SATELLITE-BASED MULTILATERAL ARMS CONTROL VERIFICATION SCHEMES AND INTERNATIONAL LAW

by

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ABSTRACT

Verification of compliance has been and will continue to be an essential component of arms control and disarmament agreements. Following a brief historical survey of verification, this study examines in detail verification provisions in all major multilateral and bilateral disarmament agreements, in force and in the drafting stage, from the perspective of monitoring compliance by satellites. The feasibility of verification from space is examined from technical and legal points of view. Important differences are noted between bilateral and multilateral agreements in terms of verification requirements. The effectiveness of, as well as confidence in, the verification process, it is suggested, will be significantly enhanced if the monitoring is carried out by an organization in which all contracting states have a say in the planning and conduct of monitoring and participate in decision-making. This study analyzes various official and private recommendations for the establishment of such an organization, with special emphasis on the proposed International Satellite Monitoring Agency (ISMA) whose constitution, structure and functions are set out in a comprehensive report prepared by a United Nations group of experts. The ISMA could play, in the opinion of the author, an important auxiliary role in monitoring compliance with many existing disarmament agreements as well as with those currently in the drafting phase.

RESUMÉ

La vérification portant sur l'application a été et continuera d'être un élément essentiel des accords de désarmement et de contrôle de l'armement. Après une brève évocation historique de la vérification, cette étude examine en détail les dispositions portant sur la vérification se basant sur les méthodes de gestions par satellite, incluses dans les accords de désarmement bilatéraux ou multilatéraux, en vigueur ou en négociations. La faisabilité de la méthode de vérification par satellite est ensuite examinée du point de vue juridique et technique. D'importantes divergences sont soulignées entre accords bilatéraux et multilatéraux en terme de spécifications et de besoins en matière de vérification. Il est suggéré que l'efficacité et la confiance en ces méthodes de vérifications sera améliorée si les activités sont conduites par une organisation au sein de laquelle les états contractants auront une influence sur la planification et les activités elles-même ainsi qu'une participation directe à la prise de décision. D'autre part, cette étude analyse plusieurs recommandations officielles ou privées visant l'établissement d'une telle organisation, avec un intérêts particulier pour l'Agence internationale de vérification par satellite (AIVS) dont la constitution, la structure et les fonctions ont été précisées par un important rapport préparé par une groupe d'experts des Nations Unies. Suivant l'opinion de l'auteur, l'AIVS pourrait jouer un rôle auxiliaire capital pour la vérification de l'application des accords de désarmement en vigueur et ceux étant actuellement en projet.

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PREFACE

The reader should take into account that research for most of this study as well as its writing was completed before or during recent dramatic changes in Eastern Europe- the disintegration of the Soviet Union, demise of the Warsaw Pact alliance and the peaceful reunification of Germany. Given such unprecedentedly rapid developments in global geo-politics and especially in the politico-military relations between former adversaries, some of the data used in the study and the conclusions based on such data may have been overtaken by events.

Throughout this study there are many references to the Soviet Union, although at the time of its submission the USSR as a federation of sixteen socialist republics no longer existed. Nevertheless, Russia as a legal successor to the Soviet Union, by far the biggest and most populous of the new independent states that have emerged on the territory of the former USSR and with most of the human and material space-oriented resources, will continue to play a major role in the disarmament debate and negotiations, especially those involving outer space activities. With the possible exception of Ukraine, it is doubtful that any of the new states, ex-former Soviet republics, will in the foreseeable future have the means and even the will to mount a major effort in space.

Whereas the momentous events of the last few years, impossible to anticipate even a short time before their occurrence, have had a profound effect on East-West relations, particularly on the military competition between the two superpowers, developing a reliable universally accessible system for verification of arms control and disarmament agreements remains one of the more urgent tasks before the international community. In that system, yet to be devised and implemented, verification by satellites should have a major role, probably an ever increasing role, as the technology of gathering information continues to improve.

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1. Introduction

The history of mankind reveals a continuous record of warfare, perhaps because war was all too often seen as the only effective means to secure the survival of a particular community that otherwise might have perished. Hence, while historically there was an overabundance of research on how to win a war, there was very little study on how to achieve a peaceful society. Although efforts had been made to make wars less destructive, the institution of war itself was left untouched.

World War I was the turning point in the history of warfare, which gave a wholly new meaning to the institution of war. The experience of this first total war, which caused incomparable human and material losses, introduced in the dialogue of states the idea of the necessity for global disarmament as well as a desire to outlaw war itself.[1]

From the historical point of view, apart from some passages in religious books such as Isaiah and Micah in the Old Testament thought to be the embryonic forms of the disarmament efforts,[2] one of the oldest documents refers to the cessation of armed conflict among divided Chinese powers of the Spring and Autumn Dynasty in 546 B.C.[3]

In Europe, the Catholic church made efforts to reduce the destructiveness of warfare by edicts such as the "Peace of God", which forbade attacks on specific places and people, and the "Truce of God", which banned the conduct of hostilities during specified times.[4] Although both kinds of documents were drawn in the late tenth century for regional use in central and southern France, they gradually spread into other countries of Europe and eventually became a part of general ecclesiastical law, adopted by the Second Lateran Council (1139) and the Third Lateran Council (1179).[5]

One of the earliest "Truce of God" regulations made by French prelates in 1041, provides

> "that all Christians, friends and enemies, neighbours and strangers, should keep true and lasting peace one with another from weapons on Wednesday to sunrise on Monday, so that during these four days and five nights, all persons may have peace, and trusting in peace, may go about their business without fear of their enemies".[6]

The Second Lateran Council (1139) reportedly declared a ban on the use of a crossbow against Christians. It is interesting to note that this "principal medieval hand-operated missile weapon[7] continued in widespread use, despite the papal decree. It may be of some interest to mention that neither the Second nor the Third Lateran Council prohibited poison weapons, which were widely used in that period.[8]

Papal decrees were widely ignored throughout the medieval period, and only occasionally would they be of help in individual cases. By the sixteenth century, the crossbow as well as the longbow had been replaced by gunpowder, inaugurating a new, more destructive phase in warfare.

2. From the Peace of Westphalia to World War I

The nation-states that came into being in the fifteenth and sixteenth centuries were much more capable of waging war on a large scale than feudal states and city states of the medieval era because of the introduction of standing armies and more efficient weapons. Among numerous wars fought between the fifteenth and seventeenth centuries, probably the most devastating conflict was the Thirty Years' War (1618-1648),[9] the last major religious war which ended with the Peace of Westphalia,[10] signed at Mürster and Osnabrück.[11]

The political arrangements made by that Treaty are regarded as the birth of modern European society. Several provisions in the Peace of Westphalia suggest disarmament regulations despite the fact that they were imposed by the victors.[12] The treaty provided, for instance, that

> "Immediately after the Restitution of Benfeld, the Fortifications of that Place shall be rased, and of the Fort Rhinau, which is hard by, as also of

Tabern in Alsatia, of the Castle of Holember and of Newburg on Rhine : and there shall be in none of those Places any Soldiers or Garison " (Article LXXXIII of the Treaty of Münster),[13]

"The Magistrate and the inhabitants of the said City of Tabern shall keep an exact Neutrality, and the King's Troops shall freely pass thro'there as often as desired. No Forts shall be erected on the Banks of this side of the Rhine, from Basle to Philipsburg; nor shall any Endeavours be made to divert the Course of the River, neither on the one side or the other." (Article LXXXIV of the Treaty of Münster),[14]

"Finally, that the Troops and Armys of all those who are making War in the Empire, shall be disbanded and discharged; only each Party shall send to and keep up as many Men in his own Dominion, as he shall judge necessary for his Security."(Article CXVIII of the Treaty of Münster).[15]

These provisions are interesting not only as one of the earliest efforts at disarmament, but also as the first disarmament initiative missing an effective verification systems.

Even before modern times, many works on abolishing war had been published in Europe, although most of them are of importance not for their specific disarmament proposals but rather for their new ideas for creating perpetual peace.[16] Several contemporary scholars, including William Penn, Abbé de Saint-Pierre and Jeremy Bentham did suggest certain concrete measures to keep Europe peaceful.[17] William Penn, for instance, thought that the parliament of Europe by which the common rules of justice for sovereign princes would be established, should mediate and arbitrate the differences between states.[18] Abbé de Saint Pierre, one of the main actors in the French Enlightenment Period, saw the road to perpetual peace through the creation of a grand alliance of Europe.[19] Jeremy Bentham was even more specific by proposing that treaties be concluded limiting the number of naval and land forces allowed to state parties.[20] His fourteen proposals are said to be the first to "lay major emphasis on disarmament as a prerequisite for maintaining peace"[21]

The famous essay of Immanuel Kant, *Perpetual Peace*, is often referred to as the source of the St. Petersburg Declaration (1868)[22] and the Hague Conventions and Declarations (1899, 1907).[23] In that essay, Kant advocated, *inter alia*, the ban on the employment of assassins and poisoners, on the violation of articles of surrender, and the instigation of treason, as the prerequisites for building mutual confidence among nations in peace time.[24]

In 1766 and 1769, the Chancellor of Austria, Prince Kaunitz, proposed to Prussia a seventy-five percent mutual arms reduction, which Prussia rebuffed.[25] In 1816, Tsar Alexander I of Russia made a similar proposal, but no great power showed any interest in considering it.[26]

However, not all proposals for disarmament from the more distant past had failed. *The Exchange of notes between Great Britain and the United States relative to naval forces on the American lakes* of 1817 (hereinafter the Rush-Bagot Agreement), is worthy of mention as "the most successful disarmament effort of the nineteenth century".[27] Both the United States and Great Britain could have justified a naval arms race after the war of 1812, which proved the importance of naval control over the Great Lakes, and in 1815 Great Britain actually announced its intention to expand armed forces in that area. It was at that time that the United States took the initiative to negotiate with the British Government the regime of the Great Lakes. Great Britain saw certain advantages in limiting its naval forces on the Great Lakes because ships located there could not move to the high seas and also because the cost of maintaining its ships was high due to the great distance from the homeland. Eventually, the Rush-Bagot Agreement was signed in 1817,[28] which prescribed limitations on the naval forces of the two parties on the Great Lakes.[29] This Agreement was made possible primarily because in North America the geopolitical situation was not so complicated as in Europe. Furthermore, both Great Britain and the United States did not intend to wage a large-scale war again. This enabled them to put economic factors ahead of politics. No comparable bilateral agreements could be achieved during the nineteenth century among European states except in cases where a victor in a war would impose upon the vanquished certain restrictions on armaments.[30]

As the nineteenth century was drawing to an end, following years of war and competition in armaments, there began to emerge a countervailing attitude towards arms proliferation during the last decade of the century.[31] In August of 1898, the Foreign Minister of Russia issued an official invitation to all the major powers to attend an international conference aimed at reducing armaments.[32] Although most governments were dubious of Russian sincerity, the second Russian circular note of 1899, which had a much more specific agenda than the initial invitation, resulted in the holding of the First Hague Peace Conference.[33]

The First Hague Conference failed to limit armaments. Reductions in naval arms were expected at that time because both Great Britain and Germany were engaged in a heated arms race which had some similarity to that between the U.S. and the USSR in the post-World War II period.[34] However, the Conference could not reach even a moderate agreement on non-augmentation of armies, navies and war budgets for a fixed term.[35] The Conference, nevertheless, succeeded in the signing of some important conventions which provided for the establishment of the Permanent Court of Arbitration,[36] the laws of land warfare,[37] and the adaptation of the principles of the Geneva Convention to maritime warfare.[38] In addition, the Conference adopted declarations on the prohibition of the throwing of projectiles and explosives from balloons,[39] on the prohibition of the use of projectiles whose sole object was the diffusion of asphyxiating or deleterious gases,[40] and on the prohibition of the use of bullets that expand or flatten easily in the human body.[41]

The deterioration of the balance of power accelerated after the First Hague Conference and the atmosphere at the Second Hague Conference of 1907 was less favourable to disarmament.[42] The Second Hague Conference, nevertheless, reached a modest measure of disarmament by prohibiting bombing from the air although the prohibition was binding only when all belligerent became parties to that Declaration.[43] This Declaration was analogous to the one which had been adopted in 1899; the participating states agreed to be bound by it only until the close of the Third Hague Conference, which was never convened.[44]

Before the outbreak of World War I, all the efforts to slow down the naval arms race between Great Britain and Germany had failed.[45] Thus, for example, in 1909, the British government proposed neutral inspection of dockyards to Germany; this was rejected.[46] In 1913, Great Britain offered a one-year moratorium on naval construction again in vain.[47] Ironically, the naval arms race turned out to be a tremendous waste of resources during the War:

> Great Britain and Germany hardly used their elaborate fleets in World War I. Nearly all the German ships were tied down in their ports by a British

> naval Blockade. As a consequence, Germany could not employ surface raiders and there was only one large scale surface-ship engagement during the war. Submarine battles and land combat proved much more significant. Nevertheless, the arms race probably contributed to the outbreak of the war.[48]

B. DISARMAMENT AND ARMS CONTROL EFFORTS OF THE INTERWAR PERIOD

1. The Versailles Treaty

Renewed disarmament efforts began during World War I, a war which easily established an unparalleled record in human and material losses.[49] Even before entering the war, U.S. President Woodrow Wilson proposed that disarmament be included in future peace treaties, a view shared by some European leaders.[50] President Wilson's famous Fourteen Points contained, *inter alia*, the following proposal:

> IV Adequate guarantees given and taken that national armaments will be reduced to the lowest point consistent with domestic safety.[51]

While unwilling to reduce their own armaments, the victorious allies imposed disarmament on the defeated countries under the Peace Treaties.[52] For instance, Part V (Military, Naval and Air Clauses) of the Versailles Treaty[53] provided that the German army be cut to 100,000 men, the General Staff be dissolved (art. 160)[54] and that conscription be abolished (art. 173).[55] Also, Germany was banned from possessing tanks, submarines, military or naval aircraft (arts. 171, 181 and 198).[56] Furthermore, all fortifications on the Rhine had to be dismantled and disarmed.[57] In terms of monitoring compliance with disarmament agreements, of particular interest is Section IV (Inter-Allied Commissions of Control) of Part V of the Versailles Treaty, which deals with inspection measures.[58] According to Section IV (arts. 203-210), all the provisions in Part V were to be implemented by Germany at the expense of the German Government including the upkeep and cost of Inter-Allied Commissions.[59] The Commissions were to "be entitled as often as they think desirable to proceed to any point whatever in German territory, or to send subcommissions, or to authorise one or more of their members to go, to any point".[60] In addition, the German Government was obliged to cooperate with the Commissions in accordance with the Treaty[61] concerning the information "relating to the location of the stocks and depots of munitions, the armament of fortified works, fortresses and forts which Germany is allowed to retain, and the location of the works or factories for the production of arms, munitions and war material and their operations" (art. 208).[62] With respect to naval matters, the German Government was obligated to allow the Naval Inter-Allied Commissions of Control to proceed to its building yards and to supervise the breaking up of the ships under construction there and to take delivery of all surface ships, submarines, salvage ships, docks and tubular docks in order to supervise the destruction of these vessels.[63] In this undertaking, the German Government also had the obligation to provide the Commission with information concerning the "designs of the warships, the composition of their armaments, the details and models of their guns, munitions, torpedoes, mines, explosives, and wireless telegraphic apparatus"(art. 209).[64] Similar provisions can be found in the air clauses of the Treaty. The Aeronautical Inter-Allied Commission of Control was accorded vast powers. Its responsibilities included:

> --- to make an inventory of the aeronautical material existing in German territory, to inspect aeroplane, balloon and motor manufactures, and factories producing arms, munitions and explosives capable of being used by aircraft, to visit all aerodromes, sheds, landing grounds, parks and depots, to authorise, where necessary, a removal of material and to take delivery of such material. The German Government must furnish to the Aeronautical Inter-Allied Commission of Control all such information and legislative, administrative or other documents which the Commission may consider necessary to ensure the complete execution of the air clauses, and in particular a list of the personnel belonging to all the German Air Services, and of the existing material, as well as of that in process of manufacture or on order, and a list of all establishments working for aviation, of their positions, and of all sheds and landing grounds.[65]

These provisions in Section IV of Part V of the Versailles Treaty are among the most demanding inspection clauses of modern times. The obligation to collaborate with the Inter-Allied Commissions of Control amounted almost to the waiver of sovereignty by requiring a sovereign country to furnish all and any information and documents requested to a foreign inspection group that would normally be regarded as vital state secrets. These measures are somewhat comparable to the so-called "on-site inspection"[66] that can be found only in certain agreements such as *The Antarctic Treaty* (1959),[67] *The Sea-Bed Treaty* (1971),[68] and *The Intermediate-Range Nuclear Forces Treaty* (1987).[69]

2. The Covenant of the League of Nations

One of the outcomes of World War I was a fairly universal desire for a peaceful international society that would not have to rely on a precarious balance-of-power system. President Wilson's Fourteen Points recommended a "general association of nations [to] be formed under specific covenants for the purpose of affording mutual guarantees of political independence and territorial integrity to great and small States alike".[70] The initiative of President Wilson resulted in the creation of the League of Nations.[71] The only mention of disarmament in the Covenant of the League can be found in Article 8, Section 1, which provides that "[t]he Members of the League recognize that the maintenance of peace requires the reduction of national armaments to the lowest point consistent with national safety and the enforcement by common action of international organizations."[72]

Although the words "consistent with national safety" were broad enough to allow individual countries to carry on the armaments programs they choose to pursue, the idea of collective security under the supervision of an international organization represented a significant innovation. The Covenant also provided that the Council of the League would "formulate plans for such reduction"[73] and after the limits of armaments were fixed, the limits would not be exceeded without the concurrence of the Council.[74] In addition, the member states undertook to "interchange full and frank information as to the scale of their armaments, their military, naval and air programmes"[75] for which the Council had an advisory function.[76]

Unfortunately, the political situation in the post-war world was not conducive to compliance with the spirit of the Covenant. Although World War I was over, civil wars broke out and political turmoil continued both in Europe and in colonial or semi-colonial regions. For these reasons, the high hope for a new international political and legal order, based on the League of Nations, remained largely unfulfilled.

3. <u>The Arms Trade Agreements</u>

In 1919 and 1925 respectively, the *Convention for the Control of the Trade in Arms and Ammunition* and the *Convention for the Supervision of the International Trade in Arms and Ammunition and Implements of War*[77] were signed in order to reduce the international arms trade. The general content of the two conventions is similar except that the Supervision Convention divides arms, ammunition and implements into five categories,[78] which would enable more effective inspection.[79] However, these conventions failed to provide effective arms control instruments because both lacked an enforcement mechanism.

