessive emphasis on materials accountancy and fostering a mechanistic approach to inspections which could discourage the spirit of inquiry on the part of inspectors that effective safeguards require. In short, there is a risk that inspectors and their supervisors will develop the attitude that their job is done when all boxes of the inspection report are filled in, without regard to what they observed, or should have.
3. To minimize this risk, inspectors, in addition to completing the standardized inspection reports, should be required to file a narrative report of their impressions and to state explicitly whether or not they have observed any conditions they regard as irregular, regardless of whether such conditions appear among the listed anomalies. Similarly, oral debriefing of inspectors following inspections, which already take place in most if not all cases, should be made a formal requirement. While the procedure just suggested entails some risk that inspectors will react with excessive zeal and imagination, this risk, given the purpose of safeguards, is preferable to that of too narrow a view of their responsibilities and is manageable by careful selection, adequate training, and effective supervision.

### 1.7.1 Anomalies

Anomaly treatment is a key element of the safeguards process in which significant progress is being made. The anomaly treatment process should strive for a "fail-safe" approach, in which no single individual or office can determine that an anomaly has been resolved or requires no further consideration. Additionally, consideration of serious anomalies should involve officials outside the Department of Safeguards.

### 1.7.2 Special Channels

To further ensure that potential problems do not go unreported or are inadequately considered, a special channel should be established through which inspectors and other safeguards personnel can report matters of concern to higher levels without fear of reprisal.

## 1.8 STAFFING AND ADMINISTRATION

1. The general level of safeguards personnel, including inspectors, is high and many competent inspectors can be found among both the short-term and long-term staff. There is no strong correlation between inspector performance and nationality, despite concerns that inspectors from countries that lack a strong industrial and nuclear background might lack some of the skills and attitudes important to becoming competent inspectors.
2. Competent inspectors should be retained for periods longer than the six to eight years term that establishes a de facto obligation of permanent employment. The recent

adoption of a three-year initial term rather than two years as in the past is a positive development.

3. Competent inspectors who have returned to their home countries and gained management experience are attractive candidates for middle management positions such as section heads and their interest in reemployment by the Agency should be encouraged. This is particularly applicable to U.S. personnel, who have generally not shown an interest in returning to the IAEA for a second tour of duty.
4. The position of "coordinator" which is presently filled in each of the three IAEA Safeguards Operations Division should be phased out when the current incumbents retire, in favor of Deputy Division Directors, who would be unambiguously responsible to the Division Director.
5. Given the sensitivity of safeguards, a reasonable degree of review and interaction with the activities of the Department of Safeguards by senior IAEA Officials from other departments is essential. The present interdepartmental safeguards review committee should be retained and its composition and responsibilities should be reviewed from time to time in light of evolving experience.
6. The present program of inspector training is generally well conceived and presented in respect to safeguards technology and procedures. However, it should be expanded to cover the international relationship aspects of safeguards practice.

## 1.9 POLITICAL CONSIDERATIONS

### 1.9.1 Differentiation

1. While significant improvements in safeguards effectiveness and efficiency can be realized through moderate adjustments in the balance among the principal technical elements of the safeguards system, much more substantial gains could be made through adjustments that are political in nature. In particular, the type of safeguards now undertaken by the Agency, which are designed to detect the diversion of a single significant quantity of nuclear material, are unnecessarily intensive for the advanced industrialized states, where the diversion of small quantities of material is not a credible proliferation strategy. However, a major differentiation between states in safeguards intensity has been viewed as politically infeasible. A key issue in improving safeguards efficiency, therefore, is the degree of differentiation in safeguards implementation that is juridically permissible and politically feasible.
  
