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A CONCEPTUAL WORKING PAPER ON ARMS CONTROL VERIFICATION:(U)
AUG 81 F R CLEMINSON, E GILMAN

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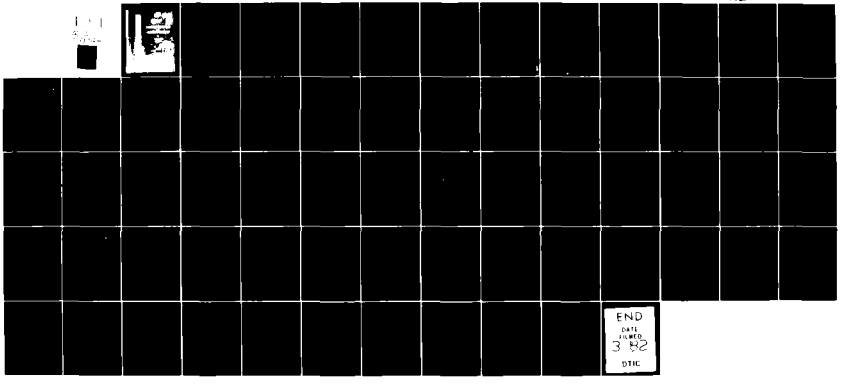

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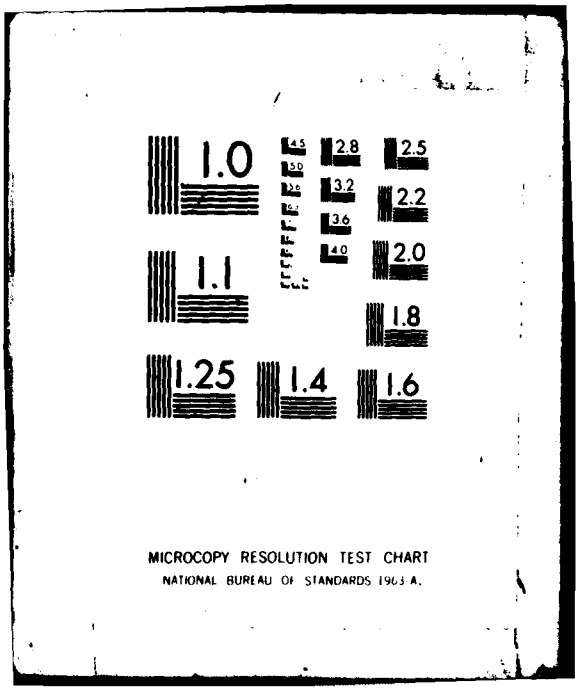
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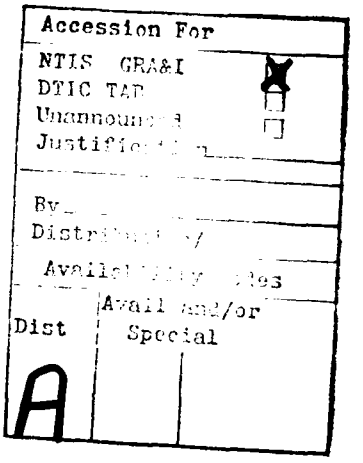
DEPARTMENT OF NATIONAL DEFENCE

CANADA

OPERATIONAL RESEARCH AND ANALYSIS ESTABLISHMENT

ORAE REPORT No. R79

A CONCEPTUAL WORKING PAPER ON ARMS CONTROL VERIFICATION



by

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This report does not necessarily represent the views of the Canadian Department of National Defence.

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ABSTRACT

With political tensions increasing throughout the world individual states and alliances have accelerated their search for security. Traditional suspicions among nations have consequently grown. Therefore, the value of future arms control agreements will depend on their verifiability. Using the experiences of the U.N. Committee on Disarmament (CD), this study looks at verification in a general sense and offers a framework for a conceptual approach to the issue.

RESUME

L'accroissement des tensions politiques à travers le monde a entrainé les Etats, de même que les alliances, à accélérer leur recherche d'une plus grande s[illegible]é. Conséquemment, les soupçons qu'ils entretenaient [illegible] le passé semblent s'être aggravés. C'est pourquoi l'efficacité des accords pour le contrôle des armements dépendra en grande partie des moyens de vérification retenus. En se basant sur les résultats obtenus par le comité des Nations-Unies pour le désarmement (CD), cette étude analyse la question de la vérification d'une manière générale, et propose un cadre de travail qui développe une approche conceptuelle sur ce problème.

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PREFACE

This paper provides the conceptual foundation for an understanding of verification which can be built upon in all areas of arms control. It is the product of co-operation, over the past eighteen or so months, between the Arms Control and Disarmament Division of the Department of External Affairs and the Directorate of Strategic Analysis/ORAE of the Department of National Defence. A good part of the material researched for the paper comes from ORAE Report No. R73, Compendium of Arms Control Verification Proposals, submitted simultaneously to the Committee on Disarmament (CD) in Geneva in June 1980 as CD-99, and ORAE Report No. R76, A Quantitative Working Paper On The Compendium Of Arms Control Verification Proposals, presented in Geneva as CD-127 in July 1980. The first edition of this particular work was introduced in Geneva as CD-199 in June by Canada as part of the on-going study on verification being conducted in Ottawa.

1. Introduction:

No single issue in the decade of the 1980's is likely to be of greater significance in international disarmament and arms control negotiations than verification. Particularly in an era of increased suspicion and uncertainty, nations are unlikely to accede to treaties affecting their own national security without some adequate means of assurance that other signatories will in fact be living up to the terms of the agreement. Recognition of the requirement for some sort of assurance is not, of course, new. On August 23, 1973, the Netherlands representative during debate in the Conference of the Committee on Disarmament (CCD) observing that the "need for verification is based on suspicion" summed it up by reminding Committee members that "to imply that disarmament should be based on mere trust and confidence is simply not realistic." It is this need to apply an increased degree of realism in dealing with verification which manifests itself today.

Although a consensus can be said to exist amongst member nations of the Committee on Disarmament (CD) concerning the requirement for some sort of verification, there is very often a basic philosophic difference regarding purpose, methodology and definition. In submitting working paper A/AC.187/101 to the Preparatory Committee for the Special Session of the General Assembly devoted to

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Disarmament (UNSSOD) in 1978, Austria alluded to these problems and underscored the necessity of injecting some "clarity" and "precision" into the discussion of verification. Although the principle of verification has been recognized in previous negotiations leading to arms control agreements (See Annex "A"), agreed definition has been conspicuously absent. Verification has been discussed almost without exception on an ad hoc basis and developed specifically to meet and perhaps to assuage political sensitivities and perceptions of national security criteria. With the experience gained from those agreements now in effect, and from the ongoing negotiations within the CD and its working groups, the need for an increased degree of realism and for "clarity" and "definition" has never been greater.

The Compendium of Arms Control Verification Proposals (CD 99)* which was tabled in the CD in June 1980 was developed by Canada as a basic and objective first step in the process of achieving a better understanding of the parameters within which arms control verification had been discussed. That volume was intended to serve as a quick reference catalogue for almost two hundred arms control verification proposals drawn from the procès-verbaux of the Eighteen-Nation Disarmament Committee (ENDC), CCD and CD for the period from 1965 to 1978 and from secondary source material for

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* Published simultaneously as ORAE Report No. R73 by Alan Crawford et al.

the period 1958 to 1978. Random perusal of the Compendium and of collateral in other sources serves to confirm the confusion and complexity of thoughts which surround the subject. Technological developments are likely to intensify this problem even further.

In August 1980 Canada submitted a second working paper (CD 127)* to the Committee on Disarmament which provided a quantitative analysis of the Compendium using simple frequency scores derived from the reference matrix in ORAE Report No. R73 (p.6) and the source index (pp. 336-356). The document highlighted, through simple arithmetic analysis, the generalized perceptions of verification in terms of predominant emphasis and preferred methodology.

2. Purpose:

This working paper is based on the Compendium and the subsequent quantification and is meant to develop further a concept of verification which can be used as a generally accepted basis of understanding. Using the background and experience of the CD, it suggests a typology of the verification process through which the arms control implications for national sovereignty and security and for the concepts of international security and confidence might be discussed, negotiated and defined. While this

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* Published simultaneously as ORAE Report No. R76 by Alan Crawford et al.

perspective has been developed in part from existing arms control agreements, its significance should be viewed in terms of those conventions (including Radiological Weapons (RW) and Chemical Weapons (CW)) which are likely to be impending in the 1980s. The development of such a typology would facilitate the ability to visualize the kinds of verification difficulties which may be encountered. By recognizing concepts which are implicit in existing treaties and agreements both bilateral and multilateral, it should be possible to apply those concepts, already accepted in a particular set of circumstances, to other arms control and disarmament (ACD) negotiations.

3. The Importance of Verification :

An arms control agreement is essentially an agreement between states to undertake restrictive measures expected to result in decreased likelihood of war. Since the benefit to each assenting state arises from the compliance of the other signatories, there is a natural desire for some form of external assurance that these signatories are fulfilling their obligations. In simple terms, verification is the means by which such assurance is gained. Consequently, the nature of the verification measures associated with an arms control agreement is usually of vital importance both to the successful negotiation of the agreement and to its successful operation once it enters into force. In any protracted arms control negotiation , different verification proposals are likely to be made by a number of participants, and successful negotiation may well depend on an acceptable compromise being reached between these proposals. This appears to be the case for virtually all kinds of prospective disarmament and arms control negotiations from

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general disarmament to control of specific weapon types or limited geographic areas.

4. Definition:

The process of verification has been variously defined in sessions of the CD and in other negotiating fora usually in terms which apply to a unique set of circumstances (See Annex B). Thus while the definition as developed for SALT II, for example, might assuage the sensitivities of the two negotiating powers, it might be found neither acceptable nor applicable in a multinational scenario. To be generally acceptable, the definition must be both simple and concise and at the same time non-partisan in origin. For the purpose of this paper, therefore, the definition as defined in the sixth editon of the Concise Oxford Dictionary is considered to meet all three criteria:

"Verification is the establishment of truth or correctness of, by examination or demonstration."