4. <u>Chemical Weapons Agreements</u>

As was mentioned in the previous section, as early as 1899, the First Hague Conference produced a declaration banning the use of projectiles the sole object of which was the diffusion of asphyxiating or deleterious gases. The horrors of poison gas, used for the first time in World War I, caused the world community to proscribe its use in war. The peace treaties imposed on the defeated countries contained provisions banning the use, manufacture and importation of poison gas.[80]

It is interesting to note that the agreement among the victorious allied nations, the 1922 *Treaty Between the United*

States of America, the British Empire, France, Italy and Japan in Relation to the Use of Submarines and Noxious Gases in Warfare (the Washington Treaty), recognized the prohibition of poison gas:

> The use in war of asphyxiating, poisonous or other gases, and all analogous liquids, materials or devices, having been justly condemned by the general opinion of the civilised world and a prohibition of such use having been declared in treaties to which a majority of the civilised Powers are parties,... (Article V)[81]

The famous *Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare* (the Geneva Protocol) signed in 1925[82] contained the same prohibition as that in the Washington Treaty of 1922. It stipulated that "this prohibition shall be universally accepted as a part of International Law, binding alike the conscience and the practice of nations".[83] This Protocol survived the Second World War and can be rightly regarded as the first important and effective multilateral arms control agreement. Although the wording of the Protocol is broad enough to encompass a wide range of weapons, reportedly no significant violation of its prohibition occurred during World War II, except by the Japanese against Chinese forces.[84] As the ban on the use of poison gas was thought "to ha[ve] become declaratory of customary international law"[85] by 1937, Japan probably could not justify its use by claiming that it did not ratify the

Protocol. Concerning the reasons for the compliance with the Protocol, two eminent authors, McDougal and Feliciano, believe that it was more fear of retaliation than a desire to comply with international law that kept both the Allied and the Axis Powers from resorting to gas warfare.[86]

5. **The Paris Pact of 1928 and the First World Disarmament Conference**

The Pact of Paris, usually known as *the Kellog-Briand Pact* (1928), can be cited as an example of an international disarmament agreement that did not have effective enforcement provisions.[87] This Pact symbolizes the continued interest during the interwar period to reduce armed forces and to make the world free from the scourge of war. That movement culminated in the First World Disarmament Conference (1932-1933), which was held in difficult circumstances characterized by creeping totalitarianism and a sagging world economy. After five years of effort by a preparatory commission acting under the auspices of the League of Nations, a draft convention aiming to limit and reduce armaments (Article 1) was completed and approved in 1930, against the opposition of Germany and the USSR.[88]

A World Disarmament Conference was convened in 1932, during which an important resolution (the so-called Simon Resolution) was issued providing for the establishment of a Permanent Disarmament Commission with a constitution, rights and duties.[89] Unfortunately, the Simon Resolution was far too broad and ambiguous to constitute an effective monitoring system. A more elaborate international control system was envisioned in the French draft proposal:

> III- In all the contracting Powers, war materials, both those of the national defensive armies and those of the contingents for common action, will gradually be made uniform, their manufacture being internationally supervised and organized.
>
> IV- There will be organized among the contracting Powers a regular and permanent supervision of the execution of their obligations in regard to their armaments. This supervision will involve an investigation at least once a year.
>
> V- The general organization - to be established within a period to be fixed-being defined on the foregoing bases, the successive stages of its establishment will be settled, all arrangements being made for any of the parties concerned to be given at any time the necessary safeguard in regard to effective and the value of the forces to be compared, and to ensure that there is no increase of forces or expenditure on armaments for any State, apart from any exceptions duly justified and accepted by the Conference.[90]

Despite all the efforts[91] of some participants including President Roosevelt's intervention,[92] the political situation in the world was such that the Conference could not but fail.

6. <u>Naval Arms Control</u>

Naval arms control provides one of the few examples of successful arms limitation during the interwar period.

Although the relations between the U.S. and Japan after World War I were increasingly strained, mainly because of their conflicting interests in the western Pacific and east Asia,[93] an interest in naval arms control nevertheless existed in these countries, as well as in Great Britain. The public sentiment in these countries was clearly against a continuation of large-scale shipbuilding. This sentiment was especially conspicuous in the U.S., being deeply influenced by the Wilsonian peace movement of the early 1920's.[94] Japan, for its part, could not maintain an extended arms race with the United States and Great Britain. Thus the freezing of the arms race to maintain at least the status quo was acceptable both to Great Britain and Japan.[95]

Among the several treaties that the Washington Conference produced, *The Five Powers Treaty (Washington Naval Treaty of 1922)*[96] involving France, Great Britain, Italy, Japan and the United States, was concluded first and is of special importance to the subject-matter of this thesis. The treaty focused on the limitation in numbers and tonnage of capital ships[97] as the most powerful component of national naval forces. A 5:5:3:1.67:1.67 ratio was established for British, American, Japanese, French and Italian capital ships, with a tonnage ceiling of 525,000 tons (Article IV). A ten-year moratorium for capital ship construction was agreed upon (chapter II, part 3, section 1) and a limit was placed on the number of guns on new ships (chapter I, article X-XII). Restrictions were agreed upon concerning the improvement of existing fortifications (chapter I, article XIX) as well as the scrapping or conversion of capital ships afloat or being built (chapter I, articles II, XII; chapter II, part 2).[98]

The Treaty also imposed limitations on the development of aircraft carriers and the same ratio was applied as to that of capital ships (article VII).[99] However, limits on submarines and cruisers could not be agreed on that conference, although those vessels turned out to be more effective than capital ships in World War II.[100] Although naval competition continued, especially in the area of cruisers, the Washington Five Powers Treaty is believed to have provided a temporary stability that the postwar world needed. The Washington Naval Treaty was revised by the *London Naval Treaty of 1930*[101] by extending control over cruisers, destroyers and submarines, although this limitation was accepted by only the United States, Great Britain and Japan with France and Italy refusing to sign.[102]

After the London Naval Conference and the First World Disarmament Conference, the world political situation rapidly deteriorated. Japan announced in 1934 that it would no longer adhere to the Washington Naval Treaty after its expiration on December 31, 1931.[103] France and Italy for their part declared their unwillingness to accept any quantitative naval limitations. The signing of *the London Naval Treaty in 1936*[104] marked the end of interwar efforts to control and regulate armaments. This treaty only regulated peripheral equipment such as the calibre of guns on the warships (art. 3)[105] and placed a six year moratorium on building of cruisers of the ten thousand ton class (art. 6).[106] Although that treaty contained detailed advance notification and exchange of information clauses (Part III, arts. 11-21),[107] its failure to include any practical verification clauses made this Treaty virtually impotent.

The disarmament efforts between the two world wars, culminating in the First World Disarmament Conference, tend to suggest that, without most elaborate verification clauses, disarmament agreements are unlikely to be effective; and to attain such kind of agreements, a favourable political environment is of vital importance - a *sine qua non*.

CHAPTER I - ENDNOTES

1. See generally P. Noel-Baker, The First World Disarmament Conference 1932-1933 and Why It Failed (New York: Pergamon Press, 1979). This book describes the atmosphere of the interwar period, emphasizing the tug-of-war between the so-called hawks and the doves from the perspective of an English high official deeply involved with the League of Nations and the First World War Disarmament Conference in 1932-33.

2. T.N. Dupuy & G.M. Hammerman, eds., A Documentary History of Arms Control and Disarmament (New York: R.R. Bowker, 1973) at 1-2. A. Nussbaum, A Concise History of Law of Nations (New York: MacMillan, 1954) at 3.

3. Dupuy & Hammmerman, ibid. at 3-4.

4. In old English Law, "Peace of God" is the rest and cessation "which the king's subject had from trouble and suit of law between the terms and on Sundays and holidays". See, H.C. Black, Black's Law Dictionary, 5th ed., (St. Paul, Minnesota: West, 1979) at 1017. Also, this dictionary describes "Truce of God" as follows: "in medieval law, a truce or suspension of arms promulgated by the church, putting a stop to private hostilities at certain periods or during certain sacred seasons." at 1351.

5. Dupuy & Hammerman, supra, note 2 at 2-11; Nussbaumm, supra, note 2 at 17-18; E. Nys, Les origines du droit international (Brussels: Thorin & Fils, 1894) at 78-81.

6. Dupuy & Hammerman, ibid. at 6.

7. Ibid. at 11.

8. Nussbaum, supra, note 2 at 18.

9. Ibid. at 115-18.

10. C. Parry, ed., The Consolidated Treaty Series, vol. 1 (New York: Oceana, 1969) at 193-357 [hereinafter Parry's T.S.]

11. The treaty was negotiated at Münster and Osnabrück mainly because France and Sweden were not in accord with the question of precedence. As a result, France was made a principal party in Catholic Münster and Sweden was the first in Protestant Osnabrück. See Nussbaum, _supra_, note 2 at 115. The formal names of the Peace of Westphalia are: _Treaty of Peace Between Sweden and the Empire Signed at Osnabrück_ and _Treaty of Peace Between France and the Empire Signed at Münster_. Both Treaties were signed on 24 October 1648.

12. Dupuy & Hammerman, _supra_, note 2 at 13.

13. See 1 Parry's T.S. 343, Dupuy & Hammerman, _supra_, note 2 at 16; C.D. Blacker & G. Duffy, eds., _International Arms Control Issues and Agreement_, 2d ed., (California: Stanford Univ. Press, 1984) at 81. Another example of imposed disarmament is the _Treaty of Utrecht_ (1713) the section IX of which provides the destruction for the fortifications:

> "IX. Le Roi T.C. fera rafer toutes les Fortifications de la Ville de Dunkerque, combler le Port, ruïner les Eclufes, qui fervent au nétoiement du Port." 27 Parry's T.S. 483., Dupuy & Hammerman, _ibid._ at 20.

Reference should also be made to the _Treaty Between the Emperor and Spain and Great Britain, and the Netherlands for a Barrier for the Netherlands_ (the so-called Third Barrier Treaty), which has an interesting provision to regulate how to dismantle the fortification of Liège completely:

> "Quel les fortifications et tous les ouvrages de la cittadelle de Liége de même que celles du château de Huy aussi avec tous les forts et ouvrages seront rasez et demolis, sans qu'ils puissent être jamais rebatis ou retablis; bien entendu que laditte demolition se ferat aux depens des états du pays de Liége, à qui les materiaux resteront pour être vendus et transportés ailleurs; le tout aux ordres et sous la direction des Etats Gen., qui enverront pour cette fin de personnes capables pour avoir la direction de dites demolitions, auxquelles

on commencera de travailler immediatement après la signature du present traité, et que l'on acheverat en dedans trois mois ou plutôt s'ils se peut, et que cependant les garnissons des Etats Gen. des Prov. Un. ne sortiront de dittes places, avant que la demolition ne soit achevée". See 29 Parry's T.S. 356. Dupuy & Hammerman, ibid. at 20-22.

14. 1 Parry's T.S. 343.

15. 29 Parry's T.S. 353. Dupuy & Hammerman, ibid. at 16; Blacker & Duffy, ibid. at 81.

16. Even during medieval era, some solution to war was sought; Pierre Dubois is reported to be the first European to try to use an international organization as a deterrence to warfare. The idea of arbitration, proposed by Grotius, as well as the Grand Design by the Duc de Sully, the minister of Henry IV of France, are also often mentioned. M.S. McDougal & F.P. Feliciano, Law and Minimal World Public Order: The Legal Regulation of International Coercion (New Haven: Yale Univ. Press, 1961) at 263-65.

17. Ibid.

18. Dupuy & Hammerman, supra, note 2 at 13, 17-20.

19. Ibid. at 13, 22-26; McDougal & Feliciano, supra, note 16, at 265-66.

20. Dupuy & Hammerman, ibid. at 13, 27-32.

21. Ibid. at 28.

22. Ibid. at 47-48.

23. Ibid. at 54-57, 59-70.

24. Ibid. at 32-36.

25. Blacker & Duffy, supra, note 13 at 87.

26. Ibid.

27. Ibid. at 82.

28. 67 Parry's T.S. 153; Dupuy & Hammerman, supra, note 2 at 39-41. The Rush-Bagot Agreement is still in force.

29. Both Great Britain and the United Stated are allowed to sustain naval force to the limits set for as follows:

> "His Royal Highness, acting in the name and on the behalf of His Majesty, agrees, that the Naval Force to be maintained upon the American Lakes by His Majesty and the Government of the United States shall henceforth be confined to the following Vessels on each side--that is
> On Lake Ontario to one Vessel not exceeding one hundred Tons burthen and armed with one eighteen pound cannon.
> On the Upper Lakes to two Vessels not exceeding like burthen each and armed with like force.
> On the waters of Lake Champlain to one Vessel not exceeding like burthen and armed with like force.
> And His Royal Highness agrees, that all other armed Vessels on these Lakes shall be forthwith dismantled, and that no other Vessels of War shall be there built or armed."

30. Blacker & Duffy, supra, note 13 at 83.

31. Ibid. at 83.

32. Ibid. See also, Dupuy & Hammerman, supra, note 2 at 48-50; J.B. Scott, ed., Instructions to the American Delegates to the Hague Peace Conferences and Other Official Reports, (New York: Oxford Univ. Press, 1916) at 1-2.

33. Dupuy & Hammerman, ibid. at 50-51; Scott, ibid. at 3-5.

34. The arms race between Great Britain and Germany was said to resemble that between the two super powers today in that: (1) the weapons in question had been untested; (2) their arms doctrine was analogous to the developed strategic theories of today ; and (3) ship construction was largely supported by the military and the industrial sector. See Blacker & Duffy, supra, note 13 at 84-85.

35. Scott, supra, note 32 at 19.

36. International Convention for the Pacific Settlement of International Disputes, 29 July 1899,187 Parry's T.S. 410. I. Brownlie, Principles of Public International Law, 3d ed., (Oxford: Clarendon, 1979) at 707-08.36.22.

37. International Convention with Respect to the Laws and Customs of War by Land, 29 July 1899, 187 Parry's T.S. 429.

38. International Convention for Adapting to Maritime Warfare the Principles of the Geneva Convention of 22 August 1864, 29 July 1899, 187 Parry's T.S. 443.

39. Declaration Respecting the Prohibition of Discharge of Projectiles from Balloons etc., 28 July 1899, 187 Parry's T.S. 456. Scott, supra, note 32 at 26.

40. Declaration Respecting the Prohibition of the Use of Projectiles Diffusing Asphyxiating Gases, 187 Parry's T.S. 453. The United States did not sign the Declaration.

41. Declaration Respecting the Prohibition of the Use of Expanding Bullets, 187 Parry's T.S. 459. The U.S. also voted against this Declaration based on objections to the technical terms of the text. See Scott, supra, note 32 at 32-35.

42. The letter calling for the second conference stated "there is at present occasion only to examine questions that demand special attention as being the outcome of the experience of recent years, without touching upon those that might have reference to the limitation of military or naval forces" cited in Scott, ibid. at 67.

43. Declaration Prohibiting the Discharge of Projectiles and Explosives from Balloons, 205 Parry's T.S. 403. Dupuy & Hammerman, supra, note 2 at 66-67. Scott, ibid. at 129.

44. Scott, ibid. at 129. The Second Hague Conference concluded thirteen conventions and one declaration. See 205 Parry's T.S. 233. For a comparison of the result between the 1899 conference and the 1907 conference, see Dupuy & Hammerman, supra, note 2 at 59-68. Regarding the negotiation process of the Second Hague Conference, see Scott, ibid. at 86-138.

45. With regard to the rapid change of naval technology, see Blacker & Duffy, supra, note 13 at 84-86.

46. Ibid. at 86.

47. Ibid. at 86.

48. Ibid. at 186.

49. Dupuy & Hammerman, supra, note 2 at 73.

50. Ibid.

51. Ibid. at 79. In 1917, Wilson thought the prerequisites to a permanent peace were: (1) a peace without victory, because a dictated peace "would be accepted in humiliation, under duress, at an intolerable sacrifice, and would leave a sting, a resentment, a bitter memory upon which terms of peace would rest, not permanently, but only as upon quicksands"; (2) the right of self determination; (3) the freedom of the seas; (4) disarmament; and (5) a league of nations to administer the peace. D.F. Fleming, The United States and the League of Nations 1918-1920, (New York: Russel & Russel, 1968) at 14.

52. France was especially determined to disarm Germany and to seek security guaranties while Great Britain sought to rapidly demilitarize its own army. See Blacker & Duffy, supra, note 13 at 91.

53. Treaty of Peace Between the British Empire, France,----- and Germany signed at Versailles, 225 Parry's T.S. 188. Part V (Military, Naval and Air Clauses) of this Treaty is found, ibid. at 264-82.

54. Ibid. at 264-65, 271.

55. Ibid. at 268.

56. Ibid. at 268, 273 and 278.

57. Ibid. at 270.

58. Ibid. at 279-82.

59. Article 204 provides that "The Inter-Allied Commissions of Control will be specially charged with the duty of seeing to the complete execution of the delivery, destruction, demolition and rendering things useless to

be carried out at the expense of the German Government in accordance with the present Treaty." Ibid. at 279.

60. Art. 205, ibid. at 280.

61. Article 206 provides :

"The German Government must give all necessary facilities for the accomplishment of their missions to the Inter-Allied Commissions of Control and to their members.

It shall attach a qualified representative to each Inter-Allied Commission of Control for the purpose of receiving the communications which the Commission may have to address to the German Government and of supplying or procuring for the Commission all information or documents which may be required.

The German Government must in all cases furnish at its own cost all labour and material required to effect the deliveries and the works of destruction, dismantling, demolition, and of rendering things useless, provided for in the present Treaty."

Ibid. at 280.

62. The latter half of Article 208 provides that:

"[t]he Military Inter-Allied Commission of Control will take delivery of the arms, munitions and war material, will select the points where such delivery is to be effected, and will supervise the works of destruction, demolition, and of rendering things useless, which are to be carried out in accordance with the present Treaty.

The German Government must furnish to the Military Inter-Allied Commission of Control all such information and documents as the latter may deem necessary to ensure the complete execution of the military clauses, and in particular all legislative and administrative documents and regulations."

Ibid. at 280-81.

63. Art. 209, ibid. at 281.

64. Ibid.

65. Art. 210, ibid. at 281-82.

66. On-site inspection involves unrestricted access to the physical objects and related facilities that are subject to control.

67. The Antarctic Treaty, December 1 1959, 402 U.N.T.S. 702, 12 U.S.T. 794, T.I.A.S. No. 4780 (entered into force 23 June 1961).

68. Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof, 11 February 1971, 23 U.S.T. 16, T.I.A.S. No. 7337, 955 U.N.T.S. 115 (entered into force 18 May 1972).

69. Treaty between the United States of America and the USSR on the Elimination of their Intermediate-range and Shorter-range Missiles, 8 December 1987, 27 I.L.M. 84 (entered into force 1 June 1988).

70. Fleming, supra, note 51 at 14.

71. The Covenant of the League of Nations is Part I of Versailles Treaty. See 225 Parry's T.S. 195.

72. Ibid. at 197-98.

73. Art. 8, sec. 2.

74. Art. 8, sec.4.

75. Art.8, sec.6.

76. Article 9 provides for the commission of the Council, which functions as an advisory organ concerning disarmament issues.