2. There is no legal basis in Agency safeguards documents or agreements for the conclusion that safeguards must be applied in an identical manner from state to state. On the contrary, INFCIRC/66 and INFCIRC/153 provide an explicit basis for differentiation in safeguards implementation between the two groups of countries to which they apply, while INFCIRC/153 includes a number of provisions specifically designed to provide a basis for differentiation among individual states covered by INFCIRC/153 agreements. Nevertheless, there are political constraints, arising from the "bias" against discrimination, that limit differentiation and have led to insistence by a large number of states on

substantial uniformity in safeguards implementation. While discrimination as such is ruled out, a limited degree of differentiation in implementation on the basis of differing circumstances should be feasible. The most obvious and appropriate circumstance to give rise to such differentiation is whether safeguards are being applied under an INFCIRC/65 agreement, or under an INFCIRC/153 agreement.

3. Major differentiation, such as the adoption of a fundamentally different safeguards regime for large industrialized states designed only to signal large-scale diversion or abrogation, is politically infeasible. More modest differentiation will be more acceptable if practiced in a low-key manner with a minimum of public notice. Such modest differentiation is of importance and should be introduced to the extent possible.
4. The Agency is not constrained by the principle of "non-discrimination" from applying substantially more rigorous safeguards procedures where this is reasonably required by difficulties encountered in verifying non-diversion, as explicitly provided for in both INFCIRC/66 and INFCIRC/153. This conclusion is, of course, equally applicable to any state where such difficulties are encountered, regardless of whether the state is an advanced industrialized or a developing one.
5. Since there is no realistic prospect of adopting a qualitatively different safeguards approach in the advanced industrialized states where small-scale diversion is not a realistic proliferation strategy, every effort should be made to persuade those states, which also have a strong interest in nonproliferation, that their best interests are

served by tempering their criticism of the Agency safeguards system. In this regard, several facts could be stressed, including:

- By its adoption of "accounting verification goals" for large bulk handling facilities and facility-by-facility detection goals, detection goals for the advanced industrialized states, as a whole, are, in fact, considerably higher than for the developing states with one or a few small facilities.
- The high proportion of the total Agency safeguards effort borne by the industrialized states reflects their higher level of nuclear activity, and in any event is very small compared to the costs and value of the nuclear power they generate.
- Significant, although not dramatic, improvements in safeguards efficiency primarily applicable to the industrialized states are possible within the broad limits of the current system and should be actively pursued.
- Acceptance of safeguards in essentially the same form as they are applied to the developing countries is a reasonable political cost for the advanced industrialized countries in relation to the importance of maintaining an effective international safeguards system in states where safeguards are of direct and important non-proliferation significance.

1.9.2 Nonsafeguards Information

1. Nonsafeguards information, whether derived from public or confidential sources, can be of considerable assistance to the effective and efficient application of safeguards and should not be disregarded. Such information can be of particular significance under INFCIRC/153 Agreements, where it provides the principal basis for judging the validity and completeness of the state's declaration of its nuclear activities.
2. Where nonsafeguards information establishes or gives reasonable ground for suspecting that an undeclared sensitive nuclear activity is present, this should be taken into account in safeguards implementation. Where the activity is one that should have been reported under an INFCIRC/153 Agreement, the Agency safeguards system does not preclude, and provides an ample basis for a challenge initiated either by the Agency itself or a member state. Where the activity relates to an INFCIRC/66 agreement and is not required to be disclosed, it should nevertheless be taken into account in planning and implementing safeguards under the agreement.
3. Even if nonsafeguards information suggests that undisclosed facilities, especially those of a sensitive nature, are absent, the Agency should not disregard its conventional assumption that such facilities cannot be ruled out. However, such "negative" information can be employed in more efficiently allocating safeguards resources, taking into account the probable reliability of the information and the conclusions drawn therefrom.

1.9.3 Designation of Inspectors

While there are legitimate grounds for the rejection of inspectors, whether individually or on the basis of nationality, the right of rejection can be abused in a manner which adversely affects safeguards efficiency, effectiveness, or credibility. In such cases, the Agency has the right and responsibility under its statute and relevant safeguards documents, to take remedial action, and should do so.