In addition to simplicity and conciseness, this definition combines two very basic functional concepts in the verification process. The first of these is the challenge aspect of "examination" which is to be found in some form in almost every arms control agreement. The second is the voluntary aspect of "demonstration", which is perhaps, in some respect analogous to the concept of "cooperative measures." "Demonstration" is likely to gain increased significance in the process of confidence building as arms control negotiations proceed in the 1980s.

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5. Categorization:

Verification has seldom been discussed in the CD in the generic sense. While the forms and modalities to be provided in a specific set of circumstances may have been technically well-defined and closely connected with the purpose of the proposed agreement, definition and clarity of purpose when applied to the process in its wider aspects remain diffused. The lack of a reference framework and more specifically a common, accepted vocabulary, has led initially to a serious problem of meaning.

An excellent example of this problem is the application of the term "adequacy" to the process of verification. It has been taken to mean that the process referred to should meet an agreed standard but that standard has remained undefined. Other adjectives such as "strict", "effective", "necessary", "valid" and "most thorough" have been used in various facets of the CD negotiations in the same context. The addition of concepts such as "transparency" and "cooperative measures" to the litany of verification suggest that the development of an agreed categorization both in form and in definition is overdue.

6. Verification Table:

When viewed as a dynamic process applicable to the full spectrum of arms control affairs, the verification process can be broadly categorized into a three-tier table (see Chart I): ... 7

CHART 1

VERIFICATION CATEGORIZATION

	REGIMES
1	ABSOLUTE VERIFICATION
2	ADEQUATE VERIFICATION
3	LIMITED VERIFICATION
4	TOKEN VERIFICATION
5	NO VERIFICATION

	METHODS
1	GENERAL ON-SITE INSPECTION
2	SELECTIVE ON-SITE INSPECTION
3	CHALLENGE ON-SITE INSPECTION
4	CONTROL POSTS/OBSERVER/ LIAISON MISSIONS
5	REMOTE SENSING IN-SITU
6	REMOTE SENSING-NATIONAL TECHNICAL MEANS
7	COMPLAINTS/CONSULTATION
8	COLLATERAL ANALYSIS

	SYSTEMS
1	PHOTO RECONNAISSANCE SATELLITE
2	"FERRET" SATELLITE
3	NUCLEAR RADIATION DETECTION SATELLITE
4	SPACECRAFT LABORATORY
5	SEISMIC SENSORS
6	CONTROL POSTS
7	REMOTE SENSING POSTS
8	PEACE KEEPING/OBSERVER MISSIONS
9	LITERATURE SURVEY
10	INTERNATIONAL INFORMATION EXCHANGE
	ETCETERA ETCETERA

(a) Verification Régimes - (The level of confidence required.) The major determining factor would be the application of political judgement influenced by deployment practices, developed and agreed cooperative measures and international security perceptions.

(b) Verification Methods - (The concept of inspection and detection methodology.) The major determining factors would be the technological level of monitoring systems and the capabilities of existing and projected analytical techniques.

(c) Verification Systems - (The existing and projected national and international systems available.) Systems would include the physical hardware developed nationally and internationally to accomplish the monitoring, synthesis, analytical and dissemination tasks.

7. Verification Régimes:

The level of verification required in a given situation is dependent upon political will and judgement influenced in a single scenario by capability as well. Because of the subjective nature of the determinants, the level of verification is difficult to quantify. Nevertheless through an analysis of the procès-verbaux of

the CD and its predecessors and of the working papers submitted by member nations, it is possible to determine five levels of verification or verification régimes. These régimes, though definable, retain a high level of subjectivity in application:

(a) Absolute Verification - Description: A régime under which no doubt is left in determining treaty compliance. In practical terms, however, the achievement of 100% verification is unlikely. Under this régime, all verification methods could be employed.

Example: The Antarctic Treaty (1959) provides for a theoretically absolute level of verification. It says in part "Each observer designated shall have complete freedom of access at any time to any or all areas of Antarctica."

(b) Adequate Verification - Description: This is the régime which is referred to most often in the CD. It is the product of the greatest degree of uncertainty because of its heavy dependence on political judgement and on the process of determining essential security requirements. Major factors determining "adequacy" would include the ability to respond to possible violations on the part of the signatories as well as the likelihood of and degree of risk posed by possible

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violation. It would be possible to rule out by agreement the use of certain methods or systems already in operation.

Example: SALT II is a treaty the verifiability of which, despite some areas of low monitoring confidence and certain national security implications, was assessed by the US Senate Select Committee to be adequate. The subjectivity of this assessment is highlighted in the proceedings of the Senate Committee.

(c) Limited Verification - Description: In this régime, the limitation in verification capability is defined in real terms and is created by the inadequacy of technology available to contracting parties.

Example: Although difficult to select an example in existing treaties, the problem of technical limitations has arisen in the negotiations concerning a possible Comprehensive Test Ban (CTB). The apparent inability to monitor sub-kiloton nuclear tests effectively at long distances is an indication of an area in which technology is inadequate at the moment for verification of a proposed arms limitation agreement.

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(d) Symbolic Verification - Description: A régime in which the verification capability is known in advance to be inadequate through a combination of lack of technology and/or of low probability of compliance. Nevertheless, the contracting parties consider that the nature of the treaty is such as to override the inadequacy of verification.

Example: The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) or Toxin Weapons and on their Destruction (1972) provides for verification through a complaints and consultation procedure. A rational analysis of past history and state of relation between the parties involved would have suggested that verification provisions of the treaty were symbolic at best.

(e) No Verification - Description: A régime in which the treaty or agreement is signed with no provision for verification.

Example: The 1925 Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases and of Bacteriological Methods of Warfare contains no provisions for verification.

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8. Verification Methods:

To meet the parameters of the various verification régimes, eight basic conceptual methods have been defined. These methods derive from the reference matrix developed for the Compendium of Verification Proposals (ORAE Report No. R73) and vary in degree of intrusiveness and application of advanced technology. Both of these factors are prime determinants in the acceptability of these methods taking into account national sensitivities and allocation of financial and technical resources.

(a) General On-Site Inspection - Description:

General on-site inspection involves unrestricted access to the physical objects and related facilities which are subject to control under the terms of specific agreements. The relevant agreements could conceivably range in scope from general and complete disarmament to control of specific weapons systems or research related to these specific weapons. Unrestricted or general access inspection is to be contrasted with selective on-site inspection. Like other verification methods, the purpose of general on-site inspection is to preclude the possibility of clandestine violations of an agreement. The degree of assurance thought to be attainable

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using this method varies. Some proposals consider general on-site inspection to be capable of uncovering all possible violations: others hold that it only increases the likelihood of discovery and thereby improves the deterrent value of the verification system.

Example: The Treaty on Prohibition of the Emplacement of Nuclear Weapons or Other Weapons of Mass Destruction on the Sea Bed or Ocean Floor (1971) can be seen as an agreement which theoretically permits General On-Site Inspection. The object of the treaty is to prohibit the emplacement on the sea floor of nuclear weapons, other weapons of mass destruction and their related launching facilities (Article 1). The treaty mandates adherents to be "free to observe activities of other states on the seabed" provided that this observation does not interfere with such activities or otherwise infringe upon existing rights under international law (Article 3(1)). Should such observation still leave doubts unresolved, parties are authorized to consult and cooperate with a view to removing these doubts (Article 3(2)).

(b) Selective On-Site Inspection - Description: Selective On-Site Inspection involves a greater degree of restriction with regard to rights of access than is the case for General On-Site Inspection. Most

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frequently such restriction takes the form of permitting entry by inspectors only for the limited purpose of monitoring compliance with agreements concerning specific weapons systems and related facilities. From this central restriction flow certain others. Access might be allowed only to a particular geographic location, such as, the site of a peaceful nuclear explosion (PNE) as under the PNE Treaty, or the site of a facility for the destruction of CWs as in a number of proposals. Second, limitations could be placed on the activities which the inspectors may undertake at the place of inspection and on the information which they may acquire there. In the case of a CW treaty, some sensitivity might be shown to analyzing the nature of a chemical agent which is in the process of being destroyed, on the pretext that sensitive information might be disclosed. Third, inspectors may also be limited as to the persons they may contact and the questions they may ask them. Clearly, the distinction between selective and general on-site inspection while significant is more one of degree than of kind. There will definitely be a boundary area between the two categories where the distinction becomes blurred.

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Example: The 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) prohibits transfer of nuclear weapons or explosive devices by nuclear weapon states to any recipient whatsoever (Article 1). Non-nuclear weapon states also agree not to receive such devices nor to develop or manufacture them (Article 2). Concerning verification, non-nuclear weapons states undertake to conclude safeguards agreements with the International Atomic Energy Agency (IAEA) "with a view to preventing diversion of nuclear energy from uses to nuclear weapons or other nuclear explosive devices" (Article 3(1)). Such safeguards under the NPT are to apply to "all source and special fissionable material in all peaceful nuclear activities within the territory" of the non-nuclear weapon state, or carried out under its control anywhere.

Parties also undertake not to provide for peaceful purposes any special nuclear material (or equipment to produce such material,) to non-nuclear weapon states (whether a party to the NPT or not) unless the material is subject to IAEA safeguards (Article 3(2)).

The safeguards required by Article 3 are to be implemented in such a way as not to affect the inalienable rights of parties to develop, produce and use nuclear energy for peaceful purposes nor the right to participate in exchange of material, equipment or information on the peaceful use of nuclear energy (Article 3(3) and Article 4.)

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(c) Challenge On-Site Inspection - Description: A derivative of the first two methods. A challenge is normally initiated by one of the contracting parties. A version of this method has in fact been in operation in Europe since 1954 with respect to chemical weapons production.