77. Dupuy & Hammerman, supra, note 2 at 96-104, 126-38.

78. The five categories are: (1) arms, ammunition and implements of war exclusively designed and intended for land, sea or aerial warfare; (2) arms and ammunition capable of use both for military and other purposes; (3) vessels of war and their armaments; (4) aircraft (assembled or dismantled) and their engines; (5) gunpowder and explosives as well as other arms and ammunition that are not covered by category (1) and (2). See ibid. at 126-28.

79. For Chapter III (Supervision on Land) (Articles 7-10) and Chapter IV (Maritime Supervision) (Articles 11-21) of the Convention for the Control of the Trade in Arms and Ammunition, see ibid. at 98-103. For Chapter II (Supervision and Publicity) (Articles 2-7) of the Convention for the Supervision of the International Trade in Arms and Ammunition and in Implements of War, see ibid. at 128-31.

80. As regards Germany, article 171 of the Versailles Treaty provides "[t]he use of asphyxiating, poisonous or other gases and all analogous liquids, materials or devices being prohibited, their manufacture and importation are strictly forbidden in Germany." 225 Parry's T.S. 268. As regards the application of the agreement with respect to other defeated countries, see McDougal & Feliciano, supra, note 16 at 633.

81. This Treaty was signed at the same time as the Washington Naval Treaty. Dupuy & Hammerman, supra, note 2 at 121. McDougal & Feliciano, ibid. This treaty did not enter into force because France failed to ratify it.

82. 94 L.N.T.S. 65. See also, ACDA, Arms Control and Disarmament Agreements: Texts and Histories of Negotiations (Washington, D.C.: GPO, 1982) at 9-18.

83. The wording is borrowed from the Washington Treaty:

> "...Whereas the use in war of asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices, has been justly condemned by the general opinion of the civilised world; and
>
> Whereas the prohibition of such use has been declared in Treaties to which the majority of Powers of the world are Parties; and
>
> To the end that this prohibition shall be universally accepted as a part of International Law, binding alike the conscience and the practice of nations;
>
> Declare:
> That the High Contracting Parties, so far as they are not already Parties to Treaties prohibiting such use, accept this prohibition, agree to extend this prohibition to the use of bacteriological methods of warfare and agree to be bound as between

themselves according to the terms of this declaration".

84. Concerning poison gas weapons used by Japan, for instance, Y. Tanaka, "Poison Gas: The Story Japan Would Like to Forget" (1988) 44: 8 Bull. Ato. Scientists 10. See McDougal & Feliciano, supra, note 16 at 634.

85. McDougal & Feliciano, ibid. at 634. Article 5 of The Central American Convention on Arms Limitation (1923) forbids the use of poison gas. See Dupuy & Hammerman, supra, note 2 at 123-24.

86. McDougal & Feliciano, ibid.

87. The General Pact for the Renunciation of War [the Kellog-Briand Pact] can be classified as a disarmament agreement in that it chose the way of renouncing war completely as an instrument of national policy. As examples of "general and complete" disarmament efforts are, Soviet proposals in 1927 and 1928 from outside of the League of Nations. See Dupuy & Hammerman, supra, note 2 at 138-55. Y. Potyarkin & S. Kortunov, eds., The USSR Proposes Disarmament (1920s-1980s) (Moscow: Progress, 1986) at 32-67.

88. Dupuy & Hammerman, ibid. at 169-83.

89. The resolution provides in Part II, Article 3:

"Chemical, bacteriological, and incendiary warfare shall be prohibited under the conditions unanimously recommended by the Special Committee."

Concerning the other limitation; toned-down provisions are found, such as:

"...that all bombardment from the air shall be abolished, subject to agreement with regard to measures to be adopted for the purpose of rendering effective the observance of this rule." (Part II, Article 1, Section 2);

"The maximum unit tonnage of tanks should be limited." (Part II, Article 2, Section (b)).

Dupuy & Hammerman, ibid. at 192-96, Noel-Baker, supra, note 1 at 103-13.

90. Proposals; Chapter III, section B. Dupuy & Hammerman, _ibid._ at 217. With respect to the French proposal, see Noel-Baker, _ibid._ at 114-20.

91. Dupuy & Hammerman, _ibid._ at 220-52. The British Draft Convention never came to a vote.

92. Noel-Baker, _supra_, note 1 at 132.

93. Additional reasons include the strain caused by the discriminating domestic laws of California and the continuation of the American Shipbuilding program (the Naval Appropriation Act of 1916). R.A. Hoover, _Arms Control: The Interwar Naval Limitation Agreements_ (Colorado: Univ. of Denver, 1980) at 5-8.

94. _Ibid._ at 22.

95. _Ibid._ at 19. Also, both Great Britain and the U.S. were in accord with the fact that the Anglo-Japanese alliance (made in 1902) would be harmful to the interests of English-speaking peoples. They agreed that peaceful dissolution of the alliance through multilateral negotiation would cause less damage to their relationship with Japan.

96. A Treaty Between the United States of America, the British Empire, France, Italy and Japan, Limiting Naval Armament, 6 February 1992. Dupuy & Hammerman, _supra_, note 2 at 108-20.

97. According to the Washington Naval Treaty, capital ship is defined "as a vessel of war, not an aircraft carrier, whose displacement exceeds 10,000 tons (10,160 metric tons) standard displacement, or which carries a gun with a calibre exceeding 8 inches (203 millimeters)." (Chapter II, Part 4, Definition). Dupuy & Hammerman, _supra_, note 2 at 118.

98. _Ibid._ at 107-19; Hoover, _supra_, note 93 at 31-32; Blacker & Duffy, _supra_, note 13, at 89-92.

99. Dupuy & Hammerman, _ibid._ at 109.

100. _Ibid._ Blacker & Duffy, _supra_, note 13 at 91.

101. Treaty on Limitation and Reduction of Naval Armament, 22 April 1930, Dept. of State Treaty Series No. 830.

102. Hoover, _supra_, note 93 at 91-94. Blacker & Duffy, _ibid._ at 92. Dupuy & Hammerman, _supra_, note 2 at 164-67.

103. Chapter III, Article of the Washington Naval Treaty provides:

> "The present Treaty shall remain in force until December 31st, 1936, and in case none of the Contracting Powers shall have given notice two years before that date of its intention to terminate the Treaty, it shall continue in force until the expiration of two years from the date on which notice of termination shall be given by one of the Contracting Powers, whereupon the Treaty shall terminate as regards all the Contracting Powers."

104. Treaty on Limitation and Reduction of Naval Armament, 25 March 1936, Dupuy & Hammerman, _supra_, note 2, at 262-72.

105. Dupuy & Hammerman, _ibid._ at 264.

106. _Ibid._

107. _Ibid._ at 265-68.

CHAPTER II

MONITORING COMPLIANCE PRIOR TO THE ADVENT OF ARTIFICIAL SATELLITES

A. INTRODUCTION

On August 6, 1945, President of the United States Harry Truman announced:

> Sixteen hours ago an American aeroplane dropped one bomb on Hiroshima. That bomb had more power than 2,000 times the blastpower of the British 'grand slam' which is the largest bomb (20,000 lb.) yet used in the history of warfare.[1]

The first use of the atomic bomb in the history of warfare was followed by the dropping of a second bomb on Nagasaki three days later. The two atomic bombs caused an unprecedented number of deaths and injuries as well as catastrophic devastation. This terrifying weapon started a new era both in global politics and the strategies of warfare-the atomic era.[2] However, neither the horrors of World War II, nor the advent of the atomic bomb succeeded in creating an atmosphere favourable to disarmament. Allied unity did not long survive the end of hostilities before being replaced by the Cold War.[3] Besides, it was widely believed that if the democratic powers had firmly opposed Hitler's Germany in the 1930's, World War II would have been avoided.[4] Therefore, even during the war the plans for world order in peacetime were based on an armed collective security, rather than on the concept of disarmament popular during the interwar period.[5]

B. THE BARUCH PLAN

After the end of World War II, one of the most urgent concerns facing the United States government was control of nuclear energy and atomic weapons, domestically and internationally. Domestically, all military and peaceful uses of atomic energy were put under the jurisdiction of the United States Atomic Energy Commission (US AEC).[6] Internationally, Great Britain, Canada and the United States issued in November 1945 a "[t]hree nation Agreed Declaration on Atomic Energy", which proposed a United Nations commission on the international control of atomic energy. The USSR endorsed the idea the next month. In January 1946, the UN General Assembly unanimously approved a resolution creating the United Nations Atomic Energy Commission (UNAEC).[7]

President Truman submitted the United States plan (known as the Baruch Plan) to the UNAEC on June 14, 1946.[8] The Plan envisaged the creation of an International Atomic Development Authority (IADA), with wide-ranging responsibilities:

1. Managerial control or ownership of all atomic energy activities potentially dangerous to world security.

2. Power to control, inspect, and license all other atomic activities.

3. The duty of fostering the beneficial uses of atomic energy.

4. Research and development responsibilities of an affirmative character intended to put the Authority in the forefront of atomic knowledge and thus to enable it to comprehend, and therefore to detect, misuse of atomic energy. To be effective, the Authority must itself be the world's leader in the field of atomic knowledge and development and thus supplement its legal authority with the great power inherent in possession of leadership in knowledge.[9]

Next, the U.S. plan focused on the necessity of enforceable sanctions,[10] which proved impossible to implement with the veto power granted to the five permanent members of the Security Council. The plan provided that no veto should be given "to protect those who violate their solemn agreements not to develop or use atomic energy for destructive purposes."[11] Existing U.S. atomic weapons were to be disposed of only after the IADA became fully operational. At such time the following courses would be taken:

1. manufacture of atomic bombs shall stop;
2. existing bombs shall be disposed of pursuant to the terms of the treaty; and
3. the Authority shall be in possession of full information as to the know-how for the production of atomic energy.[12]

Thus, the United States would relinquish its monopoly of atomic weapons only after an adequate control system had been put into operation. Also, since the control system would proceed in successive stages, the United States was prepared to relinquish information regarding control over its activities in this field in accordance with the stage reached by the IADA.[13] Hence, until the last stage of this process, the United States would enjoy a monopoly in atomic weapons in relation to all other nations.

C. FRUITLESS YEARS

Five days later, Andrei Gromyko, on behalf of the Soviet Union, submitted an alternative proposal emphasizing the destruction of existing stockpiles and a ban on production of atomic weapons rather than an enforcement system.[14] Article 2 of the Soviet draft proposal declared that a violation of the convention would constitute "a most serious international crime against humanity". Article 3 obliged the contracting parties to adopt legislation providing for "severe penalties" for violators of the convention.

The USSR also demanded that the control of atomic energy be subject to a veto in the Security Council.

Eventually, neither of these proposals was adopted. This was the first postwar case of failure in negotiating an arms control agreement and was the beginning of a pattern of failures repeated many times thereafter- the United States demanding more control and verification than the USSR was willing to accept. The USSR, on the other hand, while urging major disarmament measures, would as a rule downgrade verification, regarding it to be primarily a means of espionage that encroached upon national security. Considering that it was only much later that the two superpowers concluded certain arms control agreements, it is obvious that essential elements necessary for compromise were lacking at that time.

In June 1947, Andrei Gromyko presented to the UNAEC a detailed Soviet plan that provided for an International Control Commission (ICC) to inspect atomic facilities. However, a veto power was to be retained in the Security Council and the ban on atomic weapons was to precede the setting up of the ICC. In effect, that proposal was the converse of the Baruch plan.[15]

The next two years were unsuccessful in terms of implementing the effective control of atomic weapons. In September 1948, another Soviet draft proposal banning atomic weapons and establishing an international control system to be carried out simultaneously was rejected by Western powers.[16]

In 1949, the Soviet Union exploded its first atomic bomb. Earlier in 1949, President Truman announced that he had instructed the U.S. Atomic Energy Commission to proceed with the development of a so-called "hydrogen or super-bomb",[17] which was exploded on October 9, 1952, at the height of Cold War.[18]

In April 1952, the U.S. submitted to the newly established U.N. Disarmament Commission a plan for disclosure and verification of all armed forces and armaments in five stages, proceeding from less secret to more secret information.[19] The USSR, three days later, responded with its own counter-proposal, which provided for the simultaneous prohibition of weapons of mass destruction and the setting up of a control system.[20]

Soon thereafter, the international situation improved with the inauguration of President Dwight D. Eisenhower in the United States (January, 1953), the death of Joseph Stalin (March, 1953) and the completion of an armistice in the Korean War (July, 1953). That same year, President Eisenhower delivered two significant addresses: "Chances for Peace" (April) and "Atoms for Peace" (December) which, however, elicited only a lukewarm response from the USSR. The "Atoms for Peace" speech in essence recommended the establishment of an international atomic energy agency (IAEA) to which governments would contribute fissionable materials to promote peaceful uses of atomic energy.[21]

In 1954, France and Great Britain proposed to the newly established Disarmament Subcommittee[22] a compromise based on several U.S. and Soviet proposals.[23] The Franco-British plan envisaged three stages in the disarmament process: first, a freeze on military expenditures and manpower levels as they existed in 1953; second, a fifty percent reduction in armaments and armed forces accompanied by a ban on nuclear weapons and other weapons of mass destruction, with eventual complete prohibition of weapons of mass destruction. Before any part of the program would begin, a specific control organ was to be established.[24] While the U.S. supported the proposal, the USSR rejected it.[25]

D. THE ADVENT OF THE SATELLITE ERA

During the early post-war years, the United States stood pre-eminent in terms of military power, political influence and industrial productivity. Since only the United States had atomic bombs, it was difficult to visualize a military threat to America from a foreign nation. Although the United States greatly reduced its armed forces soon after the war, it continued research and development on a fairly large scale in the most advanced areas of military technclogy.

Assisted by some 150 German rocket scientists, and using captured V-2 rockets, the United States began its post-war space programs determined to develop a rocket capable of launching a satellite into outer space. The evaluation of the U.S. rocketry program of October 1945 by the U.S. Navy's Committee on Evaluating the Feasibility of Space Rocketry

(CEFSR) is almost certainly one of the earliest studies dealing with the question of artificial earth satellites.[26]

A RAND Corporation report entitled "Preliminary Design of an Experimental World-Circling Spaceship", published in May 1946, found that "technology and experience have now reached to the point where it is possible to design and construct craft which can penetrate the atmosphere and achieve sufficient velocity to become satellites of the earth".[27] The report claimed that a 500-pound satellite could be placed in a 300-mile orbit by 1951. The same report stressed that satellites could serve certain military functions, e.g., reconnaissance, communications and missile guidance.[28]

In 1954, the U.S. Air Force was assigned the task of developing the first US military satellite program ("Feedback"), though all branches of the U.S. armed forces had been doing satellite research separately at that time.[29] On July 29, 1955, the White House announced that the United States planned to launch a small earth-circling satellite as part of the International Geophysical Year (IGY) programs.[30] Beginning from July 1, 1957, to December 31, 1958, the IGY constituted a program of international cooperation in the exploration of the planet Earth and its atmosphere. The United States chose "Project Vanguard", which was being developed by the Naval Research Laboratory (NRL), as its contribution to the IGY. Shortly thereafter on August 1, 1955, the Soviet Union also announced its IGY satellite project.[31]

Contrary to virtually universal expectations, it was the Soviet Union rather than the United States that first successfully launched an artificial satellite -Sputnik- on October 4, 1957. It was only on January 31, 1958 that the United States succeeded in launching its first satellite, Explorer I, following the failure of Vanguard satellite.[32]

E. TERMS AND DEFINITIONS

Starting with 1960, no discussion relating to arms limitation is possible without using the term "arms control", by now the standard expression in American vocabulary.[33] The difference between the terms "arms control" and "disarmament" is obvious despite the fact that they are often used interchangeably. The definitions of the two terms offered by Professor Hedley Bull are both simple and easy to understand:

> **Disarmament** is the reduction or abolition of armaments. It may be unilateral or multilateral; general or local; comprehensive or partial; controlled or uncontrolled.
>
> **Arms Control** is restraint internationally exercised upon armaments policy, whether in respect of the level of armaments, their character, deployments or use.[34]

Professor Bull notes that disarmament and arms control interact with one another: "there can be disarmament which is not controlled, and control which does not involve a reduction of armaments".[35] There are, of course, many other definitions and explanations of these terms, as can be seen from the illustrations that follow.

According to an official publication of the Ministry of External Affairs of Canada,

> **Arms control** refers to measures that limit the growth of or otherwise regulate weapons, military forces and/or their supporting activities. Such measures can include restrictions on numbers, types, testing or training, stationing, acquisition and use. The Partial Test Ban Treaty (PTBT) of 1963, which bans nuclear weapons tests in the atmosphere, in outer space and under water, is an example of an arms control agreement. The Non-Proliferation Treaty (NPT) of 1968, designed to prevent the spread of nuclear weapons to countries that don't already have them, is another example.[36]

Disarmament, in contrast, refers to the actual reduction or elimination of weapons and/or military forces, as for example, the U.S.-USSR Intermediate-Range Nuclear Forces (INF) Treaty of 1987.[37] It follows that "if weapons or equipment have to be dismantled or destroyed, or troops returned to civilian life, it is disarmament. If not, it is arms control".[38]

According to Professor H. Lauterpacht, "disarmament" means "not the abolition of armaments, but their reduction to limits reasonably commensurate with a State's national safety and the discharge of its international obligations."[39]

Alva Myrdal in her seminal book *The Game of Disarmament*[40] states that she uses the term "disarmament" as the generic one to be given a larger connotation than "elimination of armaments". She refused to use "arms control" as an overall term for both semantic and political reasons. Semantically, the term "control" should be exclusively applied to verification measures; politically, "arms control" is an American invention which is likely to have scant or nil disarmament effect, emphasizing the control factor.[41] Disarmament, therefore, "covers all degrees of reduction of armaments, and it includes the preemption of options for further arms development (non-armament) as well as measures for regulating the production or use of arms quantity or quality".[42] "Arms control" is also seen as a "watered-down, bland and lesser version of disarmament".[43]

According to Thomas C. Schelling and Morton H. Halperin, the term "arms control" is meant:

> to include all the forms of military cooperation between potential enemies in the interest of reducing the likelihood of war,its scope and violence if it occurs, and the political and economic costs of being prepared for it. The essential feature of arms control is the recognition and cooperation even between potential enemies with respect to their military establishments. Whether the most promising area of arms control involves reduction in certain kinds of military force, increases in certain kinds of military force, qualitative changes in weaponry, different modes of deployment, or arrangements superimposed on existing military systems, we prefer to treat as an open question.[44]

Similar views are found in Herman Kahn's writings,[45] and in the Harvard Nuclear Study Group's essay on nuclear weapons.[46]

For the United States Arms Control and Disarmament Agency "arms control" includes "all those actions, unilateral as well as multilateral, by which we regulate the levels and kinds of armaments in order to reduce the likelihood of armed conflicts, their severity and violence if they should occur, and the economic burden of military programs."[47]

The choice of the term, accordingly, reflects political as well as ideological positions and different approaches towards national security. Lawrence Freedman rightly points out that the term "arms control" became popular as "the notion of managing rather than eliminating the arms race" was gaining ground in the United States[48] and that, hence, it was more acceptable than disarmament to the powerful military-industrial complex.