1.10 U.S. ACTIONS

1.10.1 The U.S. Voluntary Safeguards Offer

1. In addition to its obvious political objective, the U.S. voluntary offer to accept safeguards on all of its nuclear activities other than those of direct national security significance had the important collateral objectives of:

- o Providing the Agency with opportunities to develop and demonstrate safeguards measures and technology and to train its personnel.
- o Providing the United States with a "window" to assess Agency safeguards performance.
- o Providing a basis for the United States to upgrade Agency safeguards by insisting on effective and efficient performance.

With the changing international nuclear environment, concerns that the United States and other nuclear weapons states would have an unfair competitive advantage in

international nuclear commerce have receded and the original political imperative for U.S. acceptance of IAEA safeguards has lost some of its force. This is reflected in the low level of IAEA implementation of the offer.

2. Given the reduced political motivations, emphasis in implementation of the offer should now shift to the collateral objectives of demonstration, training, assessment, and improvement of performance. This shift in emphasis calls for the selection of facilities that offer the appropriate technical conditions as well as a management commitment to full cooperation. Among other things, the selection of such facilities requires a greater U.S. government involvement in the selection process.
3. Among the specific developmental and demonstration activities that should be considered are the assignment of resident inspectors to a facility to implement continuous inspection, the demonstration of the "mail-in" concept for optical surveillance of LWRs, and the application of an improved LWR inspection regime including NDA fresh fuel measurements at the reactor.

#### 1.10.2 U.S. Staffing

U.S. personnel, including inspectors, in the IAEA Department of Safeguards have been of high quality and have made important contribution to the Agency's safeguards program. However, until recently the recruitment and selection process was not sharply focussed and functioned essentially without input from the U.S. government. Significant improvements have been made in this process recently, but further modifications are warranted.

Specifically:

- The qualification of U.S. candidates for inspector and other safeguards positions should be reviewed by appropriate U.S. Government offices and the Agency should be informed of the results of the review, including the ranking of the leading candidates. The leading candidates should be personally interviewed by U.S. officials.
  
- Selected U.S. candidates should be given appropriate advance training and orientation including some that is specifically related to their safeguards responsibilities.
  
- Returning inspectors should be encouraged to visit relevant government offices and should be kept involved in safeguards-related activities to the extent feasible.

2.0 DURABILITY

1. There is a range of circumstances that could adversely affect the "durability" and credibility of the IAEA safeguards system. These circumstances fall into four broad categories:
  - o a deterioration in the status of the system due to increase politicization in the IAEA that might serve to impair its general effectiveness or make the system unusable in some politically controversial states;
  - o a reduction in IAEA safeguards effectiveness due to deficiencies in resources, poor management, a lack of member state compliance, or a degradation in Secretariat diligence in implementing available rights;
  - o a reduction or breakdown in the political basis for the IAEA safeguards system due to factors largely external to the operations of the IAEA safeguards system itself; or
  - o a serious breach of compliance with the IAEA safeguards system through the execution of a significant and unambiguous diversion of safeguarded material. More broadly, the relevance of the system to nonproliferation goals could be reduced if a nation manufactured a nuclear explosive device drawing either on the use of safeguarded or unsafeguarded material.
  
2. Notwithstanding these possible threats, there are few, if any, practicable and stable alternatives to IAEA safeguards

and few, if any, nations are likely to favor using or exploring any options except in the most extreme circumstances. While this absence of ready alternatives may suggest that the IAEA is to be highly durable, it also makes it all the more important to maintain as high a degree of effectiveness and objectivity in the implementation of the system as is possible.