Example: The Brussels Treaty revised 23 October 1954. In 1954 the Federal Republic of Germany undertook within the aegis of the Western European Union (WEU) not to manufacture nuclear, biological and chemical weapons. To verify this undertaking the Armaments Control Agency (ACA) established by the revised Brussels Treaty, has been monitoring the non-production of chemical weapons in Germany since 1957/58. The initiative for on-site inspections lies with the ACA. The director of the Agency appoints two to four officials of different nationalities, including one of the nationality of the country in which the inspection is to be carried out. During such "controls" the representative of the Agency enquires about the organization, operation and production programme of the plant to be inspected--the subsequent visit to the production plant concerns only the departments directly concerned with the decision phase of the inspection. Inspectors are shown built-in measuring

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instruments and have access to factory records and books. In special cases sampling is used as a means of control. After each on-site inspection the inspectors report orally to the ACA director.

This method was the subject of a working paper (CD 37) submitted to the Committee on Disarmament by the Federal Republic of Germany (FRG) on 12 July 1979.

(d) Control Posts/Observer/Liaison Missions - Description:

A control post is essentially the focal point for an inspection team. An observer mission is a variation of this type of verification method. (Peace-keeping forces could be considered a further variant whose main purpose reaches beyond simple verification.) The most common proposal is to have control posts at such locations as transportation centres, airfields, railway stations, main road junctions and ports to monitor military traffic. Such monitoring should provide warning of impending aggression by detecting any unusual flow or concentration of military power or weapons production.

One significant advantage of the control post in terms of general applicability, is that it obtains

information by direct observation and therefore does not necessarily require high technology sensors. It does however require secure communication to an information centre so that the information collected can be properly evaluated.

Example: There are many examples of the Control Post/Observer Mission method of verification ranging from the United Nations Truce Supervisory Organization (1948-1981) in the Middle East to the Internation Commission for Supervision and Control (ICSC) in Indo-China which operated under the 1954 Geneva Accords.

(e) Remote Sensing In Situ - Description: In this method, built-in measuring instrumentation (black boxes) can be remoted to a site outside the national borders or restricted area.

Example: A variant of this method is envisioned in the proposed International Seismic Data Exchange System which is being developed by the Seismic Experts Group under the aegis of the CD. This system through the cooperation and coordination of national systems is meant to provide indication of nuclear device explosions using a series of strategically located sensors.

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(f) Remote Sensing-National Technical Means -

Description: The term "national technical means" (NTM) applies mainly to the two superpowers and was not defined in SALT I and is not closely defined in SALT II. Consequently the USA and USSR may consider different types of monitoring and collection systems to constitute NTM. NTM (photo reconnaissance satellites and other such technical data collection systems) make up the principal but not the only sources of monitoring the SALT agreements.

Example: While the USA and USSR are the two major operators of NTM, the resolution sponsored by France at the 33rd United Nations General Assembly (33/11J 14 December 1978) for an International Satellite Monitoring Agency (ISMA) is currently being studied by an ad hoc group of government experts. The proposal envisages many of the characteristics of NTM being applied internationally.

(g) Complaints/Consultation - Description: An agreement by parties to a treaty to receive complaints and to consult as a result. An example is discussion in para 7(d).

(h) Collateral Analysis - Description: Perusal of world press, scientific reports and other pertinent material provides an open and usable method of verification although it must be recognized that an asymmetry exists in the availability of the collateral between different types of societies.

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9. Verification Systems:

Within each verification method, a number of systems have been developed by individual nations and groups of nations. For the most part, however, the systems of verification now in existence have been developed by the superpowers or on behalf of their alliances. Since verification in the national territory of the other has been to this time difficult to achieve, much of the research and development of verification systems has been toward remote sensing.

There are literally hundreds of specific verification systems ranging from technologically complex to relatively simple (binoculars at a distance for example could be visualized as such a simple remote system). This paper will deal with systems in a familial rather than individual fashion.

The use of long-range sensors to monitor activities within a state from outside its borders has been a positive development in this field of verifying arms control agreements. The advent of this technology has reduced to a considerable degree the significance of problems arising from the intrusiveness of many verification activities. In this case "intrusiveness" refers to the physical presence in the country being monitored. Long-range sensors are

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extensively used for intelligence-gathering purposes outside the scope of arms control agreements. Their use in this role has now apparently become internationally acceptable in terms of the superpowers' strategic balance. An arms control agreement which relies on remote sensors for verification might well include a clause prohibiting a country from interfering with the sensors monitoring the agreement.

Verification of an arms control agreement by use of the remote sensors normally employed for intelligence gathering is sometimes referred to as verification by "National Technical Means" (See CD/28 27 June 79). Since virtually all remote sensors are deployed by the superpowers there could be some difficulty in relying on them to monitor a multilateral agreement unless the agreement includes some arrangement for making the information collected by the superpowers available to other signatories, for example through an international agency. The creation of such an agency has been the subject of proposals within both the CD and its predecessors for many years (See, for example, ENDC/2 19 March 62). Because of some reluctance to divulge what is often considered intelligence information there is a tendency for the superpowers to favour bilateral

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arrangements. This will presumably be a major consideration in the study by the group of Government experts on the feasibility of the French proposal for the International Satellite Monitoring Agency (ISMA).

10. Remote Sensing Systems:

Sensing systems can be termed "remote" in three modes. First, the sensor may be distant from the object it is intended to monitor, while being proximate to the personnel operating it. Shipboard or fixed-site radars are an example of such a system. A second situation involves a sensor which is distant from both the object to be monitored and from the personnel controlling the sensor. An observation satellite is an example of this. Finally, a third type of sensor is one which operates in relative close proximity to the object to be observed while being distant from its controllers. Seismic systems used to record earthquakes fall into this latter category. For the purposes of this paper, the term "remote" refers to situations where the sensing device and the object to be monitored are distant from each other. Satellites are discussed as an example of "NTM" type systems. Seismic sensors are representative of "in-situ" systems.

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(a) Satellites

The principal agent for remote sensing is the surveillance satellite and its use in verification has been up to now a part of the National Technical Means of the superpowers. The following three satellite systems have direct relevance to arms control verification.

(1) The photographic reconnaissance mission. There are two main PR systems, "area surveillance" and "close look." The former involves the use of a wide angle, relative low resolution camera which is employed to cover large areas and note discrepancies which may need further examination before they can be identified. "Close-look" satellites are directed to the identified areas of interest in order to collect more detailed information. Greater detail (with consequent limited area coverage) can be obtained by a combination of lower orbit, longer focal length or improved resolution. ISMA as defined in the French proposal would apparently include a "close-look" capability. It is possible, as well, to have specialized sensors for different purposes, for example, for maritime observation.

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(2) "Electronic Reconnaissance" Satellites. The so-called "ER" satellites monitor electronic radiation including radar signals and radio communication. They include the electronic equivalent of both "area surveillance" and "close-look" types.

(3) The early-warning spacecraft. The primary mission of these satellites is to detect the launching of ballistic missiles. To do this they employ infra-red sensors and TV cameras and are usually placed in geo-stationary orbits. Newer versions of these satellites also incorporate nuclear radiation sensors. As mentioned earlier, in addition to the above which are mainly military and national intelligence collections, the International Satellite Monitoring Agency (ISMA), currently the subject of a feasibility study to be presented to UNSSOD II, is an attempt to internationalize a high technology verification system.

(b) Seismic Sensors

Seismic systems monitor surface and below ground level shock waves. Thus seismic sensors are not long range sensors in the sense of seeing an event at a

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distance; they deduce the event when the shock waves associated with it arrive "in-situ" at the location of the sensor. Most of the events producing such major earth shocks are natural, for example, earthquakes, and the only man-made events producing comparable shocks are large explosions of the size produced by nuclear weapons. Consequently verification proposals employing seismic sensors have invariably been confined to detecting underground nuclear explosions.

There are four main requirements for a seismic monitoring system. First, to detect a seismic "event"; second to locate it; third, to identify whether it represents a natural "event" or a nuclear explosion and fourth to measure the strength of the phenomenon. Because of limitations on equipment sensitivity there is a threshhold magnitude of "event" which is detectable. Location of an "event" usually demands detection at two or more distantly separated locations, i.e., a detection network and identification depends on the shock wave pattern or "signature" of the "event."

The magnitude of the shock produced by a nuclear explosion varies according to its location and the type of earth or rock in which it is detonated. There is some controversy over the minimum size of nuclear burst which can be detected and also over how far it is possible to disguise the

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signature of a burst to simulate a natural event.

Many countries possess seismic detection stations for earthquake monitoring and there are international data exchange networks, notably the "World Wide Standard Seismograph Network" (WWSSN) completed in 1967. However the USSR and several of its neighbours are not members of the network, leaving a large gap in its geographic coverage.

The proposal for an International Seismic Data Exchange (ISDE) System is under active consideration and may prove extremely useful upon the successful completion of negotiations on a Comprehensive Test Ban Treaty (CTB).

11. Conceptual Aspects:

A conceptualization of the verification process begins with a synthesis of research supporting the development of the Verification Classification Matrix and the subsequent discussions. There are, of course, literally scores of factors, many purely subjective, which influence the development of verification parameters. Not the least of these are the political will of nations and the perception of national security requirements on the part of the negotiants. The matrix may be seen therefore as a sort of visual representation of parameters developed from subjective judgements.

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It is apparent that certain aspects as judged by indivdual nations will not fit neatly into any conceptualization. A broad area of common and accepted understanding and a degree of perceptual flexibility on the part of negotiants, a synthesis of the survey of verification proposals as represented in ORAE Report No. R73 and the subsequent arithmetic analysis of ORAE Report No. R76, suggests that three essential factors tend to project themselves as significant determinants in terms of concept: the degree of intrusiveness, the technological level, and the resource allocation.