According to Professor Tadashi Tanaka, the choice of the term stems from the fact that some approach problems *de lege lata* and others *de lege ferenda*.[49] A closer examination of the term "disarmament", he writes, suggests that in most cases the notion of disarmament is used as the ultimate goal of negotiations, "arms control", on the other hand, only promotes movement towards the reduction or abolition of armaments.[50]

The choice of one or the other term seems to depend on the nature of the measures contemplated or agreed upon and on the politics of the parties involved. Hence, most of the multilateral agreements and the resolutions of international organizations use the term "disarmament",[51] while arms control is largely limited to bilateral agreements to which the United States is a party.

Other related terms such as "arms limitation", "regulation of armaments" and "reduction of armaments" are not always clearly defined and could cover a great variety of measures. The Stanford Arms Control Group uses the terms "arms control" and "arms limitation" interchangeably with the understanding that each of them "involves limitations on the number or types of armaments or armed forces, on their development or disposition, or on the use of particular types of armaments".[52] The Stanford Arms Control Group, however, gives the term "arms control" a broader meaning than "arms limitation", because "arms control" encompasses "measures designed to reduce the danger of accidental war or to reduce concern about surprise attack".[53] "Disarmament" is defined by that group as "the reduction of armaments or armed forces".[54] Similarly, the Ministry of External Affairs of Canada regards "arms limitation" and "arms regulation" as being used as alternatives to "arms control".[55]

Alva Myrdal believes that the expression "regulation of armaments"[56] is more appropriate as a specific term in the context of international agreements involving armaments[57] because it does not necessarily refer to the decrease of armaments unlike the word "reduction of armaments".[58]

As can be seen, the two terms and other variants of the two are used all too frequently interchangeably. Based on the above survey, in the present study, the term "disarmament" is used when (i) the reduction or the elimination of some or all weapon categories or armed forces is contemplated; and (ii) this expression has become standard regardless of the substantive content of the agreement or proposal. The term "arms control" will be employed when used in the original documentation referred to and also in mechanisms for reducing the likelihood of armed conflicts.

CHAPTER II - ENDNOTES

1. Keesing's Research Report, Disarmament: Negotiations and Treaties 1946-1971, (New York: Charles Scribner's Sons, 1972) at 1.

2. C.D. Blacker & G. Duffy, eds., International Arms Control Issues and Agreement, 2d ed. (California: Stanford Univ. Press, 1984) at 95.

3. Although Japan and Germany were demilitarized in 1945, the situation changed with the increasing hostility between the East and West; Germany restored its substantial forces in the early 1950's and Japan was allowed to own self-defense forces though its constitution prohibited militarization.

4. Blacker & Duffy, supra, note 2 at 95; T.N. Dupuy & G.M. Hammerman, eds., A Documentary History of Arms Control and Disarmament (New York: R.R. Bowker, 1973) at 241.

5. As blueprints for peace plans, there are, for instance, The Atlantic Charter (August, 1941) and Declaration of Four Nations on General Security (November, 1943), neither of which emphasized disarmament efforts as the means of securing world peace. Also the UN Charter (June, 1945) contained less concrete provisions on disarmament than the Covenant of the League of Nations. See, Dupuy & Hammerman, ibid. at 80-81, 285-90. On the other hand, the Potsdam conference discussed the postwar policy toward conquered nations such as Germany and Japan. Also, see UN Charter arts. 11, 26, 43 and 106.

6. Congressional Quarterly Special Report, History of Disarmament: in the Postwar Years, (Washington, D.C.: GPO, 1964) at 2. Blacker & Duffy, supra, note 2 at 96.

7. Concerning the USSR endorsement, see Moscow Communiqué by the Foreign Ministers of the United States, the United Kingdom and the Soviet Union, Dupuy & Hammerman, supra, note 4 at 299-301. The resolution provided that the task of the UNAEC was, in particular, to make specific proposals for the following purposes:

   (a) For extending between all nations the exchange of basic scientific information for peaceful ends;

(b) For control of atomic energy to the extent necessary to ensure its use only for peaceful purposes;

(c) For the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction;

(d) For effective safeguards by way of inspection and other means to protect complying states against the hazards of violations and evasions.

8. Congressional Quarterly Special Report, supra, note 6 at 2. Dupuy & Hammerman, supra, note 4 at 301-03. Blacker & Duffy, supra, note 2 at 96. B.G. Bechhoefer, Postwar Negotiations for Arms Control (Washington, D.C.: Brookings Institution, 1961) 41-82.

9. Dupuy & Hammerman, ibid. at 304.

10. As the object of sanctions:

1. Illegal possession or use of an atomic bomb;
2. Illegal possession, or separation, of atomic material suitable for use in an atomic bomb;
3. Seizure of any plant or other property belonging to or licensed by the Authority;
4. Wilful interference with the activities of the Authority;
5. Creation or operation of dangerous projects in a manner contrary to, or in the absence of, a license granted by the international control body.

11. Dupuy & Hammerman, supra, note 4 at 305.

12. Ibid. at 304.

13. The fundamental features of a plan on IADA provide:

"12. Progress by Stages. A primary step in the creation of the system of control is the setting forth, in comprehensive terms, of the functions, responsibilities, powers, and limitations of the Authority. Once a charter for the Authority has been adopted, the Authority and the system of control for which it will be responsible will require time to become fully organized and effective. The plan of control will, therefore, have to come into effect in successive stages. These should be specifically fixed in the charter or means should be otherwise set forth in the charter for transitions from one stage to another, as contemplated in the resolution of the United Nation Assembly which created this Commission."

"13. Disclosures. ...the United States is prepared to make available the information essential to a reasonable understanding of the proposals which it advocates. Further disclosures must be dependent, in the interests of all, upon the effective ratification of the treaty. When the Authority is actually created, the United States will join the other nations in making available the further information essential to that organization for the performance of its functions. As the successive stages of international control are reached, the United States will be prepared to yield, to the extent required by each stage, national control of activities in this field to the Authority."

14. UN Doc. AEC/8 (24 June 1946). Y. Potyarkin & S. Kortunov, eds., The USSR Proposes Disarmament (1920s-1980s) (Moscow: Progress, 1986) at 106-08.

15. Cited in Dupuy & Hammerman, supra, note 4 at 345-48.

16. Concerning conventional weapons, the Soviet Union proposed to cut the armed forces of the five permanent members of Security Council by one-third. This proposal was rejected because of Soviet troop superiority. Keesings Research Report, supra, note 1 at 46-47. Potyarkin & Kortunov, supra, note 14 at 113-14.

17. As regards the development of the H-Bomb, twelve eminent physicists in the U.S. sent a letter to the President and asked him to make a declaration that the U.S. would never use such a bomb first. "The circumstances which might force us to use it would be if we, or our allies, were attacked by this bomb. There can be only one justification for our development of the hydrogen bomb and that is to prevent its use." See Sir G. Thomson, "Hydrogen Bombs: The Need for a Policy" (1950) 26 Foreign Affairs 463 at 468.

18. Ibid. Without reaching any disarmament agreements, the peace movement, called "World Congress of Partisans of Peace" worked to provide public support for the Soviet proposal to adopt the "Stockholm Appeal":

> "We demand unconditional prohibition of the atomic weapon as a weapon of aggression and mass annihilation of the people, and that strict international control for the implementation of this decision be established. We shall consider as a war criminal that Government which first employs the atomic weapon against any country. We call upon all people of good will throughout the world to sign this appeal."

It is said that 273,470,566 people had signed the appeal. See D.H. McLacklan, "The Partisan of Peace" (1951) 27 Int'l Affairs 10 at 12. The author points out the danger of such peace movement promoted by the Communist countries. 1950 was not a breakthrough year for new disarmament proposals; only some preliminary work between the UNAEC and the UN for Conventional Armaments was pursued. The UN General Assembly set up a Disarmament Commission under the Security Council to replace the UNAEC and the Commission on Conventional Armaments. Regulation, Limitation and Balanced Reduction of All Armed Forces and All Armaments: International Control of Atomic Energy, GA Res. 502, UN GAOR, 6th Sess. Supp. No. 20 UN Doc. A/2119 (1952). The Disarmament Commission has the power to "prepare proposals to be embodied in a draft treaty (or treaties) for the regulation, limitation and balanced reduction of all armed forces and all armaments, ...". That resolution was voted against by the USSR. See Congressional Quarterly Special Report, supra, note 6 at 5. Dupuy & Hammerman, supra, note 4, at 351-52.

19. Disarmament Commission, Proposals for Progressive and Continuing Disclosure and Verification of Armed Forces and Armaments, UN Doc. DC/C.2/1 (1952).

20. France, Great Britain and the U.S. also suggested imposing military manpower numerical ceilings: for the USSR, the U.S. and China, between 1-1.5 million; for France and Great Britain, 700,000-800,000; for other States, a ceiling of less than one percent of the population. (Disarmament Commission, UN DCOR, UN Doc. DC/10 (1952). See also Blacker & Duffy, supra, note 2 at 101; Dupuy & Hammerman, supra, note 4 at 354-58.

The USSR rejected the proposal based on the fact that it did not deal with the reduction of weapons of mass destruction.

In August, the western powers again proposed a five powers conference on disarmament, which the USSR rejected. At that time, the Korean War was being waged and consequently the likelihood of reaching a specific agreement on arms reduction was slim. In 1952, Great Britain announced it possessed atomic bombs and the U.S. exploded its first hydrogen bomb. Within a year, the USSR announced as well the explosion of a hydrogen bomb. Keesing's Research Report, supra, note 1 at 5-6.

21. Dept. of State, Disarmament: The Intensified Effort, 1955-1958, Dept. of State publication 6676, (Washington, D.C.: GPO, 1958) at 3-4. The USSR later insisted on private talks with the U.S. on the condition that Soviet proposals on disarmament should be taken into consideration, which the U.S. rejected.

22. Ibid.

23. Blacker & Duffy, supra, note 2 at 102.

24. Disarmament Commission, Memorandum Submitted by France and the United Kingdom of Great Britain and Northern Ireland, UN Doc. DC/SC.1/10 (1954).

25. On 30 September 1954, the USSR announced that it was ready to regard the Anglo-French proposal of 11 June as the basis for a future disarmament convention.

26. A.G. Haley, Rocketry and Space Exploration (Princeton, New Jersey: D. Van Nostrand, 1958) 96-155; R.C. Hall, "Early U.S. Satellite Proposals" in E.M. Emme, ed., The History of Rocket Technology: Essays on Research, Development, and Utility (Detroit: Wayne State Univ. Press, 1964) 67.

27. Hall, ibid. at 76.

28. P.B. Stares, The Militarization of Outer Space: US Policy, 1945-1984 (Ithaca, New York: Cornell Univ. Press, 1985) at 27.

29. Stares, ibid. at 22-29.

30. E. Bergaust & W. Beller, Satellites !, (New York: Hanover House, 1956) at 37-38. This was not the first time the U.S. government mentioned a satellite program. In 1948, in his first report to the Congress, the Secretary of Defense, James Forrestal, announced for the first time the conduct of scientific satellite research; the so-called "Forrestal Project" soon died although it stirred enthusiasm among leading scientists of the time. See C.F. Poke, Congress and Outer Space (Ph.D. Thesis, University of Pittsburgh, 1968) [unpublished] at 92-93.

31. Stares, supra, note 28 at 287. N.L. Johnson, Soviet Military Strategy in Space, (London: Jane's, 1987) at 16-17.

32. It was not until March 1958 that Vanguard fulfilled its mission. Explorer I used a modified Redstone missile, Jupiter C.

33. The term was invented about 1960, perhaps by Schelling and Halperin. See T.C. Schelling & H. Halperin, Strategy and Arms Control (New York: Twentieth Century Fund, 1961).

34. H. Bull, The Control of the Arms Race : Disarmament and Arms Control in the Missile Age (London: Weidenfeld & Nicolson, 1961) at ix.

35. Ibid.

36. External Affairs and International Trade Canada, "Focus: On the Relationship Between Arms Control and Disarmament and Peace", (1990) 13 The Disarmament Bulletin at 18 [hereinafter EAITC].

37. Ibid.

38. Ibid.

39. L. Oppenheim, International Law: A Treatise, 7th ed., [H.Lauterpacht, ed.], vol.2 (London: Longmans, Green, 1952) at 121.

40. A. Myrdal, The Game of Disarmament, rev'd ed., (New York: Pantheon, 1982).

41. Ibid. at xxiii-xxxiv.

42. Ibid.

43. L. Freedman, The Evolution of Nuclear Strategy, (New York: St. Martin's Press, 1981) at 198.

44. Schelling & Halperin, supra, note 33 at 2.

45. H. Kahn, On Thermonuclear War, (Princeton, N.J.: Princeton Univ. Press, 1960) at 232.

46. Harvard Nuclear Study Group, Living with Nuclear Weapons, (Cambridge: Harvard Univ. Press, 1983) Chapter 9.

47. ACDA, Arms Control Report, (Washington, D.C.: GPO, 1976) at 3. The establishment of the Arms Control and Disarmament Agency (ACDA) was proposed by President Kennedy on June 20, 1961, and was established by Act of Congress on September 26, 1961 (P.L. 87-297). That law made the director of the Agency the principal adviser to the President and the Secretary of State on arms control and disarmament, and authorized the Agency to conduct negotiations and studies.

48. Freedman, supra, note 43 at 195.

49. T. Tanaka, "Some Legal Aspects of Disarmament" (1987) 30 Japanese Annual Int'l L. 18 at 18.

50. Ibid. at 21.

51. Ibid. at 19-20.

52. Blacker & Duffy, supra, note 2 at 3. The term "arms limitation" is found, e.g., art.1 of The ABM Treaty.

53. Ibid.

54. Ibid.

55. EAITC, supra, note 36 at 18.

56. The term "regulation of armaments" is found, e.g., in art. 11, para. 1, art. 26 and art. 47, para. 1 of The UN Charter.

57. Myrdal, supra, note 40 at xxxiv.

58. Ibid. The term "reduction of armaments" is found, e.g., in art. 8 of The Covenant of the League of Nations.

CHAPTER III

SPACE TECHNOLOGY IN THE SERVICE OF ARMS CONTROL VERIFICATION

A. INTRODUCTION

On May 11, 1989, President Bush, in a speech on Soviet-American arms control policy, resurrected the "Open Skies" proposal, originally proposed by President Eisenhower in 1955.[1] President Eisenhower proposed an arrangement that would allow unarmed aircraft from the United States and the Soviet Union to fly over the territory of the other country.[2] The implementation of this proposal, according to Eisenhower, would lessen the danger of a surprise attack and reduce international tension. Eisenhower's proposal reflected U.S. emphasis on a first-inspection-then-disarmament policy, which the USSR suspected as being merely an instrument of espionage. The postwar disarmament proposals by the two superpowers were characterized by their sharp differences. The U.S. preferred carrying cut verification measures before, or at least at the same time as, the disarmament clauses were to be put in effect. The U.S. also emphasized conventional arms reduction, in light of the imbalance of conventional forces between East and West in Europe. By contrast, the Soviets had been fervent proponents of nuclear arms elimination as the first stage of complete disarmament, though they had a strong aversion to on-site inspection as a verification measure. A series of disarmament proposals exchanged between the two great powers were used more or less as propaganda for international consumption; hence, no wonder that the "Open Skies" proposal was seen by the Eastern bloc countries as another propaganda tool during the Cold War period.

Thirty-four years later, when President Bush made a similar proposal, it found a much more receptive Soviet Union:

> President Eisenhower's suggestion tested the Soviet readiness to open their society. And the Kremlin failed that test. Now, let us again explore that proposal, but on a broader, more intensive and radical basis, one which I hope would include allies on both sides. We suggest that those countries that wish to examine this proposal meet soon to work out the necessary operational details, separately from the other arms control negotiations. Such surveillance flights, complementing satellites, would provide regular scrutiny for both sides. Such unprecedented territorial access would show the World the true meaning of the concept of openness.[3]

Although most arms control experts regarded Bush's proposal more or less as a test of Soviet commitment to change, many high officials, including Joe Clark, Canada's Secretary of State of External Affairs, saw the proposed aircraft surveillance as an important arms control measure.[4] Nevertheless, there is a general agreement today that verification measures by satellites, seismic sensors and other kinds of ground facilities, function adequately enough to make aerial surveillance less than indispensable for many monitoring tasks. In this respect, the current situation is considerably different from that of the Eisenhower era which brought about the U-2 incident in 1960.

B. MONITORING MEASURES BEFORE THE SATELLITE ERA

While planning for aerial reconnaissance of the Soviet Union began in the United States as early as 1945, no significant results could be obtained in the immediate post-war years due to the short focal length of cameras and to the fact that the United States had no airplanes designed specifically for reconnaissance.[5] It was not until July 1956 that the aircraft U-2 (designated as "Article 341" by the CIA) conducted its first operational mission. The U-2 had the capacity to fly great distances at extremely high altitude on relatively little fuel.[6] The aircraft was equipped with instruments recording the electronic impulses of defence radars as well as of other installations propagating electromagnetic radiation.[7] Between 1956 and 1960 U-2s made approximately twenty deep penetrations of Eastern Europe and the Soviet Union. U-2 flight schedules, however, were rather tentative, and no overflights were made between early 1958 to April 1960.[8]

After the downing of a U-2 by the Soviet Union on May 1, 1960, the next generation of photoreconnaissance aircraft, the SR-71, was introduced in 1966. This aircraft could fly at Mach 3.3 at an altitude of 30,000 meters, its main sensors include a pair of 48-inch focal length technical objective cameras, a nose-range panoramic oblique lens, and a high resolution side-looking airborne radar (SLAR) system,[9] which have been used to image Soviet military facilities.[10] SR-71s conducted their missions concurrent with the satellite era until 1990, and are now reportedly mothballed. The continued utility for certain purposes of aerial reconnaissance is obvious: aircraft fly lower and observe from different angles than do satellites. They are often more flexible than satellites, which pass in fixed orbits at predictable times.[11]

Since 1946, photographic reconnaissance techniques using balloons have also been used under the sponsorship of the CIA and the Reconnaissance Branch of the U.S. Air Force. However, the effectiveness of balloon missions for collection of intelligence concerning targets such as bomber and fighter bases, missile launching sites, nuclear weapons stockpiles, other military installations and radar sites has turned out to be unsatisfactory.[12] Although balloon reconnaissance projects were not as promising as had been expected, some of their technology has been found useful for the development of satellite reconnaissance.[13]

C. MILITARY SATELLITES IN THE SERVICE OF ARMS CONTROL VERIFICATION

1. Introduction

In general, military uses of satellites are of two kinds. First, satellites support military activities by enhancing the performance of weapons on earth based and targeted against that environment. These so-called military support satellites, in other words, do not have the capability to damage, destroy or otherwise interfere with other space objects or objects on the earth or in the atmosphere. Second, satellites could be used to base or deploy devices for the destruction of other satellites, missiles and nuclear warheads after they have been launched into outer space.[14] While in the latter role, satellites have not yet been put to the test, the use of satellites as military support systems has grown steadily since the first military reconnaissance satellite, Discoverer 13, was launched in 1960. The Soviet counterpart, Cosmos 4, was successfully launched in 1962. It is military support satellites that are of vital importance as tools for monitoring arms control and disarmament agreements.