3. It is a thesis of this study that the U.S. safeguards strategy for the 1980s and 1990s should be developed to minimize the potential advent of as many of the aforementioned adverse developments as is possible. While the great majority of the nations of the world share the basic ethic of non-proliferation, and while the NPT Review Conference and IAEA General Conference of 1985 were quite encouraging, the situation still is fragile and one could see a recurrence of the policies of confrontation that started to dominate the activities of the IAEA (and most notably the General Conference) in recent years. Such adverse trends could emerge from the PUNE Conference or there might be more of a tendency to reexamine and debate issues as the time for extending the NPT draws nearer.
4. The United States, the IAEA Director General and others have been engaged in a relatively successful process to counter the trends that had been gaining momentum in Vienna to overly politicize the operations of the IAEA. The climate has been improving significantly over the past three to four years; however, the United States probably could do more to systematically up-grade its backstopping and support of the IAEA and its safeguards operations. More systematic efforts should be undertaken to reestablish the principle that the IAEA should be regarded, to the extent practicable, as a

basically technical organization with important operational responsibilities: to recruit highly competent personnel for the IAEA inspectorate; and to brief these individuals systematically on their responsibilities and to interact with them before, during, and after their assignments in Vienna.

5. It seems clear, from all past experience, and likely future developments, that the ability of the IAEA to achieve increases and material support for the safeguards program will be coupled with the ability to provide adequate resources to those programs in the IAEA -- such as technical assistance -- that are of prime interest to nations in the developing world. There will be a predictable increase in the tensions in the IAEA, if the less advanced, but still numerous members of the IAEA, believe that there is a marked imbalance to funds spent on technical assistance or if the debate over modes of financing safeguards becomes increasingly strident, acrimonious and time-consuming.
  
6. In a separate section of this report, the issue of financing safeguards and whether any modifications in U.S. policies in this regard should be considered is discussed. In brief, this study recommends that the United States should press over the next year to reach a long-term solution to this issue based on the compromise formula it already has tabled in Vienna or possibly some combination of the U.S. formula and the Venezuelan proposal which, in essence, would freeze the existing financing formula. The United States also should continue to favor financing the IAEA technical assistance program out of the voluntary budget. However, in the event differences over safeguards financing remain a chronic and increasingly harmful bone of contention and have

an adverse effect on the resources made available to safeguards, the United States might wish to consider some supporting alternate schemes of financing. These could include an approach that would more effectively and closely relate member states assessed contributions for financing safeguards to a nation's installed nuclear power capacity and whether it possesses major fuel cycle facilities.

7. The behavior of the United States in and of itself can have an important bearing on the continued "durability" of the IAEA and its safeguards system. While it is important for the U.S. to stand firm -- and at high political levels -- against efforts to introduce extraneous political issues in the Agency, it should be recognized that another U.S. walkout at some future point in time (again presumably over Israel) accompanied by a significant reduction in the level of U.S. financial contributions to the Agency could, in and of itself, be seriously threatening to the IAEA's health and durability. If the United States walks out again as it did in 1982, it might be far more difficult for the United States to become active again in IAEA matters as it did when it resumed participation in 1983. U.S. withdrawal from the Agency would reduce the on-going input and influence that the United States now has on the Secretariat in the safeguards area. A second U.S. withdrawal even might be interpreted as the beginning of the end for the IAEA given the position of importance that the United States still occupies as a global leader. For all of these reasons it is assumed that the United States will weigh very carefully the merits of any further withdrawal and only take such a step in the most provocative circumstances.

8. Over the longer term, consideration also should be given to separating the U.S. appropriations for the IAEA from the appropriations made available to other UN organizations -- bearing in mind the growing antipathy that the United States has had toward UN bodies.
  
9. As a related matter, U.S. attitudes towards nuclear power and safeguarding the nuclear fuel cycle also can have indirect effects on the IAEA safeguards program although the effects are likely to be less direct. For example, if some future U.S. Administration adopts a highly antagonistic attitude towards the use of plutonium in the nuclear fuel cycle this could serve to shake international confidence in the ability of the IAEA to effectively safeguard such operations. Such a policy, moreover, also could place the United States at odds once again with those IAEA member states committed to reprocessing and to some plutonium use -- including development of the breeder.
  