12. Intrusiveness:

The degree of intrusiveness of a proposed verfication method appears to be a factor in terms of national sensitivity and acceptability. While individual examples may be extracted from the procès verbaux of the ENDC, CCD and CD, the overall trend (derived from an analysis of supporting data contained in ORAE Report No. R76, p. 24) is indicated in Chart 2. The columns on the left indiciates the results of the total population proposals while the ones on the right represent states sponsored proposals. It is obvious that states sponsored prosposals tend toward non-intrusive or ancillary methods.*

* Ancillary methods, as explained in ORAE Report No. R73 (p.6), include complaints procedures, international control organizations and review conferences.

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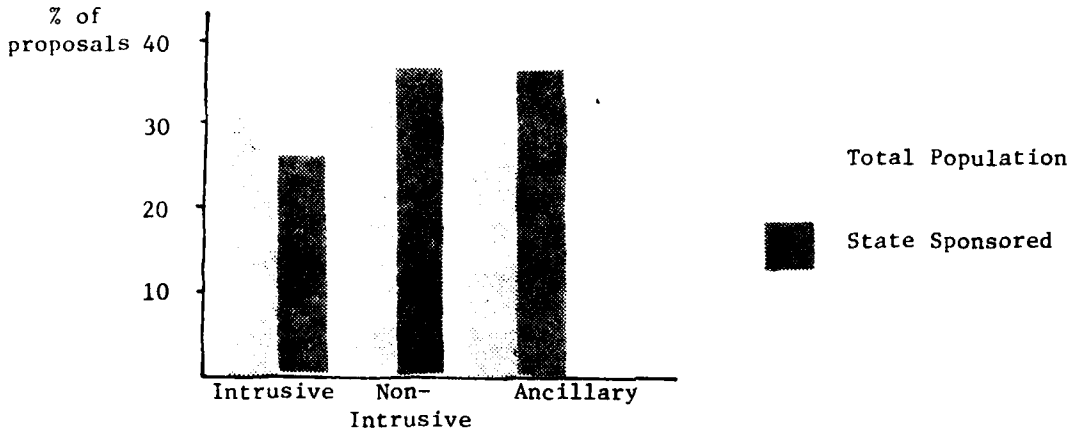
Chart 2



A specific example of the significance of the intrusiveness of verification proposals which span the life of the ENDC, CCD and CD, is the negotiation on a Comprehensive Test Ban Treaty. As early as 1963, the Soviet Union had made proposals which included the emplacement of automatic seismic stations under certain situations and conditions for "2-3 (on-site) inspections a year being carried out in the territory of each of the nuclear powers." (ENDC/73 31 Jan 63) Constraints however included a ban on the carrying of cameras and a requirement that aircraft windows be screened; provisions which were indicative of the sensitivity to intrusiveness on the part of the Soviet Union at that time. It would

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have been reasonable to assume that in the intervening seventeen years advanced technology in terms of satellite reconnaissance and telemetry intercept would have reduced the significance of such intrusion. Nevertheless, in August of 1980 a press release summarizing the results of the latest trilateral (US, UK, USSR) negotiations reported that in "breaking significant new ground in international arms control" in terms of a comprehensive test ban and the possibility of espionage, the three parties had overcome the obstacles by agreeing to "authorizing on-site inspections--to be conducted by teams of outside experts--at the request of one party -- permitting the affected country to refuse inspection if it provides reason for its decision." Apparently during the intervening 17 years of intermittent negotiations which separated the two reports, the factor of intrusiveness combined with the absence of agreement in concept, definition and vocabulary had precluded agreement. The nature of intrusiveness has changed and the subject deserves a separate study indepth, perhaps as a functional working paper in the CD.

For the purpose of this paper, the question of intrusiveness devolves essentially into two aspects: physical intrusion and cognitive intrusion. The former

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refers to access by foreign inspectors into the territory of the party being monitored. Cognitive intrusion involves the acquisition by foreigners of sensitive military or economic information. While these two forms of intrusion are obviously highly interrelated there are nevertheless some important differences.

Physical intrusion generally can be strictly controlled by the party being monitored since physical access can usually be limited to specific sites and to the performance of certain tasks. Indeed, humans may only be involved indirectly as when automatic, unattended "black boxes" are employed.

Cognitive intrusion is possible whenever humans are allowed access to the territory of a party since human senses are extremely flexible, unlike a sensing device designed solely to monitor a limited range of phenomena. Hence the possibility always exists that information outside the scope of the arms control commitment may be learned. The question of cognitive intrusion may even arise with regard to matters more directly related to the matter being verified. For example, protests might be made concerning the sampling of a CW agent in the process of being destroyed, using the argument that subsequent chemical analysis of the samples might reveal sensitive information about the nature of the substance. While cognitive

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intrusion usually implies some physical intrusion, it is possible to conceive of a system where no physical access is needed to acquire sensitive information. The obvious examples are satellites and other long-range sensing devices.

Thus, the distinction between physical and cognitive intrusiveness has some meaning. It is also reflected in the objections raised by some states. For example, many verification proposals have been challenged on the grounds that national sovereignty is violated (i.e. physical intrusion) and that the system amounts to legitimized espionage (i.e. cognitive intrusion) presumably the latter was meant to be neutralized by "screening of aircraft windows."

The issue of intrusion remains a sensitive problem as confidentiality appears to continue to be almost an obsession with a number of states in regard to their "national security" affairs. Consequently, objections over intrusion are likely to continue to arise to some extent in some states. In addition to the military aspects, fears about industrial espionage both on the part of governments and commercial enterprises will continue to be a consideration. As well, political objections might be raised to the question of granting major verification responsibilities to an international body. A rational analysis of modern international verification techniques suggests however that

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the significance of "intrusiveness" should steadily decrease with time.

13. Technology:

Technology is ambivalent in its effect. Since it is a process which is in and of itself basically neutral, the most significant factor determining its effect is the human decision on the direction in which technologically innovative energies might be directed. From an arms control standpoint, therefore, concern must be directed equally at the decision making apparatus (which determines the allocation of resources and the application of effort) as well as at the technological process itself.

In the next decade, arms control activity, whether bilateral or multilateral, is the area in which technology is likely to make a major impact as a factor in international stability. Techniques in verification, particularly in remote sensing have advanced dramatically as a result of the vast amount of financial and material resources poured into the improvement of national technical means (NTM) of verification by the superpowers. Satellite reconnaissance and surveillance platforms, electronic intelligence collection systems and seismic detection methods form a sophisticated package of high technology verification techniques. To the extent that bilateral agreements based on NTM between the superpowers are perceived as contributing to international stability, new technology can be said to have made an impact in this area already.

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As the multilateral aspects of arms control negotiations become more significant, however, international verification methods will have to be developed to meet the demands of member nations. To meet the arms control requirements of weapons systems increasingly sophisticated with the application of technology, systems, such as NTM now used by superpowers in their bilateral agreements, will be required at the same level of sophistication and developed by applying similar technological innovations.

NTM include an array of sophisticated collection techniques including photographic reconnaisance satellites, aircraft-based systems (such as radar and optical systems) as well as sea and ground-based systems (such as radar and antennae for collecting telemetry) which remain under national control. For the bilateral agreements in the SALT negotiations the intrusive nature of the on-site method of verification has been eliminated by the extensive use of remote sensing techniques. Both parties have agreed not to inhibit intentionally the other's remote sensing capability. While in terms of the SALT agreements, remote sensing appears to provide "adequate" verification, its application to other areas of arms control negotiations may not prove "adequate."

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14. Resources Allocation:

Closely associated with technological advances is the factor of resource allocation to verification in terms of finance and of manpower. Here, as in terms of new technology, there is an obvious cleavage between the superpowers and the rest. Stated bluntly, the superpowers may prefer inspection by each other on matters related to their strategic security rather than inspection by some international agency.

Cost factors constitute an important consideration in assessing any verification system. Unfortunately, the ignoring of this important aspect of verification proposals, make assessments difficult. It is, nevertheless, possible to point out whether a system is likely to involve major costs and whether such expenditures appear to be justified by the effectiveness of the system. Where costs are high, the serious question arises: who will foot the bill?

An excellent example of the cost of a technologically advanced system under international control is the proposal for an International Satellite Monitoring Agency (ISMA). The schedule and cost of deployment and operation of the ISMA system has been estimated and provided well in advance (See Chart 3). If in fact there is serious consideration of the option, the ability to finance it and the organization under which such a system would operate must be