Effective arms control verification requires state-of-the-art technology, which generally remains classified. Thus, any attempt to explain verification technology is subject to error when relying strictly on non-classified data and freely available literature. The best approach, under such circumstances, is to learn the basic physical principles of intelligence technology and to scrutinize comparable civilian technology since the boundary between the civil and military uses of outer space is blurred.[15]

This chapter first describes military observation satellites and then examines possible uses of remote sensing technologies, which can be utilized for verification of arms regulation agreements.

2. Orbital Mechanics

The characteristics which are useful in determining the nature of a particular spacecraft include its perigee, being the nearest point to the earth in the satellite's orbital voyage and the apogee, being the farthest point from the earth. The greater the difference between the two, the more elliptical the orbit. If the apogee and the perigee are essentially identical, the satellite has a circular orbit. The time for a satellite to make one circuit around the earth is called a "period". Satellites appear to travel faster if nearer to the earth and slower if farther. Satellites at an altitude of 35,900 kilometres (22,400 miles) take twenty-four hours to complete a single orbit. Hence, if their orbital inclination is zero, such satellites appear stationary in relation to any given point on earth; this is the so-called geostationary orbit. On the other hand, geosynchronous satellites include any satellites with a twenty-four hour period, irrespective of orbital inclinations.[16]

Certain kinds of orbits are more suitable to particular kinds of missions. The orbits of military satellites can be roughly divided into three types: low earth orbits (LEO from some one hundred sixty kilometres to fifteen hundred kilometres), intermediate orbits (from fifteen hundred kilometres to geosynchronous orbit) and high orbits (geosynchronous orbit and beyond).[17] Low orbits (LEO) are used for photographic reconnaissance satellites, while intermediate orbits are used relatively less frequently due to the high-energy particles in the Van Allen radiation belts. Reportedly, ten to fifteen percent of all space objects are in this region.[18] Communication satellites are found, primarily in high orbits.

The Soviet Union utilizes highly elliptical orbits-perigees of five hundred kilometres and apogees of forty thousand kilometres, with a twelve hour period, for communication and early warning. Using this orbit and an inclination of sixty-five degrees, a satellite obtains a good view of North America.[19] High orbits are also suitable for early-warning because of the wide coverage they provide; thus three geosynchronous satellites placed one hundred twenty degrees apart allow for continuous monitoring of virtually the entire surface of the earth.[20]

3. Reconnaissance Satellites[21]

(a) Introduction

It has been authoritatively estimated that some twenty-two hundred military satellites had been launched between 1958 and 1984, more than seventy-five percent of all satellites placed during the same period in outer space.[22] Approximately forty percent of all military satellites are used for photographic reconnaissance purposes.[23] On average between one hundred and one hundred and twenty military satellites have been launched annually during the past two decades. The number of military satellites is generally on the decrease due to the improving average lifetime of modern spacecraft.[24]

(b) Imaging/ Photographic Reconnaissance Satellites

(i) Passive Sensors

The term "photographic reconnaissance satellite" can be somewhat misleading, because images are not necessarily pictures, but picture-like representations. The difference between these terms stems from the portion of electromagnetic spectrum the sensor utilizes: visible light, photographic (near) infrared, thermal infrared, and radar.[25] Infrared light with 0.75 to 1.0 micrometers (um) wavelength is called photographic (near) infrared, because it takes pictures in the same manner as visible-light photography. Near infrared light has the advantage of allowing for taking pictures on hazy days, with better contrast and clarity than visible light counterparts.[26] Moreover, near infrared light can be used for detecting camouflaged targets because objects being observed are recorded in colours that are different from their natural colour. For example, living vegetation appears in vivid red tones, whereas cut vegetation and materials painted green are shown from pinkish to bluish tones.[27] Thus, camouflaged installations, weapons and vehicles can be detected by using near infrared scanners.[28] Near infrared light, nevertheless, has the same disadvantage that visible light has; it is usable only in daytime. Furthermore, like visible light sensors, infrared cannot penetrate cloud and fog.[29]

The thermal infrared wavelength varies between three and fourteen um and produces imagery using the radiation emitted by objects. Since it is very sensitive to temperature differences, thermal infrared light can be used for making thermal images. Thus it can detect underground nuclear tests and missile silos or pinpoint submarines at depths of more than forty meters.[30] However, thermal infrared scanners provide much poorer resolution imagery than visible light photos due partly to the effects of diffraction.[31]

(ii) Active Sensors

Visible light and infrared light are often called passive sensors because they depend on radiation emitted from other objects. By contrast, radar (radio detection and ranging) generates its own radiation and uses bouncing radio waves from objects in order to obtain imaging. The wavelength of radar varies usually from three centimetres to fifty centimetres, which constitutes the part of the microwave portion of the spectrum. Accordingly, radar is referred to as an "active" sensor.[32] The advantage of radar lies in the fact that it penetrates clouds and can be used twenty-four hours a day in any weather. Radar also can penetrate dry sand and map what is below the sand.[33] However, radar also has disadvantages such as lower resolution than optical scanners and it requires a significant power source.[34]

The most important radars for arms control verification are line-of-sight, over-the-horizon (OTH), phased-array and synthetic aperture radars (SARs).[35] SARs are used for obtaining radar images with high resolution. All radars have the disadvantage of requiring big antennae due mainly to their great energy requirements in monitoring small objects and in minimizing the diffraction spreading phenomenon.[36] This obstacle has forced radar users to design the SAR, which "uses relatively small antenna but takes advantage of the motion of the antenna relative to the ground to create the same effect as that of a very large antenna".[37] There are two types of SAR: the strip-map type and the spotlight type. The strip-map type provides long strip maps of the ground (e.g. the Sahara Desert) whereas the spotlight type provides a map of a small region, but also provides higher resolution than the strip-map type of SAR.[38]

(iii) Resolution

The quality of imaging sensors depends on several factors, one of the most important being resolution. The simplest definition of resolution is the minimum distance between two white spots on a black background that are separately distinguishable by the sensor (spatial resolution).[39] Other important factors include atmospheric conditions, camera shake and the strength of contrast in the scene being monitored.[40] What can be actually seen from photographic reconnaissance satellites is a closely guarded secret. One evaluation of such satellites would have them producing pictures of the palm of one's hand or of licence plates on cars in Moscow's Red Square.[41]

Among the basic types of sensors, including film, electro-optical and radar, the resolution of the electro-optical sensor is generally defined differently from spatial resolution - the area on the ground that a single pixel (picture elements constituting a grid of thousands of tiny instant sensitive sensors) sees at any given point in time (Instantaneous Field of View (IFOV)).[42] Spatial resolution enables the sensor to record small details in a scene, while spectral resolution is the particular wavelength of the electromagnetic spectrum that a sensor can detect.[43] It is reported that "[a]s a rough guide, resolution of no better than twenty meters is useful primarily for natural resources analyses and other economic purposes (although large structures such as roads, ports, runways, and large ships can be detected at twenty to thirty meters); resolution of one to ten meters is useful for military reconnaissance; and resolution of better than one meter is needed for precise description and technical analysis of military hardware."[44] The resolution limit at this time is thought to be somewhere between ten to thirty centimetres.[45]

The resolution required for detection of an object or activity of military interest and the analysis of various targets is different. However, the resolution available in current military satellites is quite sufficient to detect, identify and describe most types of military targets.[46]

(iv) The Numbers of Launches

Between 1977 and 1981, the United States launched eleven photographic reconnaissance satellites (two point two per year) while the USSR launched one hundred seventy-five (thirty-five per year) and China, one.[47] The total number of launches decreased between 1982 and 1988: the United States having launched twelve (one point seven per year), the USSR two hundred and thirty-seven (thirty-three point nine per year) and China seven (one per year).[48] The USSR has launched more reconnaissance satellites than the U.S. because the Soviet satellites have a lifetime of only fourteen days, compared with three years for U.S. satellites.[49] Apart from the two superpowers, China is the third country to have launched military photoreconnaissance satellites.[50] It is probable that the Israeli remote sensing satellite also performs military observation functions.[51]

(v) Particular Orbit

In general, photoreconnaissance satellites operate in sun-synchronous orbit at altitudes of around two hundred kilometres. Sun-synchronous orbits provide a view of the same region at the same angle during the same time of the day. Since each area is covered twice a day, a series of comparable views of the same scenes are provided to photo interpreters.[52]

(vi) Photographic Reconnaissance Satellites of the United States

"Discoverer 14", placed in orbit on August 18, 1960, was the first American reconnaissance satellite from which film capsules were recovered.[53] The second generation of reconnaissance satellites, KH-5, launched in February 1963,[54] represented a significant improvement over the early "Discoverer" system.[55] Missions performed by these satellites are of two basic types: area-surveillance and close-look. A large area is scanned in area surveillance for objects of potential military interest using a wide angle, low resolution camera. Obtained electric signals are transmitted to the earth within the communication range of one of the U.S. Air Force ground stations. In a close-look mission, a high resolution camera, with its relatively narrow swath width, is used in order to re-photograph areas of particular interest found during area surveillance. Early close-look satellites (second generation), had a short lifetime, some three to five days; at the end of the mission, a capsule containing the film was ejected from the satellite and recovered, in most cases, by C-130 aircraft.[56] Such satellites were launched, on average, once a month.[57] However, by the time the third generation of close-look satellites came into being, the average lifetime of such satellites had increased to two weeks.[58]

The third generation satellites, KH-7 (area-surveillance) and KH-8 (close-look), were first placed into orbit in July and August 1966.[59] The average lifetime of KH-7 and KH-8 series satellites were respectively twenty three point seven days and twenty seven point nine days.[60] These satellites were reportedly able to alter their orbits to avoid obstructing cloud cover.[61]

With the launching of the satellite known as "Big Bird", the fourth generation of U.S. reconnaissance satellites, area surveillance and close-look missions were now conducted by a single satellite.[62] The first "Big Bird" was launched on June 15, 1971.[63] Satellites of this type are placed into a north-south, polar sun-synchronous orbit with an apogee and perigee of one hundred fifty-five miles and one hundred miles respectively, inclined ninety-six point four degrees.[64] Because the development of the Big Bird satellite program eliminated the need for area-surveillance satellites, no such satellites have been launched since 1972.[65] Images taken during area-surveillance missions are converted into electronic signals on board satellites, then transmitted to earth as compared with photographs taken during close-lock missions which are put in powered capsules, retrieved in mid-air and transported to Washington for processing and analysis.[66]

Despite Big Bird's advanced features, it nevertheless suffered from certain weakness such as the small number of films and pods on board the satellite, which limited the number of close-look photographs, relatively poor quality of the resolution of quickly obtained area-surveillance images, and the inability to penetrate poor weather conditions.[67] The problem was partly solved by the launch in 1976 of a near real-time, close-look reconnaissance satellite, the KH-11 (code-named Kennan) into a north-south, sun-synchronous orbit.[68] Different from Big Bird, which flies as low as one hundred miles, the upgraded KH-11 operates between the altitudes of one hundred and fifty and one hundred and eighty miles[69] thereby assuring longer orbital life due to reduced atmospheric drag on the satellite at the higher altitude.[70] The KH-11 satellite represents a genuine breakthrough in providing the first real-time photographic capability. The KH-11 is also equipped with sophisticated technologies such as Multispectrum Sensors (MSSs), a combination of mirrors and telescopes capable of taking many pictures at once. As each picture is taken in a different region of the electromagnetic band, the outcome is more comprehensive than provided by standard pictures.[71]

However, the KH-11 satellite is still unable to see through clouds. In December 1988, the first military satellite that used radar to produce high quality images was launched aboard the space shuttle Atlantis under the code-name of Indigo-Lacrosse.[72] The imaging sensor aboard this satellite provides all-weather, day-night capability and creates photographs using computers.[73]

The first advanced KH-11 version, or KH-12, was launched from Space Shuttle Columbia in August 1989 into a two hundred mile orbit at fifty-seven degrees inclination.[74] Another KH-12 satellite was placed into a one hundred and ten mile orbit from Space Shuttle Atlantis in February 1990.[75] The KH-12 is equipped with a telescope to take pictures using visible light and infrared radiation. Although the KH-12 series cannot see through clouds, its high resolution of ten centimetres compensates for that weakness.[76] As of December 1989, five U.S. imaging reconnaissance satellites were in operation: three KH-11 satellites (launched in 1984, 1987 and 1988), one KH-12 satellite (launched in 1989) and one Lacrosse satellite (launched in 1988).[77] Following Iraq's invasion of Kuwait on August 2, 1990, these American satellites provided vital military information, passing several times a day over the Middle East.[78]

(vii) Photographic Reconnaissance Satellites of the USSR

Soviet photographic reconnaissance began with the launch of Cosmos 4 satellite in April 1962. From the resolution standpoint, Soviet photoreconnaissance satellites fall into three categories: low, medium and high. Low resolution satellites (fifteen to twenty meters) orbit at an altitude of two hundred to three hundred kilometres and cover most of the world during missions lasting some two weeks. High-resolution satellites have a close-look mission, descending as low as one hundred and fifty kilometres. Like their U.S. counterparts, these satellites possess rather narrow fields of view and must manoeuvre periodically to prevent premature orbital decay. Medium resolution satellites orbit around four hundred kilometres altitude at orbital angles of seventy-nine and seventy-three degrees and are able to manoeuvre periodically.[79]

Between 1962 and 1968, most of the Soviet photoreconnaissance satellites had an orbital life of about eight days. New generation satellites, beginning with the launch of Cosmos 208 in March 1968, lasted about twelve days, and could change orbital characteristics.[80] By 1983, for the first time, the average lifetime of photoreconnaissance satellites was increased to three weeks.[81] The Cosmos 1504 close-look satellite launched in 1984 had a lifetime of fifty-three days.[82] Thereafter, satellite life dramatically increased, up to two hundred and five days by 1985, with Cosmos 1731, and two hundred and fifty-nine days by 1987.[83]

Soviet photographic reconnaissance satellites are highly standardized and mass-produced not only to meet frequent launchings, but also as a part of Soviet military strategy. Due to their quantities and sufficient stockpiles, the Soviet reconnaissance program is less vulnerable to launch failures and anti-satellite (ASAT) weapons. While Soviet state-of-the-art satellites can be replaced within a few months at the latest, their American counterparts may require several years to be replaced.

On August 3, 1990, less than forty-eight hours after Iraq's invasion of Kuwait, the Soviets launched Cosmos 2089 from the cosmodrome Plesetsk to cover the Middle East region every sixteen hours.[84]

(viii) Photographic Reconnaissance Satellites of China

On April 24, 1970, China joined the small group of space-launching nations - the USSR, the U.S., France and Japan - with the launch of its first artificial satellite, China-1. With the launch of the China-3 military reconnaissance satellite, in July 1975, China joined an even more exclusive group of countries.[85] By 1987 at least seven such satellites had been launched with an average lifetime of some five days.[86] On August 5, 1988 a new type reconnaissance satellite, China-23, was placed into orbit and was recovered twenty-two days later.[87]

(ix) Photographic Reconnaissance Satellites of France

France was the third nation to launch its own satellite with its own rocket. As early as 1973, the French Defense Ministry announced an interest in developing military reconnaissance satellites jointly with the civilian Centre Nationale d'Etudes Spatiales (CNES).[88] Not being part of the military segment of NATO, France has to seek information from the U.S. National Reconnaissance Office in Washington.[89] Unsatisfied with this arrangement, France eventually decided to develop its own photographic reconnaissance satellite, "Helios". Helios is scheduled to be launched into a polar orbit of ninety degrees at an altitude of eight hundred to eight hundred and fifty kilometres around 1993. Helios will be equipped with optical sensors including infrared and electro-optical devices. Its optical sensor is expected to have a ground resolution of one meter.[90] Italy, in 1987, and Spain, a year later, decided to participate and invest in the Helios program - with Italy assuming fourteen point five percent and Spain six point five percent of the cost. The extent of their involvement suggests that France will continue to control the program.[91] Helios is designed as a military version of the civilian SPOT (Satellite Probatoire Observatoire de la Terre) satellites.[92]

(x) Photographic Reconnaissance Satellites of the United Kingdom

The United Kingdom appears to have cancelled its own independent imaging reconnaissance satellite programme in 1988, code-named Zircon.[93] As a result of its close ties with the United States, the United Kingdom is not in urgent need of possessing national intelligence-gathering satellites.[94]

(c) Electronic Reconnaissance Satellites

(i) The concept of ELINT

The main function of the electronic reconnaissance satellite (ELINT) is to detect and monitor information from electromagnetic radiation emanating from sources other than atomic detonations or radioactive activities. The monitoring of electronic emanations of radar makes it possible to pinpoint the locations of air-defense systems, ABM systems, early warning stations, airfields, air bases and satellite tracking and control stations of sensed nations.[95] ELINT satellites can also determine the distance between the radar and the object detected and the object's altitude, size, speed and directional data, using non-imaging radar systems.[96]

In the context of verification, "telemetry intelligence" (TELINT) implies "data electronically transmitted from sensing instruments on a weapons system being tested to personnel conducting the test, who monitor the functions and performance parameters".[97] Data obtained by TELINT include rocket motor thrust, fuel consumption, guidance system performance, the number of warheads carried by a given missile, the range of the missile, its payload and throw-weight, the size of its warheads and the accuracy at the point of release.[98]

Information about ELINT has been more strictly classified than that obtained by photographic reconnaissance satellites. Thus, although much information is available about photographic reconnaissance satellites, no discussion in U.S. official documentation accessible to the public can be found on ELINT. Information about Soviet ELINT activities is even harder to obtain.[99]

(ii) ELINT Satellites of the United States

The first ELINT satellite was launched in March 1962 by the United States in near polar orbit with a perigee of one hundred and eighty miles and an apogee of four hundred miles.[100] Some U.S. ELINT satellites are launched into a slightly higher orbit than photographic reconnaissance satellites and have very long orbital lives, ranging from several months to hundreds of years. However, battery capacity as well as the reliability of various complicated electronic receivers and tape recorders limit the true orbital life of these satellites to several years. Like photoreconnaissance satellites, ELINT satellites are of two types: one type is used for large area-surveillance and locating of approximate radar positions; the other type is used for gathering more detailed data.[101]