10. The durability of the IAEA safeguards system also will depend, in part, on the continued professionalism and competence of its inspectors and the efficiency with which they are put to use, once hired. The existing pattern of appointments which limits career assignments seems to be an acceptable one, although the desirable goal of continuity also may be fostered by additional career or long-term assignments. Since promotions within the IAEA Secretariat are hard to come by and are generally limited to those very few officers making the IAEA Secretariat a longer-term career -- consideration should be given to granting awards, bonuses and high level commendations to those members of the safeguards staff that are perceived to be performing in an outstanding manner.

Also, as recommended elsewhere, over a period of years, highly competent individuals should be encouraged to serve more than one tour with the IAEA Inspectorate.

11. There are some "hardship" features now associated with being an IAEA inspector that merit attention including those attributable to too much travel away from home. Also, too small a fraction of an inspector's time is spent in the field. Techniques such as the increased use of IAEA field offices and longer-term assignments in the field should be explored as possible ways to ease these difficulties.
  
12. Finally, if a nation successfully and unambiguously diverts material that is under IAEA safeguards to a nuclear weapons program, the safeguards system would suffer a serious blow especially if the offending state were able to take such an action with impunity. There well could be a crisis of confidence about the viability of the entire nonproliferation regime let alone the IAEA safeguards system in particular. This strongly suggests that the continued viability of the safeguards system may depend on the evolution of an effective policy to apply sanctions against violators of accepted nonproliferation norms.

3.0 SAFEGUARDS RESOURCES

1. For determining the kind of financing scheme that the US. should favor for the IAEA safeguards system over the next several years, four basic tests can be postulated:
  - o Assurance that adequate resources will be available on a stable and predictable basis to support the increased demands that will be placed on the IAEA safeguards system as nuclear power programs around the world increase.
  - o Removal of the issue of financing safeguards as one of the more recurrent and acrimonious topics within the IAEA Board of Governors and the General Conference. Relatedly, the United States obviously wishes to avoid a situation where the tensions between financing safeguards and technical assistance grow so severe as to threaten the viability of the IAEA structure. So long as the question of safeguards financing festers as an unresolved issue, the "durability" of the IAEA safeguards system is at some risk.
  - o Compliance with basic principles of equity, including an appropriate balance between the principle that IAEA safeguards contribute to the security of all nations and the philosophy that the poorer nations should be provided with some protection against escalating safeguards costs that, by and large, they are not responsible for creating.

- o Assurance that any financing approach that the United States favors will be politically acceptable not only within the IAEA but domestically within the Congress.
2. After reviewing the options available to the United States in the immediate future, introduction and adoption of any new or radical reform of the safeguards financing scheme would appear to be completely impracticable. However, if no acceptable near-term agreement can be achieved on a long-term safeguards financing formula, and if it appears that the issue will continue to fester with possibly serious adverse effects, the United States should be prepared to consider a shift to a more basic change in the financing regime.
3. Related to the issue of safeguards financing, is the issue of financing technical assistance. As explained earlier, many of the lesser developed IAEA member states have complained about the imbalance in the program favoring safeguards over technical assistance. While it can be expected that there will be continued agitation in favor of more resources for technical assistance, the authors of this study do not believe that a fundamental change in the method of financing the IAEA's technical assistance program is now required. Instead, it is felt, that the United States may want to devote more attention to dealing with a perception in Vienna that the United States is primarily interested in safeguards aspects of the Agency and only distantly interested in the substance and direction of the Agency's programs (both in voluntary fund and the regular budget) that are of more central interest and concern to the developing countries. If U.S. officials agreed that indeed there is a need to deal with this perception in Vienna, then a possible remedy may be

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to have the U.S. government agencies involved give more systematic review and attention to the nonsafeguards as well as safeguardsrelated aspects of the IAEA programs.