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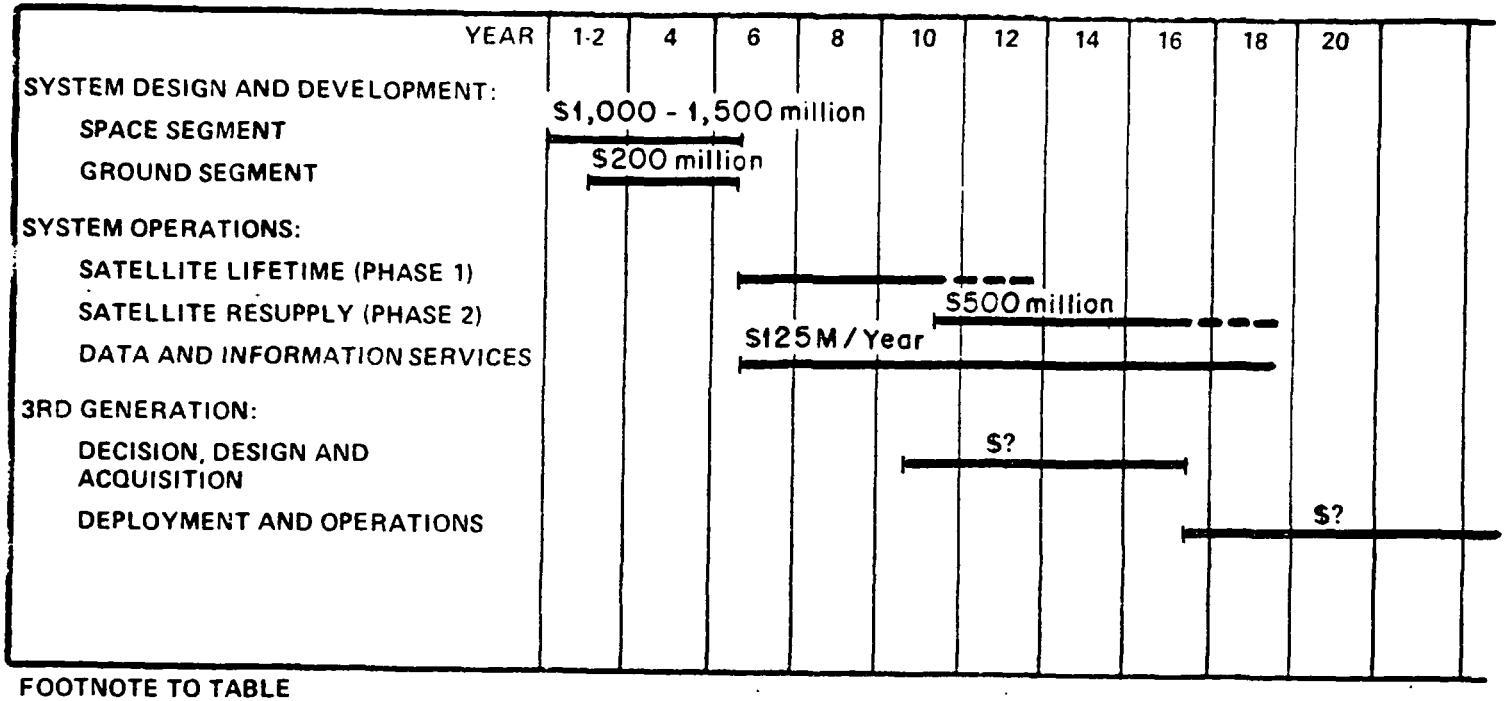
seriously considered. The feasibility study is scheduled to be completed by 1982.

Manpower requirements are a more uncertain issue with regard to the adequacy of verification proposals. In some cases it is clear that teams of inspectors might be required to implement adequately the proposed system. Frequently, as well, highly skilled technicians might be needed. For example, in the initial proposals of ISMA, an estimated 150 to 200 productive personnel, that is highly skilled technicians and analysts, would be required in the first stage of development of the Data Processing and Analysis Centre.

CHART 3

SCHEDULE AND COST OF DEPLOYMENT AND OPERATION OF ISMA SYSTEM



FOOTNOTE TO TABLE

SYSTEM COST ASSESSMENT

SPACE SEGMENT	OPTICAL SATELLITE $300M. INFRARED SATELLITE $350M. RADAR SATELLITE $300M. ESTIMATED COST RANGE (INCLUDING R & D) $1,000 to $1,500 MILLION.
GROUND SEGMENT	INITIAL INVESTMENT $200 MILLION. THIS INCLUDES THE ANALYSIS CENTRE WITH ITS COMPUTERS, DATA RETRIEVAL AND PROCESSING SYSTEMS, PLUS THE FIXED AND MOBILE COMMAND AND DATA LINKS AND TRANSPORTATION.
THE RUNNING COSTS	$125 MILLION PER ANNUM. INCLUDES $55 M ON TRAINED OPERATIONS PERSONNEL (1,000). $15M ON R & D PERSONNEL (100). $25M ON SOFTWARE DEVELOPMENT CONTRACTS AND THE BALANCE FOR EQUIPMENT MAINTENANCE AND SMALL-SCALE R & D IN HOUSE.

Sources: Etude Sur la Création d'une Agence Internationale de Satellites de Controle - Paris - 4 Mai, 1979; and the Report on the 34th Pugwash Symposium - Avignon - 14-18 April, 1980.

15. Concept and Practice:

It can be argued that, although conceptually conventions now in existence cover the full range of verification regimes (Annex "A") and recognize the applicability of a variety of verification methods, it becomes difficult if not impossible to translate these concepts into reality in terms of practical organizations and systems.

From a historical standpoint it was the superpowers which, in the early 1960s, fostered the proposal foran International Disarmament Agency as an essential ingredient in their pursuit of General and Complete Disarmament (ENDC/5 19 Mar 62). This concept has been refined in various forms by other countries and groups of countries during the intervening years down to and including the 1980 sessions of the CD. Several of the national experts participating in the work of the CD Working Group on chemical weapons in June 1980 proposed an International Verification Control Agency which in this specific case would work closely with national agencies.

The inability of the international community to respond in a positive manner has been variously attributed to reasons ranging from acute sensitivity to intrusiveness to ideological incompatibility. A frequent argument put forward is the assumed inability of multinational verification to protect commercial secrets. There is a

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pervasive view that verification at the international level is simply not applicable in practical terms to the major disarmament issues including nuclear and chemical weapons.

These sensitivities are not surprising. National security has been historically guaranteed by a nation's armaments, and governments have always sought to deny to potential adversaries precise information regarding numbers, quality and disposition of weapons and armed forces. There is a close relationship between what is required under the name of verification and the application of modern intelligence techniques to matters that are regulated by international agreement. What distinguishes verification from arms-related intelligence most of all is its method of approach. While the mission of intelligence is to determine the characteristics or activities of an opponent's weapons and forces, verification must assess only whether these characteristics or activities exceed the limitations imposed by an agreement. Verification is as likely to be an exercise of qualification as one of determination of capability or intent. Verification is likely to be most successful in an atmosphere of cooperation, and violations of slight military importance, unless they appear unintentional and are corrected when discovered, may deserve particular attention. Verification, under an agreement, is therefore of equal importance to all contracting parties. ... 39

16. International Verification Organization:

It must be drawn to the attention of theorists who argue the difficulty of translating conceptualization into reality, that functional international verification organizations do already exist. In large measure they span the gamut of arms control problems, however inadequately, and when viewed together provide working prototypes from which more effective organizations could be developed. Some, but not all of these, are sponsored or associated with the United Nations. The significance of these organizations is that while they have been developed to function under a specialized mandate, they incorporate the development of systems, operating procedures and terms of reference which, with modification, could apply to any arms control scenario. In the nuclear field, the International Atomic Energy Agency (IAEA) (See Annex "C") is active in developing and monitoring a programme of nuclear safeguards. In terms of chemical weapons verification, and more latterly conventional arms monitoring, the Agency for the Control of Armaments (ACA) of the Western European Union (WEU) acts as a model (Annex "D"). A number of United Nations Observer Missions beginning with the establishment in 1948 of the United Nations Treaty Supervisory Organization (UNTSO) which continues to

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operate today, have provided effective verification, using control and observer posts and liaison teams, of troop movements, disengagement zones and limited arms areas.

While as mentioned earlier, observer missions do not necessarily require high technology systems to be effective, the United Nations activities in the Sinai have been augmented in this regard. The development and operation of the Sinai Field Mission (Annex "E") in the buffer zone as part of the disengagement arrangements agreed to by both signatories, has provided significant experience in the application of seismic and remote sensing systems to a practical arms control scenario. It includes as well aspects of the utilization of national and international systems within an overall verification organization.

Finally the ISMA resolution in UNGA 34 as previously mentioned concerns a verification system which is central to the package of systems collectively referred to as Remote Sensing: National Technical Means (NTM).

17. Conclusion:

While recognizing that in all of these cases the functional organizations described above were formed to fit a specific need often within a designated time-frame and limited mandate, they represent practical and operational applications of the concepts of verification which have been outlined in this paper. The missing ingredients needed to apply these concepts to the effective solution of arms control problems currently before the CD are two: political will and financial support. Neither of these, given the determination of member nations individually and collectively, should pose an insurmountable problem.

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Bilateral Arms Control Agreements and Relevant Verification Provisions

Agreement	Limitations	Verification Régime	Verification Methods
Anti-Ballistic Missiles (ABM) Systems Agreement (1972) (to be reviewed at 5-year intervals - next 1982)	Deployment of ABM systems limited to national capital regions of each country plus one other area	Adequate	Remote sensing-National Technical Means (satellites)
SALT I Agreement (1972) Interim agreement on limitation of offensive arms (expired but continues to be observed)	A freeze of aggregate numbers of fixed land based KBM launchers and of ballistic missile launchers on submarines	Adequate	Remote sensing-National Technical Means (satellites) (parties undertook not to use deliberate concealment or impede NTM)
Threshold Test Ban Treaty (TTBT) (1974) (not in force)	Undertaking not to test underground nuclear weapons with a yield of more than 150 KT	Adequate	Remote sensing-National Technical Means (seismic)
Treaty on underground explosions for peaceful (PNET) (1976) (not in force)	Bans underground nuclear explosions for peaceful purposes in excess of 150 KT or aggregate yield in excess of 1,500 KT	Adequate	Remote sensing-National Technical Means (seismic) Collateral analysis Possible challenge on-site
SALT II Agreement (1979) (not ratified but continues to be observed)	Provides for overall ceiling on strategic nuclear delivery vehicles, sub-ceiling on launchers for all MIRVs plus heavy bombers with air launched cruise missiles over 600 KM range, MIRV launchers, warheads, etc.	Adequate	Remote sensing-National Technical Means (satellites and telemetry) (parties undertook not to use deliberate concealment, telemetry excryption and include functionally related observable differences)
Treaty on the Non-Proliferation of Nuclear Weapons (1970)	Prohibits transfer of nuclear weapons by Nuclear Weapon State Parties and receipt, manufacture or otherwise acquire nuclear weapons by Non-Nuclear Weapon State Parties	Adequate	Selective/Challenge On-Site Inspection (modified) Reporting to IAEA