The United States has still another series of ELINT satellites as part of its Satellite Data System (SDS) program, the main function of which is to improve communication links for Strategic Air Command (SAC) bombers. SDS satellites eavesdrop for sustained periods of time over the northern part of the USSR, using a geosynchronous orbit.[102] As of December 1989, six ELINT satellites were believed to be in service.[103]

In addition to satellites, the U.S. signal intelligence community uses electronically-equipped ships and ground bases in locations such as Turkey and Taiwan. These ground bases use line-of-sight, phased-array and over-the-horizon radar. The line-of-sight radar is effective provided there are no obstacles between antenna and the target. However, its utility due to the curvature of the earth is limited to observing what happens at low altitudes. The phased-array radar is a large system with many individual tiny radars that are steered electronically to track fast-moving objects. This obviates the need to have a moving antenna dish. The U.S. phased array radar "Cobra Dane" is reported to be able to detect a basket-sized object at a distance of two thousand miles.[104] The over-the-horizon radar is still another system used for verification purposes. It makes use of atmospheric reflection and detraction phenomena and thus is not limited by earth curvature. What makes this radar particularly effective is its ability to maintain surveillance of small areas such as missile test ranges.[105]

(iii) ELINT Satellites of the USSR

The first Soviet satellite involved in an ELINT mission was launched in 1967. Three or four such satellites were launched during the next decade.[106] It is believed that at least eight Soviet ELINT satellites may have been orbiting at any one time. They are located in near polar orbits at an altitude of some six hundred and thirty kilometres, providing daily coverage of the whole world.[107] Since 1980 the USSR has launched four medium-size ELINT satellites annually.[108]

In 1985, the Soviets launched the largest military satellite in history, Cosmos 1603, orbiting at an altitude of five hundred and thirty miles and inclined seventy-one degrees, which reportedly is the typical angle of Soviet ELINT satellites. Its purpose is to detect detailed U.S. radio intelligence data and U.S. Ballistic Missile Early Warning System (BMEWS) and phased array radar signals.[109] As of December 1989, eleven Soviet ELINT satellites were in service, according to American sources.[110]

(d) <u>Ocean Surveillance Satellites</u>

(i) The Concept of Ocean Surveillance Satellites

The function of an ocean surveillance satellite in the service of arms control monitoring is to detect and track surface ships and submarines. These tasks are carried out by sensors such as long-range radars, infrared and microwave radiometers, radar altimeters, photographic and television imaging sensors, microwave scatterometers and the synthetic aperture radar (SAR) on board ocean surveillance satellites.[111]

(ii) Ocean Surveillance Satellites of the United States

It is not possible to identify U.S. satellites that function exclusively for ocean surveillance. Once it was suggested that close-look satellites of the KH-8 type were performing ocean surveillance missions along with other tasks.[112] The U.S. Navy's first dedicated ocean surveillance satellite to detect locations of surface ships was launched in April 1976 under the code name "White Cloud". The "White Cloud" series of satellites are equipped with infrared and microwave sensors, flown in near-circular orbit at an altitude of some seven hundred miles and collect radar and radio emissions from target ships.[113] The positioning of "White Cloud" satellites in space allows twenty-four hour observation of surface warships and detection of signals from a distance of about three hundred kilometres.[114]

Seasat-1, the U.S. Navy's oceanographic research program satellite was placed in a near-circular orbit in 1978 at an altitude of eight hundred kilometres, with a four kilometre resolution over a fifteen hundred kilometre swath.[115] This satellite provides all-weather high-resolution images of ocean waves, ice fields, icebergs, coastal features and surface vessels.[116]

(iii) Ocean Surveillance Satellites of the USSR

In 1967 the first Soviet experimental ocean surveillance satellite, Cosmos 195, was launched from the Tyuratam launching complex. From the start of its mission, the satellite attracted the attention of Western observers owing to its unique orbital movement. Initially Cosmos 195 series satellite would be placed into a low circular orbit of some two hundred and sixty kilometres at sixty-five degrees inclination. Some days later, it would be propelled to an altitude of about nine hundred kilometres.[117] This series of satellites only became operational in 1974. When, in January 1978, one of the Soviet ocean surveillance satellites, Cosmos 954, malfunctioned and disintegrated over the Canadian North, it was revealed that it carried a nuclear reactor to provide power for the on-board radar and other equipment. The advantage of nuclear power in spacecraft is that it provides more energy than solar cells and is less vulnerable to nuclear or particle beam weapon attack.[118] The reason for changing orbits is that, at high altitudes, the satellites can remain in orbit long enough - up to five hundred years - for short-lived radioactive fission products to completely decay.[119]

Since 1974, the Soviet ocean surveillance program consists of two basic types of satellites - EORSATs and RORSATs. RORSATs are used for detecting surface ships and EORSATs for picking up radio and radar transmissions. Two satellites of each type are designed to function in tandem.[120] Due to technical difficulties, RORSATs reportedly are used sporadically for specific missions; EORSATs eavesdrop to compensate for the unreliability of RORSATs.[121]

A more recent Soviet ocean surveillance satellite "Okean" oceanographic satellite was launched into a six hundred and fifty kilometre orbit in 1988. A Second "Okean" was launched in 1989. Both satellites carry side-looking imaging radar providing one to two kilometre resolution and are particularly useful in producing more detailed maps of ice-covered areas.[122] In recent years, two or three Soviet ocean surveillance satellites have been operating at any one time.

(e) Early Warning Satellites

(i) The Concept of Early Warning Satellites

The purpose of early warning satellites is to detect ICBM attacks as well as missile tests through sensors sensitive to the infrared radiation emitted by the hot plume of rockets. Before the advent of satellites, early warning of a missile attack was provided by ground radars which gave early warning of only about fifteen minutes. With satellites, early warning time doubled to about thirty minutes.[123]

(ii) Early Warning Satellites of the United States

In the late 1950's, fifteen minutes warning time for the United States was assured by the BMEWS, line-of-sight radars in Alaska and Greenland.[124] The Missile Defense Alarm System (MIDAS) satellite project began in 1958 and the first successful launch of a MIDAS satellite took place in 1960. The infrared sensors of MIDAS, however, could not distinguish between radiation emitted from rocket engines and that generated from the sun.[125] The weakness was eliminated by the introduction of a new generation of MIDAS satellites, first placed into near equatorial geosynchronous orbit in August 1968. Entitled the Integrated Missile Early Warning System (IMEWS), it could detect both ICBM attack and missile tests.[126]

Since 1971, Defense Support System (DSP) satellites have also been performing the function of missile early warning. The first DSP satellite was launched in May 1971 into geosynchronous orbit and carried a focal plane array telescope with two thousand infrared detectors. A principal objective of the DSP spacecraft was to detect submarine-launched ballistic missiles (SLBMs) which have shorter flight paths before reaching U.S. territory.[127] This system consists of three DSP satellites, two over the Pacific and Atlantic Oceans (DSP West) and one over the Indian Ocean (DSP East). A third-generation DSP was launched in 1989. At least nine of these spacecraft will be launched over the next several years. The new DSP is superior to the previous satellites in several important respects, including greater sensitivity and longevity, having a life-span of seven to nine years. In addition, it possesses advanced radiation detection sensors and laser communications equipment for quick retransmissions of encrypted warning data.[128] As of December 1989, five DSP satellites have been in operation: three provide primary operational services, the other two are stored as backups in case of emergency.[129] Within three minutes of a Soviet first strike, the data obtained by early warning satellites is sent to NORAD/Space Command, which then uses the information to discern what type of Soviet strike is under way - all within five minutes of enemy launch.[130]

A highly improved version of reconnaissance satellites, code-named "Teal Ruby" has been in the process of development since 1977.[131] Teal Ruby contains more than ten thousand detectors in its sensors, which provide ten meter resolution from a three hundred and sixty mile circular orbit.[132] In addition to early warning, Teal Ruby is capable of detecting and tracking small targets such as airplanes, cruise missiles, ships and ground-based weapons.[133]

Still another generations of spacecraft, called the "Boost Surveillance and Tracking System" (BSTS) is being developed. BSTS were conceived as dual function satellites, to provide missile early warning and guide Strategic Defense Initiative (SDI) weapons.[134]

(iii) Early Warning Satellites of the USSR

The first Soviet satellite dedicated to early warning was reported to be Cosmos 520, launched in 1972 into a very eccentric semi-synchronous orbit similar to Molniya orbits.[135] In 1975 the Soviets launched Cosmos 775 believed to be an advanced type of an early warning satellite. The satellite was placed into a equatorial geosynchronous orbit, over the Atlantic Ocean, as the most suitable location for observing submarine launched ballistic missiles (SLBMs).[136] According to the SIPRI's World Armaments and Disarmament Series, all Soviet early warning satellites have similar characteristics - roughly sixty-three degrees inclination, a highly elliptical orbit of perigees and apogees of around six hundred kilometres and forty thousand kilometres respectively, and an approximately twelve year lifetime. The Soviet early warning satellite network is believed to consist of nine satellites, forty degrees apart, most likely to provide coverage of the same ground track every one hundred and sixty minutes.[137]

(f) Nuclear Detection Satellites

Nuclear detection satellites were developed primarily to verify compliance with the Partial Nuclear Test Ban Treaty of 1963.[138] The essential purpose of these satellites was to detect nuclear explosions in any environment, especially at high altitudes and in outer space.

(i) Nuclear Detection Satellites of the United States

In the early days of the Cold War, the Vela series satellites were used for low-yield, nuclear-explosion detection in the atmosphere and in outer space. Project Vela consisted of three separate systems· Vela Uniform, which used seismic detectors to detect underground and underwater explosions; Vela Sierra, which used earth-bound measuring instruments to detect atmospheric and space-based nuclear explosions; and Vela Hotel which used satellites to detect nuclear detonations.[139]

Vela satellites were launched in pairs in near-circular orbits with a perigee and apogee of 10,000 kilometres and 111,500 kilometres respectively. These satellites had extremely long orbital life-times, more than one million years.[140] The first Vela pair was placed into orbit in October 1963.[141]

One of the more spectacular achievements of Vela satellites was the detection on September 22, 1979, of a major explosion in the vicinity of South Africa, suspected of having been an experimental nuclear explosion.[142] Although such sensors could not pinpoint the exact location of the explosion, they did detect a two to four kiloton yield detonation from an altitude of sixty thousand kilometres.[143]

DSP spacecraft have also been used for the detection of nuclear explosions in space and in the atmosphere since 1971. In addition, the NAVSTAR Global Positioning System (GPS) is equipped with a space-based nuclear detection (NUDET) system.[144] The GPS network, when completed, will consist of eighteen satellites in near-circular orbits of 17,600 miles.[145]

(ii) Nuclear Detection Satellites of the USSR

The USSR does not appear to have deployed a dedicated nuclear detection satellite system. Reportedly, sensors capable of detecting nuclear explosions are on board satellites deployed in Molniya-type orbits and on the Global Navigation Satellite System (GLONASS).

(g) <u>Communication Satellites</u>

The transmission of data gathered by space-, air- and land-based sensors requires reliable communications systems. Space based communications networks transmit data gathered by satellites to military control and command centers at various levels of command. Communications satellites therefore represent an important, indeed indispensable, component of arms control verification and monitoring. In addition to the United States and the Soviet Union, the military of France, Great Britain and China possess national satellite communications system.[146]

D. MANNED SPACE SYSTEMS

1. The Concept of Manned Space Systems

Manned Space Systems consist of the Space Transportation System (STS) and space station. As a tool of arms control verification, however, manned space systems are often regarded as a poor alternative to current intelligence-gathering satellites, mainly due to the exorbitant cost to sustain crews safely in space.

2. U.S. Manned Space Activities

In the early 1960s, the Dynasoar (later X-20) Project, a manned hypersonic glide vehicle that could be boosted into space to "bounce" off the upper atmosphere and then be directed back to earth to land at preselected sites,[147] was being developed by the Defense Department for the purpose of strategic reconnaissance, satellite inspection/interception, and as a platform for bombardment.[148] This project was cancelled in 1963.[149] Soon thereafter, a feasibility study of a near-earth Manned Orbiting Laboratory (MOL) started and presidential approval of that project was given in 1965.[150] MOL was programmed for strategic reconnaissance by means of a huge ninety-inch telescope[151] as its primary mission, along with other possible uses such as satellite inspection and satellite destruction.[152] MOL was cancelled in 1969, mainly because a new photographic reconnaissance satellite, Big Bird

(KH-9), was being developed and promised to provide, considerably sooner, as much intelligence information as the MOL at lower cost.[153]

Currently, the U.S. either possesses or is developing three manned space systems that can be useful for arms control verification: the Space Shuttle[154], the U.S./International Space Station, "Freedom"[155] and the National Aerospace Plane (NASP).[156]

The Department of Defense (DoD) was heavily involved with the Space Shuttle project from the beginning. It continues to be the Shuttle's most important user. Of the three hundred eleven Shuttle missions originally scheduled between 1983 and 1994, one hundred and fourteen (thirty-seven percent) were allocated to the DoD, compared to ninety-three (thirty percent) for NASA and thirty-eight (twelve percent) each for U.S. commercial and foreign users.[157] Furthermore, President Reagan's National Security Directive Order 164 required that at least one third of all Shuttle flights be booked for the U.S. Air Force.[158]

Given its manoeuvrability in orbit and the possibility of including military personnel on board, the U.S. Space Shuttle can serve as a formidable reconnaissance tool. One of the crews of the 41-G mission launched in 1984 said: "with a trained eye every time I look out I will see something interesting. ... I am convinced that the eye-mind combination can see far more subtle things than any camera can photograph."[159] In addition to various hand held cameras and other instrumentation, the Shuttle's cargo bay can carry a four hundred and thirty kilogram Large Format Camera (LFC) that has at least twenty-three meter resolution in panchromatic mode.[160] Examples of photographs taken by Shuttle crews are: the launch site at Tyuratam where the Soviet space shuttle was being constructed,[161] a Soviet surface-to-air (SAM) missile site at Choybalsan, Mongolia,[162] the ballistic missile silos and submarine facilities at Petropavlovsk on the Kamchatka Peninsula,[163] the Ramenskoye Flight Test Centre[164] and a suspected twenty-five year old nuclear accident site of Kyshtym, about sixty miles southwest of Sverdlovsk.[165]

The first generation American manned space station "Skylab" series was abandoned in 1973 in favour of the Space Shuttle project.[166] As far as the U.S./International Space Station "Freedom" is concerned, (currently in the process of development), its intended use by the United States for SDI experiments and reconnaissance ran into considerable resistance on the part of other participating states.[167] The Pentagon's position, as expressed by Secretary of Defense Weinberger, that "[m]ilitary and civilian programs, such as the space station, must be available for defense experiments or other American national security uses consistent with international law",[168] significantly delayed conclusion of arrangements among international partners.[169]

Given the monitoring challenges facing the U.S./International Space Station, including technological problems and budget restraints,[170] its value as an instrumentality for verification remains uncertain.

Another developing program, the "National Aerospace Plane"(NASP) is conceived as a vehicle capable of reaching speeds of 17,000 miles per hour to escape earth's gravity using hydrogen-burning engines capable of operating both in the atmosphere and in the vacuum of space and to fly directly into orbit from an airfield.[171] One of the military missions identified for NASP is strategic reconnaissance.[172] The problems of the aerospace plane program are immense, and include still developing technology and uncertain budgetary allocations.[173]

3. USSR Manned Space Activities

In comparison with the United States, the Soviet manned space systems show a more systematic approach. Soviet programs consist mostly of manned space station activities, although the USSR has also constructed and tested its own space shuttle and has likely worked on a spaceplane.

The USSR has been methodically working on a space station located in near earth orbit at an altitude of between two hundred and four hundred kilometres.[174] The world's first space station, Salyut 1, was launched as early as 1971. According to the U.S. Office of Technology Assessment, Salyut space stations have been routinely used for reconnaissance purposes,[175] a claim denied by the Soviets.[176] The Salyut's telescope is reported to be capable of transmitting images of half-meter spatial resolution, which is more than enough for precise identification of many military targets.[177] It is also believed that the Salyut 7's cosmonauts have monitored and assessed Soviet ground, sea and air military exercises.[178]

First of the third generation of space stations, "Mir" (meaning "peace" in Russian) was launched into a two hundred fifteen mile orbit in 1986.[179] A former U.S. Secretary of Defense has claimed that Mir is used primarily for military missions.[180] Although the accuracy of that statement cannot be verified, Mir is thought to be used at a minimum for reconnaissance missions.[181]

While Mir appears to be a useful instrument of verification on the surface, Soviet officials are not optimistic about the future of manned space stations because "[m]any people in our country believe the price of Mir is very high, and that it would have been better to use automatic satellites instead of a manned space station".[182] The USSR began to develop its own space shuttle, "Buran", in 1982, and successfully launched it in 1988.[183] According to U.S. Defense Department officials, Buran's planned use includes ASAT, reconnaissance, crew transport and satellite repair and maintenance.[184] However, it appears that the political and economic instability in the

Soviet Union has temporarily, at least, put a moratorium on Buran's activities.[185]

Very little is known about the Soviet spaceplane, except that it is in the research phase.[186]

E. REMOTE SENSING SATELLITES

1. Introduction

As mentioned in Section C.1 of this Chapter, the boundary between military and civilian space technology is becoming indistinguishable. By way of illustration, France decided to develop its military photographic reconnaissance satellite based on civilian SPOT technology rather than the other way around. This section, therefore, surveys current civilian satellite programs that could be used for arms control verification.

2. Landsat

As of April 1992, five Landsats have been successfully placed into orbit launched in 1972, 1975, 1978, 1982, and 1984. Landsat 1 (previously known as Earth Resources Technology Satellite) and Landsat 2 were placed in orbit at nine hundred and twenty kilometres, and equipped with visible multispectrum scanners (MSS) and Return-Beam Vidicom (RBV) cameras.[187] Landsat 3, launched in 1978, was placed in the same orbit, but carried upgraded sensors such as infrared

MSS.[188] Landsat 4 and 5 were placed into a seven hundred kilometre orbit with ninety-eight degrees inclination and are equipped essentially with the same sensors carried on previous Landsats. The Thematic Mapper (TM)[189] aboard Landsat 4 and 5 has six visible and near infrared bands with thirty meter resolution and one thermal infrared band with one hundred and twenty meter resolution.[190]

Following the transfer of ownership in 1985 of Landsat to the Earth Observation Satellite Company (EOSAT), a joint venture of the Hughes Aircraft Company and the then RCA Corporation,[191] plans were announced to launch two new satellites, Landsat 6 and 7. These satellites would be equipped with advanced observational technology that would permit higher resolution, possibly of ten meters.[192] President Carter's Presidential Directive 37 of 1978 limited the resolution of U.S. remote sensing satellites to no better than ten meters although no formal federal regulations were adopted to that effect. This limitation was eventually lifted in January 1988.[193] It has been reported that if Landsats 4 and 5 were to be moved down from seven hundred kilometres to two hundred kilometres orbit, an orbit that has been exclusively used by military reconnaissance satellites, the corresponding resolution would be enhanced to eight meters.[194] In accord with a new government policy, EOSAT announced in 1987 that it would introduce five meter resolution on board Landsat 7 to be launched in 1994.[195]

At the beginning, EOSAT faced considerable obstacles mainly due to delays in receiving expected government subsidies. The original contract in 1985 stipulated that, in return for a $250 million subsidy over the following five years by the U.S. government, EOSAT would build two new satellites and continue to operate Landsats 4 and 5.[196]

Successive administrations have failed to appropriate sufficient funds to enable EOSAT fully to carry out its program.[197] An additional setback occurred with the loss of the Space Shuttle Challenger, leading to long delays in launching Landsat 6.[198] More recently, new questions have been raised as to the wisdom of commercialization of the Landsat system considering the strong support given by the governments of France and the USSR to their civilian remote sensing organizations.[199]

While some experts doubt the future commercial competitiveness of EOSAT in view of the existence of French and Soviet counterparts, owing mainly to Landsat's lower resolution, Landsat does have a substantial advantage in that it can provide multispectral imagery of a quality superior to that of its two rivals.

Receiving stations in operation all over the world for Landsat coverage include: Prince Albert (Canada), Goddard Space Flight Center (United States), Cuiaba (Brazil), Man Chiquita (Argentina), Fucino (Italy), Johannesburg (South Africa), Riyadh (Saudi Arabia), Hyderabad (India), Bangkok

(Thailand), Jakarta (Indonesia), Alice Springs (Australia), Beijing (China) and Tokyo (Japan). Another three are planned: Auckland (New Zealand), Islamabad (Pakistan) and Quito (Ecuador).[200]

3. SPOT

The French remote sensing satellite, "Système Probatoire d'Observation de la Terre", or SPOT, was placed into sun-synchronous orbit some eight hundred and twenty kilometres above the earth by Ariane 1 launcher from Kourou, French Guiana, in February 1986. SPOT is equipped with twin HRV ("haute resolution visible") instruments providing a multi-spectral resolution of twenty meters and panchromatic resolution of ten meters.[201] The SPOT HRVs have a movable mirror entry system that gives an oblique viewing capability of up to twenty-seven degrees, which enables the spacecraft to revisit the same area up to seven times during the twenty-six days of an orbital cycle and take stereoscopic images a capability not matched by Landsat.[202] Half of SPOT's data is in the form of computer tape while the remainder is in photographic form.[203]

SPOT images have been extensively published in the mass media, especially those that revealed Soviet naval and nuclear weapon storage installations at Murmansk and Severomorsk,[204] the Krasnoyarsk phased-array radar,[205] and suspected laser weapon facilities at Nurek and at the Sary Shagan test site.[206] SPOT Image Corporation has also sold to the media such imagery as Iranian military facilities near the Persian Gulf, Soviet space launching facilities at Tyuratam, the nuclear test site at Semipalatinsk and the Chernobyl nuclear reactor.[207] While SPOT 2, launched in January 1990,[208] belongs to the first generation of observation satellites, France is already working on its second generation of SPOT satellites scheduled to be launched some time in 1992 and 1993.[209]

Operational SPOT receiving stations include: Toulouse (France), Kiruna (Sweden), Gatineau (Canada), Prince Albert (Canada), Hyderabad (India), Maspalomas (Canary Islands), Cuiaba (Brazil), Islamabad (Pakistan), Lad Krabang (Thailand), Hataoyama (Japan), Johannesburg (South Africa) and Riyadh (Saudi Arabia). In addition, Ecuador, Israel, China, Taiwan, Indonesia and Australia are either constructing ground receiving stations or negotiating for their construction.[210]

4. <u>USSR</u>

In late 1987, the USSR announced that it was prepared to market satellite photographs of five meter resolution through the Soviet trading company Soyuzkarta. The images made available in the West proved to be of surprisingly high quality, quite superior to Landsat images. There can be no doubt that these satellites, having such high resolution, could be of great value as an arms control monitoring system.[211]

The principal shortcoming of Soviet remote-sensing satellites lies in their use of film pod systems, which are dropped from satellites periodically and recovered on the earth in contrast to the transmission of images electronically in digital form as is done by Landsat and Spot. In consequence, the acquisition of such photographs takes more time than by the other systems.[212]

5. **European Space Agency (ESA)**

The first remote sensing satellite of the European Space Agency (ESA),[213] ERS-1 was successfully placed into an eight hundred kilometres polar orbit using the Ariane in 1992. ERS-1 is capable both of ocean and land observation with SAR expected not only to be used for oceanographic purposes but also to penetrate through clouds often covering Eastern Europe.[214] Construction of an Advanced Earth Remote Sensing Satellite, or AERS-1, primarily for land applications, is also under consideration.[215]

6. **Canada**

While Canada is not currently developing an independent satellite launching capability, it nevertheless has state-of-the- art technology in image processing,[216] as evidenced by its development of the Radarsat program.[217] The objectives of Radarsat are: (1) to support energy projects in the Arctic and offshore through an imagery radar satellite system, capable of providing all-weather sea ice information (day and night, through fog and cloud) for the safe and efficient extraction and transportation of Arctic oil, gas and minerals; (2) to provide data on land mass for geological exploration, forest management and environmental monitoring; and (3) to give Canadian industry entry to the market for earth observation satellite systems.[218]

Radarsat is scheduled to be launched in 1994 and will be placed into polar orbit at an altitude of approximately six hundred kilometres. It will be equipped with a C-band SAR sensor whose resolution is expected to be twenty-five to forty meters. The swath width of that spacecraft will be seventy-five to two hundred and fifty kilometres and its designed lifetime five years.[219] The Radarsat system will have considerable capability for the monitoring of arms control agreements, especially because of its cloud-penetrating radar.[220]

7. India

While India had been developing the Indian Remote Sensing Satellite, IRS-1 since 1977, it was launched only in 1988 by Proton booster provided by the USSR.[221] IRS-1 carries two types of sensors: two high resolution sensors of thirty-seven meters and one low resolution sensor of seventy-three meters at an altitude of some nine hundred kilometres.[222] IRS-2 was successfully launched in August 1991 from the Baikonur launch site.[223]

8. Japan

Japan is the fourth nation to launch a satellite with its own launcher. Since 1970, forty scientific and application satellites have been launched by Japan.[224] The first remote sensing satellite, Marine Observation Satellite, or MOS-1, was successfully put in sun-synchronous orbit of five hundred and sixty-four miles in February 1987. MOS-1 carried various sensors including a multispectral electronic self-scanning sensor (MESSR), which provides sea-surface colour data with a fifty meter resolution and one hundred kilometre swath width in four spectral bands.[225]

Another program, the Earth Resources Satellite, JERS-1, was successfully launched in February 1992 to undertake observation of the earth surface and to explore natural resources.[226] JERS-1 carries a SAR similar to Seasat-1 and an optical sensor package such as a linear array stereo camera with thirty meter resolution.[227]

9. Israel

The first Israeli satellite, Ofeq-1, was successfully launched in September 1988. Israel thus became the eighth state capable of placing a satellite into orbit.[228] Ofeq-1 was put in low elliptic orbit with a ninety-eight minute period and passed all territory between fifty-seven degrees north latitude and fifty seven degrees south latitude.[229] Ofeq-1 attracted great attention, by demonstrating Israeli capability to operate photographic reconnaissance satellites as well as its ability to launch ballistic missiles. Ofeq-2 was successfully placed into orbit in April 1990,[230]

10. Conclusion

As outlined above, an increasing number of countries have acquired remote sensing satellites, and still others have built receiving ground stations. The superpower monopoly in this field has virtually ceased, although the United States and the Soviet Union possess far superior space technology, including sensor resolution and interpretation systems. Since, in essence, civilian remote sensing technology differs only slightly from that used for military intelligence gathering, virtually all of the satellites described in this section could play a role in the process of arms control verification.

CHAPTER III - ENDNOTES

1. M. Dowd, "Bush Voices Hope on Soviet Change, but with Caution" N.Y.Times (13 May 1989) A.1 & 6; R.R. Rostow, Open Skies: Eisenhower's Proposal of July 21, 1955 (Austin, Texas: Univ. of Texas Press, 1982).

2. "I propose, therefore, that we take a practical step, that we begin an arrangement, very quickly, as between ourselves--immediately. These steps would include: To give to each other a complete blueprint of our military establishments, from beginning to end, from one end of our countries to the other; lay out the establishments and provide the blueprints to each other. Next, to provide within our countries facilities for aerial photography to the other country--we to provide you the facilities within our country, ample facilities for aerial reconnaissance, where you can make all the picture you choose and take them to your country to study, you to provide exactly the same facilities for us and we to make these examinations, and by this step to convince the world that we are providing as between ourselves against the possibility of great surprise attack, thus lessening the danger and relaxing tension."

   Senate Committee on Aeronautical and Space Sciences, Statement by the President of the United States on International Cooperation in Space--A Chronology: October 1957-August 1971, S. Doc. 92-40, 92d Cong., 1st Sess. 5 (1971); Dep't of State of the United States, "Statement by President Eisenhower at the Geneva Conference of Heads of Government: Aerial Inspection and Exchange of Military Blueprints, July 21, 1955", Documents on Disarmament 1945-1959, vol.1, at 486; see also, W.J. Levison, "Capabilities and Limitations of Aerial Inspection" in S. Melman,ed., Inspection for Disarmament (New York: Columbia Univ. Press, 1958) 59 at 61.

3. "Transcript of Bush's Remarks on Transforming Soviet-America Relations" N.Y.Times (13 May 1989) A6.

4. J. Clark, "Don't Dismiss Open Skies", N.Y.Times (5 June 1989) A17.

5. W.E. Burrows, Deep Black: Space Espionage and National Security (New York: Random House, 1986) at 55-60.

6. Ibid. at 77.

7. D. Baker, The Shape of War To Come (New York: Stein & Day, 1981) at 76.

8. Rostow, supra, note 1 at 193.

9. Although SLARs have been extensively used for airborne systems, such radars are not practical for satellites, because antennae would have to be kilometres long to identify the targets. Canadian Institute for International Peace and Security, Satellite Surveillance and Canadian Capabilities (Background Paper No. 7) by R. Backingham (February 1986) at 7.

10. T. Sakata, Military Satellites (in Japanese) (Tokyo: Kyoikusha, 1985) at 18; see also, M. Krepon, Arms Control: Verification and Compliance (New York: Foreign Policy Association, 1984) at 164-65.

11. Clark, supra, note 4 at A17. Concerning updated information on reconnaissance aircraft, see D.E. Fink, "Role of U-2 High-Altitude Surveillance" (16 June 1980) Aviation Week & Space Technology 200 [hereinafter AWST]; M.A. Dornhelm "U.S. Reconnaissance Weakened by SR-71 Program Termination" (22 January 1990) AWST 38; "High-Performance D-21 Drone Used With Blackbird, B-52" ibid. 42; "Spy Plane Sets Speed Record, Then Retired" N.Y.Times (7 March 1990) A16.

12. Burrows, supra, note 5 at 59. Of the total of more than 500 balloons launched, 243 were lost during their flight and only 44 were retrieved. Many balloons are thought to have been shot out of the sky. A different evaluation of the effectiveness of balloon reconnaissance is found in Rostow, supra, note 1 at 192.

13. Rostow, ibid. at 192-93.

14. UNIDIR, Disarmament: Problems Related to Outer Space, UNIDIR/87/35 UN Publication Sales No. GV.E.87.0.7 at 16-17.

15. B. Jasani, "Military Use of Outer Space", in World Armament and Disarmament: SIPRI Yearbook 1988 (Oxford: Oxford Univ. Press, 1988) 75 at 89.

16. B. Jasani, Outer Space: Battlefield of the Future (London: Taylor & Francis, 1978) at 4-9; B. Jasani, "Reconnaissance Satellites", in World Armaments and Disarmament: SIPRI Yearbook 1975 (Cambridge, Massachussets: MIT Press, 1975) 378 at 378-81; P. Farinella & B. Bertotti, "Orbital Mechanics and Military Satellites" in D. Carlton & C. Schaerf, eds., The Arms Race in the Era of Star Wars (New York: St.Martin's Press, 1988) 272 at 272-78. See also, Appendix 1.

17. Farinella & Bertotti, ibid. at 278-79. Some authors regard LEO as the term applied to the region below 500 kilometres, which means orbits have period of between 90 minutes and a few hours. See, Ashton B. Carter, "The Current and Future Military Use of Space", in J.S. Nye, Jr. & J.A. Schear, eds., Seeking Stability in Space: Anti-Satellite Weapons and the Evolving Space Regime (Maryland: Univ. Press of America, 1987) 29 at 30-31.

18. Carter, ibid. at 35; see Appendix-2.

19. Ibid. at 34-35; see Appendix-2.

20. Farinella & Bertotti, supra, note 16 at 280-81.

21. "Surveillance and reconnaissance are distinctive missions in theory, if not always in practice. Surveillance refers to a fairly regular monitoring activity, whereas reconnaissance implies a quest for information of a nature specific kind and generally on a more urgent basis." cited in C.S. Gray, American Military Space Policy: Information Systems, Weapons Systems, and Arms Control (Cambridge, Massachusetts: Abt Books, 1982) at 24. In this work, however, uses the two terms interchangeably.

22. B. Jasani & G.E. Perry, "The Military Use of Outer Space" in World Armaments and Disarmament SIPRI Yearbook 1985 (London: Taylor & Francis, 1985) 133 at 133.

23. B. Jasani, "Military Activities in Outer Space", B. Jasani, ed., Outer Space: A New Dimension of the Arms Race (London: Taylor & Francis, 1982) 41 at 43.

24. During the first decade, the number of launches was on the increase. See Jasani, ibid. For detailed information on annual number of military satellites launched, see World Armaments and Disarmament: SIPRI Yearbook Series.

25. J. Richelson, "The Keyhole Program" (1984) 7 J. Strategic Studies 121 at 121-23.

26. T. Karas, <u>The New High Ground: System and Weapons of Space Age War</u> (New York: Simon & Schuster, 1983) at 30.

27. Richelson, <u>supra</u>, note 25 at 122.

28. <u>Ibid.</u>

29. A.S. Krass, <u>Verification: How Much is Enough?</u> (London: Taylor & Francis, 1985) at 30. Karas, <u>supra</u>, note 26 at 106-07.

30. Krass, <u>ibid.</u> at 32.

31. Reportedly, the best thermal infrared imagery is some one hundred times poorer that the best visible light pictures. Krass, <u>ibid.</u> at 31.

32. <u>Ibid.</u> at 38.

33. E. Brookner, "Radar Imaging for Arms Control" in C. Tsipis, D.W. Hafemeister & P. Janeway eds., <u>Arms Control Verification : The Technologies That Make It Possible</u> (Washington, D.C.: Pergamon-Brassey's, 1986) 135 at 138 and 142.

34. Krass, <u>supra,</u> note 29 at 38.

35. <u>Ibid.</u> at 38-49.

36. <u>Ibid.</u> at 45.

37. <u>Ibid.</u>; see also, B. Jasani, "The Military Uses of Outer Space" in <u>World Armaments and Disarmament: SIPRI Yearbook 1979</u> (London: Francis & Taylor, 1979) 256 at 269-70.

38. Brookner, <u>supra</u>, note 33 at 140.

39. A. Florini, "The Opening Skies: Third-Party Imaging Satellites and US Security" (1988) 13:2 Int'l Security 91 at 94; Richelson, <u>supra</u>, note 25 at 123.

40. Florini, <u>ibid.</u>

41. R. Jastrow, <u>How to Make Nuclear Weapons Obsolete</u> (Toronto: Little Brown, 1983) at 58; W.J. Broad, "Spy Satellite Aim is to Track Iraq" <u>N.Y.Times</u> (20 October 1990) A4.

42. Florini, supra, note 39 at 94.

43. Ibid. at 95.

44. Ibid.

45. Ibid. Dr. Jasani stated that the feasible spatial resolution was fifteen cm, due to improvements of lenses, photographic films with a fine grain and high sensitivity as well as computer image enhancement. For more detailed information about resolution, see Jasani, SIPRI 1975, supra, note 16 at 391-94; Krass, supra, note 29 at 16-28; T.D. Lindgren, "Commercial Satellites Open Skies" (1988) 44: 3 Bull. Ato. Scientists 34 at 35.

46. Jasani, supra, note 23 at 46-47; see Appendix-3.

47. Ibid. at 331-40.

48. World Armaments and Disarmament : SIPRI Yearbook 1983, 1984, 1985, 1986, 1987, 1988 and 1989 Tables on photographic reconnaissance satellites launched during 1983-1989.

49. B. Jasani, "Military Use of Outer Space", in World Armaments and Disarmament: SIPRI Yearbook 1987 (Oxford: Oxford Univ. Press, 1987) 57 at 58-59.

50. China is the fifth nation to launch a satellite using its own launcher.

51. J. Simpson, P. Acton & S. Crowe, "The Israeli Satellite Launch: Capabilities, Intentions and Implications" (1989) 5 Space Policy 117.

52. Karas, supra, note 26 at 100; Richelson, supra, note 25 at 134; Jasani, Outer Space: Battlefield of the Future, supra, note 16 at 14-20. See Appendix-2.

53. Some experts claim that this was accomplished on 11 August 1960 by Discoverer 13. See e.g., T. Greenwood, "Reconnaissance and Arms Control" (1973) 228: 2 Scientific American 14 at 18; Rostow, supra, note 1 at 193.

54. 28 February 1963 is the beginning of the Keyhole (KH) Program. However, names of satellites are given retrospectively. Hence, the first SAMOS became KH-1. Richelson, supra, note 25 at 133.

55. Greenwood, supra, note 53 at 18.

56. B. Jasani, "Verification Using Reconnaissance Satellites" in World Armaments and Disarmament: SIPRI Yearbook 1973 (Stockholm: Almqvist & Wiksell, 1973) 60 at 62.

57. Greenwood, supra, note 53 at 19.

58. Ibid.

59. Richelson, supra, note 25 at 134.

60. Ibid. at 141. Table: US Photographic Reconnaissance Satellites 1960-1983. It can be concluded that this result stems from the fact that the KH-7's launch success rate(25 out of 30, or 83.3%) is much lower than that of the KH-8's counterpart (30 out of 30, or 100%). If the launch success rate was the same, the lifetime of the KH-7s would be much longer than the figure provided here.

61. Greenwood, supra, note 53 at 19.

62. For detailed information about satellite programs, see D. Baker, supra, note 7 at 59-70.

63. Throughout the 1960's, Atlas and Titan 2 were extensively used as boosters in US civilian as well as military satellite programs. However, the heavy Big Bird was launched by Titan-34D launcher. H. York, Race to Oblivion: A Participant's View of the Arms Race (New York: Simon & Shuster, 1970) at 151; Gray, supra, note 21 at 25.