Multilateral Arms Control Agreements and Relevant Verification Provisions

Agreement	Limitations	Verification Régime	Verification Methods
Geneva Protocol (1925)	Prohibits the use in war of asphyxiating, poisonous or other gases and of bacteriological method of warfare	None	None
Antarctic Treaty (1961)	Prohibits nuclear explosions and disposal of radioactive wastes, any measures of a military nature and the testing of any type of weapons	Absolute	General On-Site Inspection Remote Sensing (using aerial observation)
Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water (1963)	Prohibits any nuclear weapon test explosion in the atmosphere, in outer space and under water	None	None Original Parties to the treaty expected verification by National Technical Means
Outer Space Treaty (1967)	Prohibits placing in orbit objects carrying any weapon of mass destruction, the establishment of military installations and fortification and the listing of any type of weapon or the conduct of military manoeuvers on celestial bodies	Limited	Selective On-Site Inspection (if possible) Observation of the flights of space objects
Treaty for the Prohibition of Nuclear Weapons in Latin America (Tlatelolco) (1968)	Prohibits the testing, use, manufacture, production, acquisition, receipt, storage, installation or deployment of any nuclear weapon by any means whatsoever	Adequate	Challenge On-Site Inspection Reporting to IAEA

Agreement	Limitations	Verification Régime	Verification Methods
Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and the Sub-Soil Thereof (1972)	Prohibits emplacement of nuclear weapons as described in treaty title	Adequate	General On-Site Inspection
Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction (1975)	Prohibits the development, production, stockpiling or acquisition of bacteriological and toxin weapons and provides for the destruction of existing stocks	Symbolic	Complaint/Consultation procedure
Convention on the Prohibition of Military or Other Hostile Use of Environmental Modification Techniques (1980)	Not to engage in military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury	Symbolic	Cooperation/Consultation procedure

ANNEX B

Definitions

Verification is a process of gathering and analysing information, permitting a conclusion. (A/AC.187/109)

Verification is the process of assessing compliance with the provisions of arms control treaties and agreements (US Senate Sub-Committee).

Verification is the process of determining to the extent necessary to adequately safeguard national security that the other side is complying with an agreement (Glossary, SALT II Agreement).

Verification is the process of determining whether a party is living up to its international obligations under a treaty or agreement (US Senate Sub-Committee).

Verification is the process of ascertaining that a commitment laid down on a particular agreement in the field of disarmament or arms limitation is being met. (A/AC.187/109)

Verification is the attempt to check the truth of a statement against the facts of the case.

Verification is the establishment of truth or correctness of by examination or demonstration. (Oxford Concise)

ANNEX C

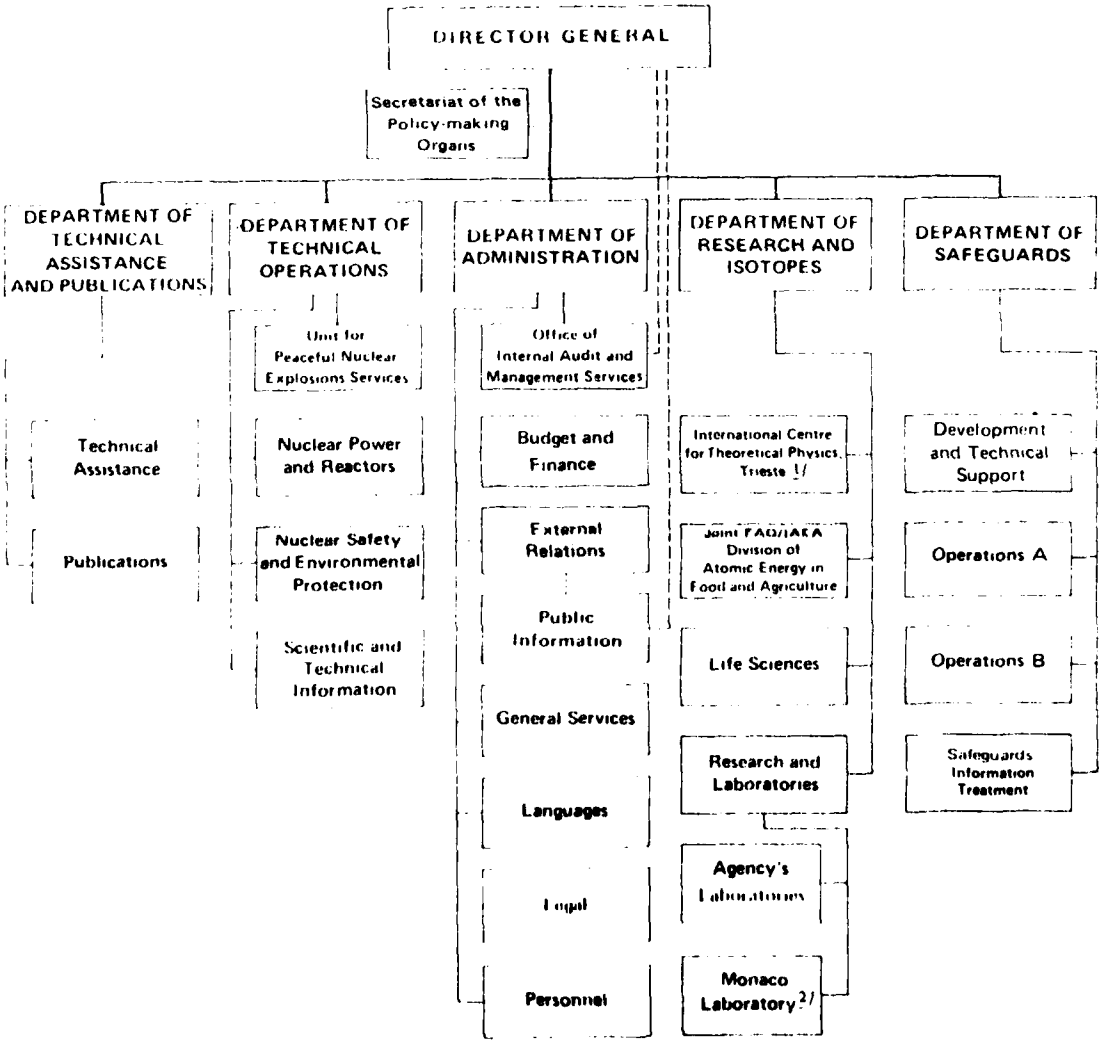
International Atomic Energy Agency (IAEA)

Arms Control Problem: Nuclear

Verification Methods: On Site
Collateral
Analysis

Created in 1957, the primary purpose of IAEA was to facilitate the peaceful use of atomic energy by providing technical assistance to states. An additional function pertaining to the process of verification was in accordance with the statute of the IAEA:

"To establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities, and information made available by the Agency or at its request or under its supervision or control are not used in such a way as to further any military purpose; and to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a state, to any of that state's activities in the field of atomic energy."



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Application of safeguards (a system of technical measures within the framework of international non-proliferation policy entrusted to the IAEA in its statute and by UN NPT) took second place to the primary role until the entry into force of the Non-Proliferation Treaty (NPT) in 1968. The NPT requires that member non-nuclear states will accept a set of safeguards on peaceful nuclear material including periodic inspections and audits, thus discouraging their diversion to military purposes. These safeguards must be directly negotiated with and are administered by the IAEA.

The broad objective of IAEA safeguards is to play their part in the international endeavours aimed at deterring the proliferation of nuclear weapons. The IAEA's safeguards activities encompass among other things the sum of the measures taken to verify that safeguards obligations assumed by States under agreements with the IAEA are fulfilled.

Nuclear material is essential for the production of nuclear weapons or other nuclear explosives and may be used for military purposes other than nuclear weapons. Under NPT agreements, IAEA safeguards focus on verifying that no nuclear material is diverted from peaceful activities. Also, certain non-nuclear materials may be essential for producing nuclear material suitable for use in nuclear weapons or other nuclear explosives. Such materials are required to be safeguarded under certain non-NPT type agreements.

IAEA safeguards agreements define conditions under which safeguards will be applied in nuclear installations. Nuclear installations are divided into "facilities" and "other locations" for safeguards purposes. In addition, nuclear equipment may be subject to safeguards under non-NPT agreements, at the request of IAEA Member States.

Nuclear material accountancy within the framework of IAEA safeguards begins with the nuclear material accounting activities which are undertaken by or on behalf of facility operators in response to requirements set by the SSAC*, arising from obligations defined in agreements between the IAEA and a state. These activities and the corresponding accounting information generated are verified through independent IAEA inspection. These inspection activities, after evaluation, provide one of the means of detecting diversion and of deterring diversion by the risk of early detection. They also make it possible to determine the degree of assurance provided by the safeguards measures.

Nuclear material accountancy depends very much on procedures, methods and techniques for sampling and measurement of nuclear matter. Physical standards are required to calibrate measurement methods and provide a basis for

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* SSAC (State Systems of Accounting for, and Control of, Nuclear Material).

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determining the accuracy of measurements. A good quantitative system and control programme is essential for adequate nuclear material accountancy.

Nuclear matter must be measured to determine the amounts to be accounted for, and the accounts are therefore subject to uncertainty due to measurement errors which are inherently associated with all quantitative systems. Statistical concepts and methods are used to estimate measurement errors and to determine the level of quantitative uncertainty associated with each nuclear material account: they are further used as a basis for tests of statistical and safeguards significance and to reduce inspection effort and intrusion (153/para 6).

The IAEA safeguards approach to any particular facility is based on nuclear matter accountancy, complemented by containment and surveillance measures. The most desirable combination of these measures is that which permits the safeguards objectives to be achieved at acceptable costs and with minimum intrusion into routine plant operations.

Information received from a state or provided by a facility, i.e. notifications, design information, various other reports and documents, and the records of nuclear material kept by facilities are the basis on which the IAEA builds to discharge its safeguards responsibility. In this regard, safeguards inspection is the most important procedure implemented to verify the completeness, correctness and validity of such information.

The main instrumentality used by the IAEA to carry out its verification function under INFCIRC/153 is the national accounting and control system of the state to which safeguards are being applied. The IAEA requires that certain minimum elements be included in the national system which provides information to the Agency. The Agency's primary role is to verify the findings of this national mechanism.

Finally, precautions against disclosure of industrial secrets take several forms under the INFCIRC/153 safeguards system. First, the access given IAEA inspectors is limited. A state can exclude sensitive areas during the selection of the "strategic points" which are listed in Subsidiary Agreements, thus preventing at least regular inspection of these areas. Second, the IAEA becomes legally liable if any information leakage occurs for which it is responsible. Third, the IAEA applies strict internal "safeguards" within its own organization to avoid such leakage. The fact that IAEA inspectors may be accompanied by representatives of the state being inspected helps prevent undesired disclosures. Furthermore it is sponsored by the United Nations.

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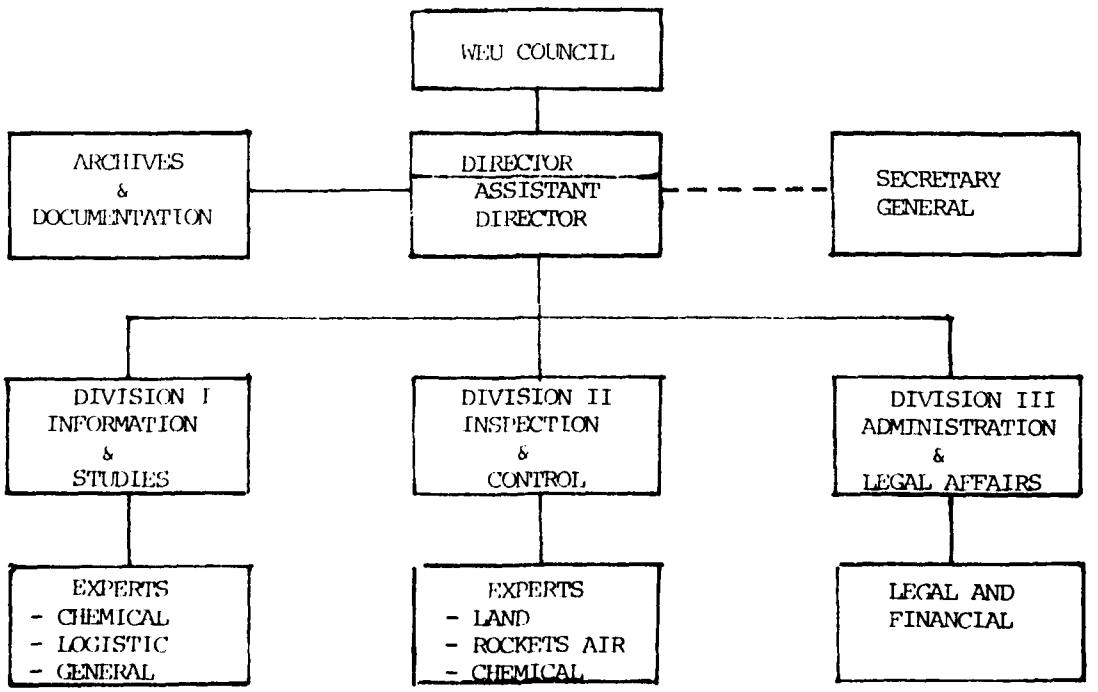
Agency for the Control of Armaments (ACA)

Arms Control Problem: Chemical
(conventional)

Verification Methods: On site
Collateral Analysis

The Armaments Control Agency established by the revised Brussels Treaty of 23 October 1954 has been monitoring the non-production of chemical weapons since 1957/58 as well as conventional armaments in member states of the Western European Union (WEU). Although a problem of prior consent under certain circumstances exists, the Agency executes its mission through two methods of "documental control" and "field control measures."



ORGANIZATION CHART

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The operating procedures in respect to chemical weapons inspection are outlined in CD/37 submitted by the FRG on 12 July 1979. The initiative for on-site inspections lies with the Armaments Control Agency of the WEU. The director of the Agency appoints two to four officials of different nationality, one of them a national of the country in which the inspection is to be carried out. A representative of the competent national authority assists the Agency in the execution of its controls.

During such controls the representatives of the Agency enquire about the organization, operation and production programme of the plant.

The subsequent visit to the production plant covers only those departments dealing with the decisive phase of reaction. The inspectors are shown built-in measuring instruments so that they can verify the quantities of the pre-products employed in the production of a substance and the final output. If further clarification is required, the findings are compared with the factory's records or books.

The inspectors pay special attention to the factory's safety precautions. These are always clearly visible, cannot be concealed, and together with the lack of special equipment and installations, provide the clearest possible indication that no chemical warfare agents are being produced in the plant.

In special cases sampling as a means of control is useful and effective for identifying specific substances and determining whether they are prohibited warfare agents. The high degree of toxicity of most of these substances poses the problem of liability in the case of accidents or damage caused or suffered by inspectors.

The inspection is carried out in stages in order to avoid, as far as possible, any interference with the civilian sector. As soon as the inspectors are satisfied that the non-production pledge is being kept, the control must cease. If the visit to the production plant, including the inspection of special safety precautions (first control measure), is not deemed to be sufficient, the control may be extended to the employment of initial and intermediate products in the controlled stage (second control measure). If there is still no certainty that chemical weapons are not being produced, the factory's records may be checked against the instrument readings (third control measure). Samples may be taken as the fourth and last measure.

After each on-site inspection the inspectors report orally to the director of the Agency. They also prepare a written classified report which remains in the Agency's files. It may not be brought to the notice of any person outside the Agency. Neither the factory concerned nor the competent national authority is consulted in the preparation of the report.

The representative of the national authority who has taken part in the inspection also prepares a report so that the authority concerned may have its own documents available in the event of recurrent inspections. This report is transmitted to the management of the factory concerned.

The staff of the Armaments Control Agency are international officials. They must in no circumstances whatever reveal to third parties information obtained as the result of their official tasks. Special protection is accorded to industrial, economic, commercial and scientific information, whether classified or not.

The Armaments Control Agency submits annual reports to the Council of the Western European Union. These reports contain the number of controls, the names of the companies concerned, and the results, stating such difficulties or problems that may have occurred without, however, going into detail.

Recognizing that the ACA inspection actually takes place in a non-adversary relationship, one may conclude that it is possible for on-site inspections to prove, without disclosing any classified information on the production process, that chemical warfare agents are not being produced, and the experience gained from WEO controls demonstrates that the practices outlined above could be useful in establishing effective and economically unharmful verification of a world-wide ban on the manufacture of chemical weapons.

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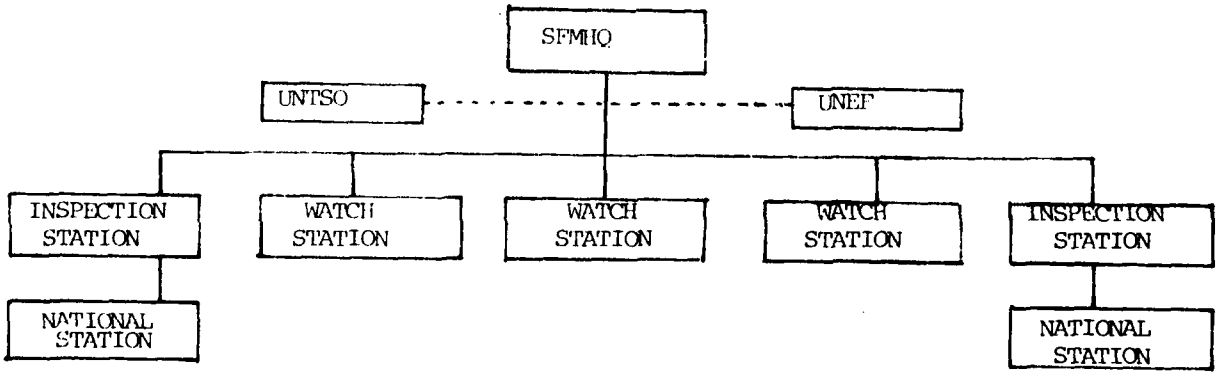
United States Sinai Support Mission (SSM)

Arms Control Problem: Conventional

Verification Methods: Remote sensing
in situ
(Inspection Team/
Control Posts)

Under the disengagement arrangement as concluded in the Sinai II agreement of 4 September 1975, the Sinai Support Mission (SSM) was established. This mission, which has employed and continues to up-date advanced remote sensing techniques in support of the more conventional international monitoring system employing mobile inspection teams, observer posts, etc., is closely coupled as well to national verification systems of the two contracting parties. The basic responsibilities of the SSM were to report any movements of armed forces or preparation for such movements into the Giddi or Mitla passes (see map) and to verify the nature of operations at the national electronic surveillance stations in the buffer zone.



ORGANIZATION CHART

In order to provide surveillance at the level required and to ensure compliance to the terms of the agreement on the part of the contracting parties, the Sinai Field Mission (SFM) was established with a tactical early warning system consisting of four general sensor fields, three manned watch stations, inspection stations as located with the two national surveillance stations and a headquarters in the field overlooking the Giddi Pass.

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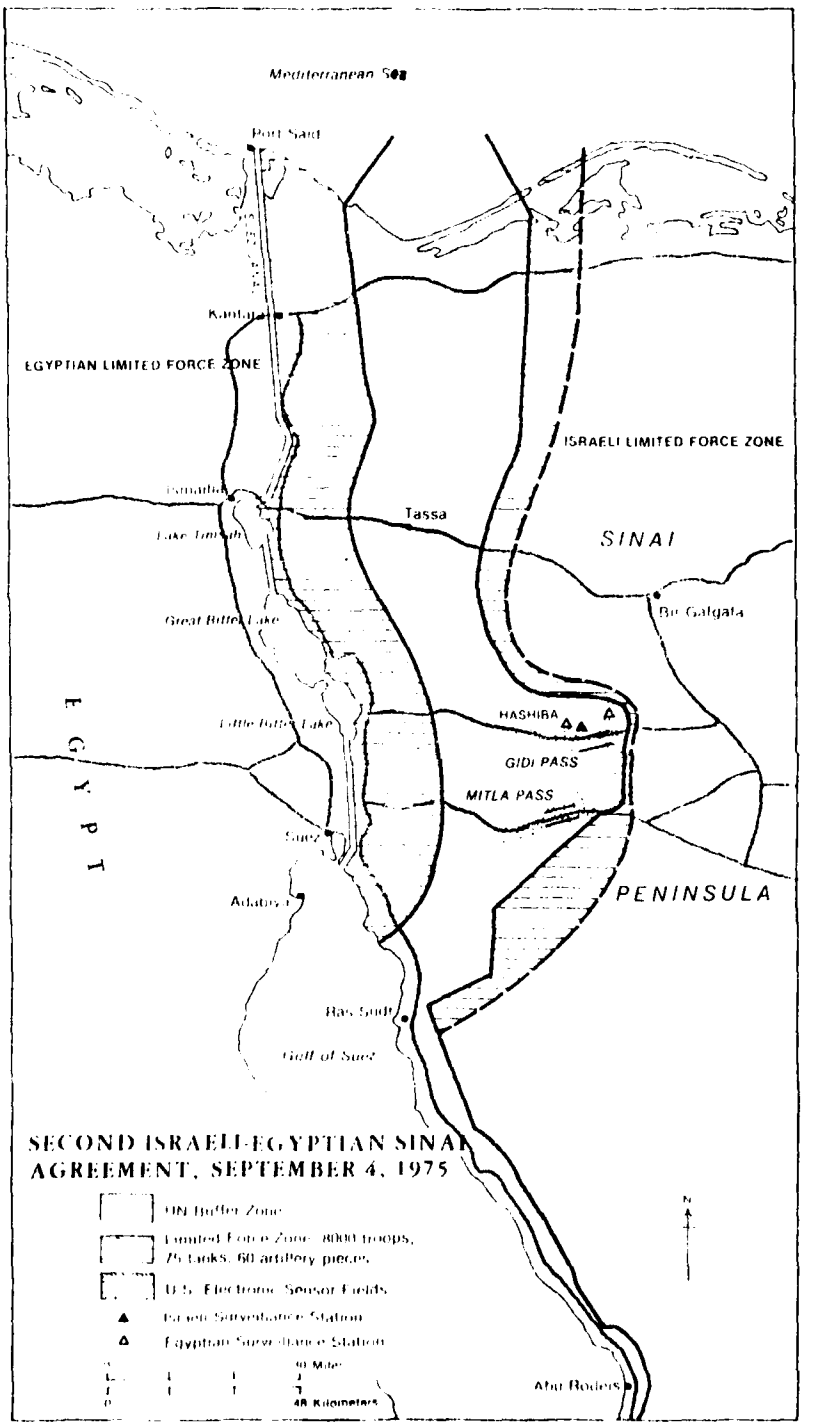

Source: Nadar Safran, Israel, The Embattled Ally (Cambridge, Mass. and London: The Belknap Press of Harvard University Press, 1978), p.555.

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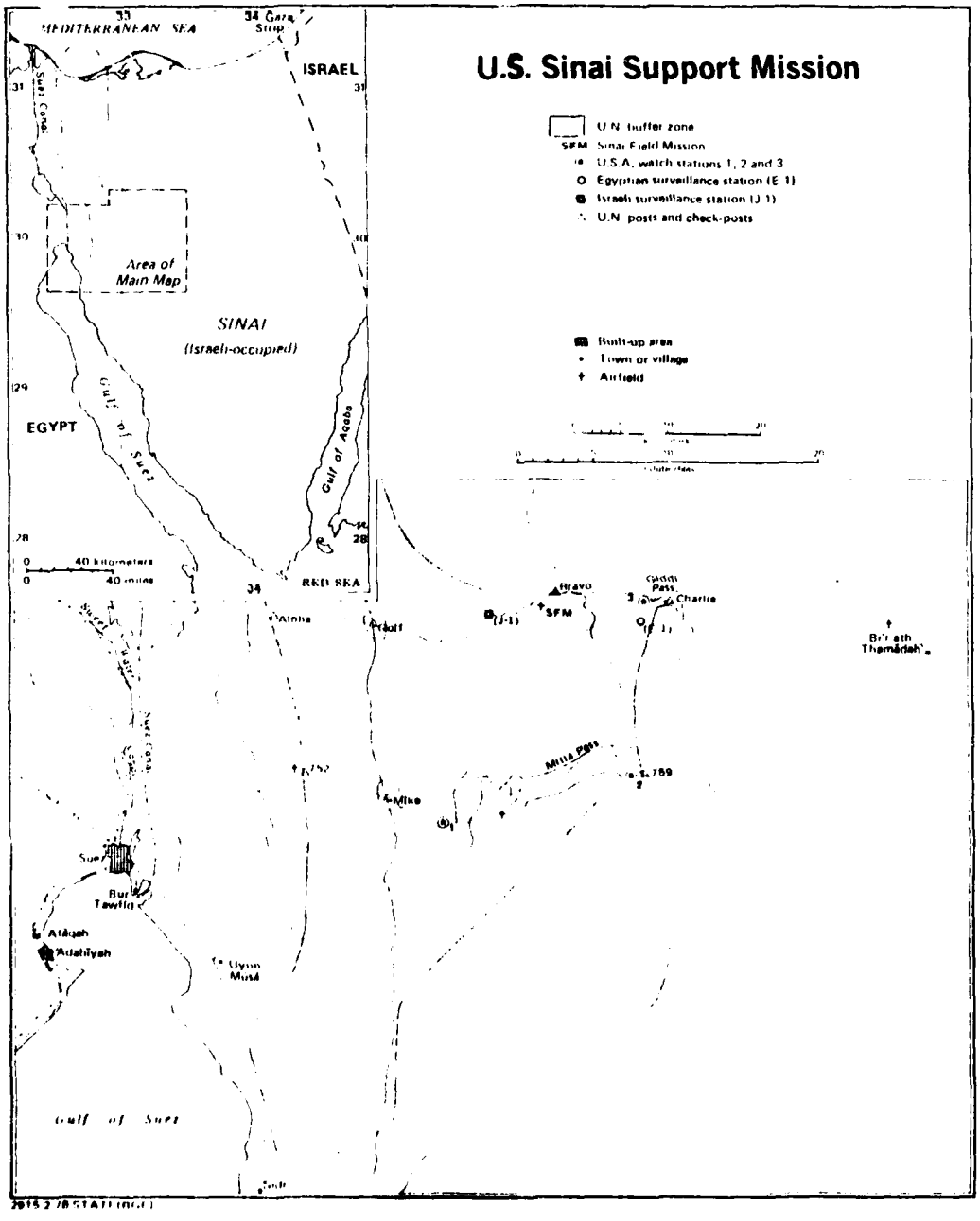

Source: U.S. Sinai Support Mission, Report to Congress, April 13, 1978, p.4.

As originally constituted the SFM worked closely with two international (United Nations) control missions each charged with aspects of overall verification.

The United Nations Emergency Force (UNEF II), formed after the 1973 October war and disbanded in 1978, had primary responsibility for supervising the Sinai disengagement arrangements and for assuring compliance with various provisions of the Sinai II Agreement. It maintained checkpoints at key road intersections throughout the Buffer Zone and patrolled the area to prevent or detect any unauthorized movement therein. It also monitored the Limited Forces Zone and Missile Free Zones established by the Sinai II Agreement through bi-weekly and special inspections by UN military observers from 17 countries functioning under the second UN control mission, the United Nations Truce Supervisory Organization (UNTSO) headquartered in Jerusalem. It has functioned with representatives from both superpowers since 1948.

The SFM complemented the role of the UNEF in the Buffer Zone by monitoring the Mitla and Giddi Passes, and it worked in close cooperation with UNEF patrols and personnel at checkpoints to carry out this responsibility. It also coordinated frequently throughout the day with UN officers in controlling the movement of personnel and vehicles in and out of the Egyptian and Israeli electronic surveillance sites.

Except for SFM vehicles, permitted to circulate freely within the early warning area, all traffic in the Sinai Buffer Zone had to be authorized and escorted by the UN Emergency Force (UNEF), which retained overall responsibility for the area. All vehicles moving in the vicinity of the Passes were detected when they activated one or more of the ground sensors guarding the passes or when they were observed visually by SFM personnel on duty at the watch stations. On a typical day up to some 200 vehicles or other objects had been detected by the sensor fields and recorded by personnel on duty at the watch stations. Usually these sensor activations were caused by authorized UN or SFM vehicles, natural seismic disturbances, or scheduled aircraft overflights.

SFM worked closely to effect coordination of monitoring activity with UNEF, until its disbandment in 1978, and with UNTSO. Operational guidelines and procedures were discussed and discharged. The functions of SFM continue to evolve with improved detection and identification requirements. Initially sensor activations were received and analyzed at the three watch stations, with findings reported

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to the operations centre at SFM headquarters. The system was improved to promote more timely tracking and centralization of the detection/identification system process. Remotely controlled day and night vision cameras have been used to augment the seismic detection as has a remotely controlled television system,SFM has worked with thermal imaging devices similar to forward looking infrared system (FLIR). This application of advanced technology to more conventional methods in the verification process at the international level is of significance.

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With political tensions increasing throughout the world individual states and alliances have accelerated their search for security. Traditional suspicions among nations have consequently grown. Therefore, the value of future arms control agreements will depend on their verifiability. Using the experiences of the U.N. Committee on Disarmament (CD), this study looks at verification in a general sense and offers a framework for a conceptual approach to the issue.

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