64. J. Richelson, "Technical Collection and Arms Control", in W.C. Potter, ed., Verification and Arms Control (Lexington, Massachussets: Lexington Books, 1985) 169 at 175.

65. B. Jasani, "A Decade of Military Uses of Outer Space" in World Armaments and Disarmament: SIPRI Yearbook 1981 (London: Taylor & Francis, 1981) 121 at 123. The same author, however, stated in a different article that older generation area-surveillance satellites were launched when urgent observation appeared to be necessary and existing Big Birds were in the process of orbital decay, since at least 25 day interval required before the next Big Bird could be launched. See B. Jasani, "Reconnaissance Satellites" in World Armaments and Disarmament: SIPRI Yearbook 1974 (Cambridge, Massachussets: MIT Press, 1974) 287 at 289.

66. Jasani, supra, note 23 at 44; Jasani, SIPRI Yearbook 1974 ibid. at 289. Gray, supra, note 21 at 41.

67. W. Burrows, "Space Spies" (1990) 263: 3 Popular Science 60 at 62.

68. Jasani, supra, note 37 at 280. The KH-11 was reported as Project 1010 of the CIA as early as 1972. Like Big Bird, KH-11 was launched by a Titan-34D booster.

69. Karas, supra, note 26 at 106-07.

70. The lifetime of the first KH-11 was 770 days, but it was extended up to 1166 days in 1981. On average, a KH-11 has a three year lifetime. B. Jasani, supra, note 23 at 46; J. Pike, "Military Use of Outer Space", in World Armaments and Disarmament: SIPRI Yearbook 1989 (Oxford: Oxford Univ. Press, 1989) 65 at 74.

71. C. Lee, War in Space (London: Hamish Hamilton, 1986) at 64; B. Jasani & F. Barnaby, Verification Technologies: The Case for Surveillance by Consent (London: Berg, 1984) at 29 & 125; MSSs are of two types: a combination of a telescope and a rotating mirror and liner arrays of detectors such as Charge Coupled Devices (CCD). A CCD is a high density storage device, covered with approximately 1000 by 1000 rectangular grids of microscopic light-sensitive elements and provides light-weight, low power, very sensitive image sensors. See M.M. Blouke & J.R. Jenessick, "Charge Coupled Device Image Sensors" in supra, note 33, 104; B. Woodward, Veil:the Secret Wars of the CIA 1981-1987 (New York: Simon & Shuster, 1987) at 222; Burrows, supra,note 67 at 62.

72. C. Covault, "Atlantis' Radar Satellite Payload Opens New Reconnaissance Era" (12 December 1988) AWST 26; D. Charles, "Spy Satellites: Entering a New Era" (1989) 243 Science 1541; Originally, it was code-named Ikon and planned to be launched by the Space Shuttle Discovery on September 29, 1986. See also, "Satellite with 150-ft Span Set for Launch on Mission 27" (7 November 1988) AWST 25; "Mission 27 Launch Set for Dec.1" (21 November 1988) AWST 23.

73. Woodward, supra, note 71 at 221.

74. J. Pike, "Military Use of Outer Space" in World Armaments and Disarmament: SIPRI Yearbook 1990 (Oxford: Oxford Univ. Press, 1990) 59 at 78. Correct nomenclature for the new imaging intelligence satellite is uncertain since reportedly US intelligence community ceased to use KH designation. However,because most publications referred to advanced KH-11 type satellite as KH-12, that name is used in this study as well. See e.g., Burrows, supra,

note 67 at 61-62; see also, "Secret CIA Satellite Launched by Shuttle Columbia Observed 'tumbling' by Astronomers in 7 Countries" (9 October 1990) AWST 35.

75. E.H. Kolcum, "Atlantis Lofts AFP-731 Reconnaissance Satellite" (5 March 1990) AWST 22.

76. Pike, supra, note 70 at 75-76. KH-12 also carries a large propellant load in order to more quickly manoeuvre over a reconnaissance target. See "Soviet Claim Reconnaissance Satellite Launched by Atlantis has Failed" (26 March 1990) AWST 23.

77. See Appendix-4.

78. V. Kiernan, "Satellites Crucial in Countering Iraq" Space News (13-19 August 1990) 1 & 20; V. Kiernan, "Desert Shield Commanders Tap into US Spy Satellites Above" Space News (3-9 September 1990) 1 & 34; W.J. Broad, supra, note 41 at A.4 & C.6; "Next Shuttle Flight to Carry Sensors for Providing Intelligence on Persian Gulf" (22 October 1990) AWST 29. See also, Appendix-5.

79. N.L. Johnson, Soviet Military Programs: 1980-1985 (San Diego: American Astronautical Society, 1987) at 38-40; B. Jasani, "The Military Use of Outer Space" in World Armaments and Disarmament: SIPRI Yearbook 1984 (London: Taylor & Francis, 1984) 351 at 354; R.D. Humble, The Soviet Space Programme (London: Routledge, 1988) at 56-57.

80. Jasani, supra, note 56 at 66; Jasani, Outer Space: Battlefield of the Future, supra, note 16 at 36; Baker, supra, note 7 at 60; Gray, supra, note 21 at 25. The grouping of generation overlaps considerably; for instance, first generation satellites had been used until 1967, while the second started in 1963. Lee, supra, note 71 at 54-55.

81. N.L. Johnson, Soviet Military Strategy in Space (London: Jane's, 1987) at 50.

82. Jasani, supra, note 79 at 354.

83. Jasani, supra, note 15 at 79; Jasani, supra, note 49 at 59.

84. L. Rains, "Soviet Orbit Photo Satellite 48 Hours After Iraq Invasion" Space News (13-19 August 1990) 3.

85. B. Jasani, "Reconnaissance Satellites" in World Armaments and Disarmament: SIPRI Yearbook 1976 (Cambridge, Massachussets: MIT Press, 1976) 102 at 103.

86. Jasani, supra, note 15 at 180; B. Jasani, "Satellite Monitoring: Programmes and Prospects" in B. Jasani & T. Sakata, eds., Satellites for Arms Control and Crisis Monitoring (Oxford: Oxford Univ. Press, 1987) 3 at 27.

87. Pike, supra, note 70 at 127.

88. B. Jasani, "Military Satellites" in World Armaments and Disarmament: SIPRI Yearbook 1977 (Cambridge, Massachussetts: MIT Press, 1977) 103 at 132.

89. J. Paolini, "French Military Space Policy and European Cooperation" (1988) 4 Space Policy 201 at 204. That difference kept West Germany and France from cooperating on the French SAMRO (satellite militaire de reconnaissance optique). See C. Voute, "A European Military Space Community: Reality or Dream?" (1986) 2 Space Policy 206 at 209.

90. Jasani, supra, note 15 at 80-81; Paolini, ibid.; "France Defines Satellite To Complement Spot Series" (23 October 1989) AWST 18.

91. M. Krepon, "Spying from Space" (1989) 75 Foreign Policy 92 at 99; Paolini, ibid. at 206-07.

92. Concerning SPOT, see infra Chapter III E.3.

93. Jasani, supra, note 15 at 89.

94. P.B. de Selding, "UK Minister Balks at Call for European Spy Satellite" Space News (16-22 July 1990) 1 and 20.

95. Richelson, supra, note 65 at 179; R.D. Glasser, "Signal Intelligence and Nuclear Preemption" (1989) 19: 2 Parameters: US Army War College Quarterly 46.

96. Richelson, ibid.

97. R.A. Scribner & K.N. Luongo, Strategic Nuclear Arms Control Verification: Terms & Concept (Washington, D.C.: AAAS, 1985) at 35.

98. Richelson, supra, note 65 at 179.

99. P.J. Klass, Secret Sentries in Space (New York: Random House, 1971) at 191.

100. B. Jasani, "Military Use of Outer Space" in World Armaments and Disarmament: SIPRI Yearbook 1982 (London: Taylor & Francis, 1982) 291 at 296; Karas, supra, note 24 at 109; Klass, supra, note 102 at 191; C. Lee, however stated in his book War in Space that the first ELINT satellite was launched in December 1961. See Lee, supra, note 72 at 73.

101. Jasani, supra, note 57 at 63; Jasani, SIPRI Yearbook, supra, note 16 at 393. Rhyolite (since 1973), Argus, Chalet/Vortex, and Mugnum belong to the same category of ELINT satellites. All these satellites are placed into geosynchronous orbit. See e.g., E.H. Kolcum & W.B. Scott, "Titan 34D Upper Stage Failure Sets Back Pentagon Intelligence Strategy" (12 September 1988) AWST 26; "IVs Meets Mission Objectives on Defense Dept. Shuttle Flight" (4 February 1985) AWST 20; "Final Preparations Under Way for Signal Intelligence Satellites Mission" (6 November 1989) AWST 24; W.J. Broad, "Shuttle Set for a Secret Mission Tonight" N.Y.Times (28 November 1989) C7; E.H. Kolum, "Night Launch of Discovery Boosts Secret Military Satellite into Orbit" (27 November 1989) AWST 29.

102. Richelson, supra, note 65 at 181. To cover northern territory of the USSR, another constellation of U.S. Jumpseat ELINT satellites circles the earth in highly elongated polar orbit. See A. Wilson, "Earphones in the Sky Play Growing Role for Military Comms" (1988) 12 Interavia 1301.

103. See Appendix-4.

104. "Cobra Dane" radar (29 m diameter, 6 story) is located on Shemya Island in the Aleutians, Alaska. It is supplemented by "Cobra Judy" phased array radar aboard on the surveillance ship.

105. R.A. Scribner, T.J. Ralston & W.D. Metz, The Verification Challenge: Problems and Promises on Strategic Nuclear Arms Control Verification (Boston: Birkhauser, 1985) at 54-56; Krass, supra, note 29 at 38-45; Richelson, supra, note 65 at 183-85; D. Ford, The Button (New York: Simon & Schuster, 1985) at 73-77.

106. Pike, supra, note 71 at 76.

107. Johnson, supra, note 82 at 60.

108. Lee, supra, note 72 at 74.

109. "Soviet Orbit Large New Military Electronic Intelligence Satellite" (14 January 1985) AWST 19; Jasani, SIPRI Yearbook 1974, supra, note 66 at 296. Concerning the Proton SL-12 booster, see e.g., P.M. Banks & S.K. Ride, "Soviets in Space" (1989) 260: 2 Scientific American 34; Johnson, supra, note 80 at 109.

110. See Appendix-4.

111. Jasani, supra, note 38 at 267-70.

112. Richelson, supra, note 65 at 187; Jasani, Outer Space: Battlefield of the Future, supra, note 16 at 43.

113. J.W. Canan, War in Space (New York: Harper & Row, 1982) at 109.

114. Jasani, supra, note 38 at 274. "White Cloud" satellites are classified into ELINT Ocean Surveillance Satellites (EORSATs). The Navy also tried to develop a Radar Ocean Reconnaissance Satellites (RORSATs), "Clipper Bow" to detect ships in any weather. This project was cancelled in 1979. See Canan, ibid. at 274; B.G. Blair, "Reconnaissance Satellites" in B. Jasani, ed., supra, note 23, 125 at 133.

115. Jasani, supra, note 38 at 282.

116. Ibid. at 273.

117. Johnson, supra, note 82 at 61.

118. Jasani, supra, note 38 at 271.

119. Jasani, ibid. at 274. Cosmos 954 incident resulted in a call by some heads of states including the US President Carter to ban nuclear reactors from low orbits. See, "Soviet Launch Surveillance Spacecraft" (5 May 1980) AWST 25.

120. A. Willson, "Eyes in the Sky" (1988) 9 Interavia 88 at 923; "Soviet Nuclear-Powered Satellite Boosts Naval Surveillance Capability" (19 August 1988) AWST 18; P. Stares, Space and National Security (Washington, D.C.: Brookings Institution, 1987) at 24; Pike, supra, note 74 at 80.

121. Stares, ibid.

122. C. Covault, "Soviet Military Space Operations Developing Longer Life Satellites" (9 April 1990) AWST 44.

123. Jasani, supra, note 23 at 56.

124. Jasani, Outer Space: Battlefield of the Future, supra, note 16 at 44.

125. Ibid. at 45; Jasani, supra, note 57 at 64 & 86.

126. Jasani, SIPRI Yearbook 1974, supra, note 66 at 292.

127. "Advanced Missile-Warning Satellite Evolved From Smaller Spacecraft" (20 February 1989) AWST 45; Ford, supra, note 108 at 64-70; Blair, supra, note 117 at 125-27; Baker, supra, note 7 at 149. Focal plane infrared mosaic devices and integrated microelectronics were crucial in detecting dim targets such as aircrafts, cruiser missiles, and MIRV (Multiple Independently Targetable Reentry Vehicle) buses. Jasani, SIPRI Yearbook 1981, supra, note 65 at 134; B. Jasani, "A Role for Satellite for Arms Control Verification" in World Armaments and Disarmament: SIPRI Yearbook 1980 (London: Taylor & Francis) 187 at 196.

128. C. Covault, "New Missile-Warning Satellite to be Launched on First Titan 4" (20 February 1989) AWST 37; E.H. Kolum, "Titan 4, Delta 2 Launchers Generate Confidence in Military Space Operations" (19 June 1989) AWST 40.

129. Pike, supra, note 75 at 80. See also Appendix-5.

130. C. Covault, "USAF Initiates Broad Program to Improve Surveillance of Soviet" (21 January 1985) AWST 16.

131. "USAF Postpones Teal Ruby launch" (13 June 1983) AWST 121; C. Covault, "USAF Initiate Broad Program to Improve Surveillance of Soviets" (21 January 1985) AWST 14; "Rockwell Readies Teal Ruby Sensor for Environmental Tests" (17 June 1985) AWST 20; B.A. Smith, "Air Defense Group Urges Early Launch of Teal Ruby" (1 December 1986) AWST 34; Jasani, supra, note 130 at 196; Baker, supra, note 7 at 235; Gray, supra, note 21 at 26.

132. B.A. Smith, "Teal Ruby Spacecraft to be Put in Storage at Norton AFB" (8 January 1990) AWST 22.

133. Ibid.

134. T.M. Foley, "US Developing Survivable Warning/Antimissile Satellites" (23 January 1989) AWST 34. BSTS will be manoeuvrable to evade attacks and will have shielding against hostile threats.

135. G.E. Perry, "Identification of Military Components Within the Soviet Space Programme" in B. Jasani, ed., supra, note 23, 135 at 146; Johnson, supra, note 780 at 112; Johnson, supra, note 82 at 71.

136. Jasani, supra, note 85 at 112; Jasani, supra, note 88 at 124.

137. Johnson, supra, note 80 at 105; see also Appendix 4 and 5.

138. See, Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, 5 August 1963, 14 U.S.T. 1313, T.I.A.S. No. 5433, 460 U.N.T.S. 43, reprinted in 21 I.L.M. 889.

139. Burrows, supra, note 5 at 176; Basham & O. Dahlman, "International Seismological Verification" in J. Goldblat & D. Cox, Nuclear Weapon Tests: Prohibition or Limitation? (Oxford: Oxford Univ. Press, 1988) 169 at 172.

140. Jasani, supra, note 57 at 64; Jasani, supra, note 23 at 58.

141. Jasani, supra, note 57 at 87.

142. B. Jasani, "Military Satellites" in World Armaments and Disarmament: SIPRI Yearbook 1978 (London: Taylor & Francis, 1978) 69 at 73-79; Jasani, supra, note 130 at 198; Jasani, supra, note 23 at 58.

143. Ibid.

144. Richelson, supra, note 65 at 195-96; Jasani, supra, note 130 at 198.

145. Richelson, ibid. at 196; "Third Defense Dept. Delta S/GPS Satellite Launched Successfully as Navigation System Grows" (28 August 1989) AWST 21; "Fourth Global Positioning Satellite Launched Atop Delta 2 Booster" (30 October 1989) AWST 21. Fully operational GPS would provide real-time data on yield, height, and location of within 100 meters of nuclear explosions. See W.T. Wander, "US and Soviet Military Space Program" in K.N. Luongo & W.T. Wander, eds., The Search for Security in Space (Ithaca, New York: Cornell Univ. Press, 1989) 11 at 16.

146. See e.g., D. Ball, Can Nuclear War Be Controlled ?169 Adelphi Paper (London: IISS, 1981); M. Clarke, "Strategic Command and Control and Militarisation of Space", in S.

Kirby & G. Robson, The Militarisation of Space (Sussex: Whearsheaf Books, 1987) 29; G. Blair, Strategic Command and Control: Redefining the Nuclear Threat (Washington, D.C.: Brookings Institution, 1985); W.M. Arkin, "Nuclear Weapon Command, Control, and Communications" in World Armaments and Disarmament: SIPRI Yearbook 1984 (London: Taylor & Francis, 1984) 455; P.B. Stares, "US and Soviet Military Space Programs: A Comparative Assessment" (1985) 114: 2 Daedalus 127.

147. P. Stares, The Militarization of Outer Space: US Policy 1945-1984 (Ithaca, New York: Cornell Univ. Press, 1985) at 129.

148. Ibid. at 129-30.

149. Ibid. The Dynasoar project was reportedly cancelled for economic and technical factors. "[T]oo many problems needed to be solved for a limited return in capability." Cited in Stares, ibid. at 97.

150. Ibid. at 97-98; see also, H. Kautzleben, "Some Research on US and Soviet Strategies Concerning Manned Activities in Outer Space" in B. Jasani, ed., supra, note 23 at 250.

151. Stares, ibid. at 98.

152. Ibid.

153. Ibid. at 160; Gray, supra, note 21 at 25; see also, A.J. Young, Law and Policy in the Space Stations' Era (Dordrecht: Maritinus Nijhoff, 1989) at 203.

154. The first Space Shuttle test flight, lasting two-days and six-hour, was successfully completed in April 1981.

155. In addition to the U.S., ESA, Canada, and Japan are participating in this space station program. See Agreement Among the Government of the United States of America, Governments of Member States of the European Space Agency, the Government of Japan,and the Government of Canada on Cooperation in the Detailed Design, Development, Operation, and Utilization of the Permanently Manned Civil Space Station, 29 September 1988, reprinted in, S. Gorove, ed., U.S. Space Law, National and International Regulation, 11.A.22. (release January 1989).

156. The NASP is a manned spaceplane that can operate from runways at any large airfield and accelerate directly to orbit at twenty times the speed of sound. This project, also known as the X-30 experimental airplane and Orient

Express was first announced by President Reagan in his 1986 State of Union message. Civilian versions would fly between New York and Tokyo in three hours. See e.g., A.R. Curtis, Space Almanac (Maryland: Arcsoft, 1990) at 282-83.

157. A.J. Young, Space Transportation Systems (LL.M Thesis, McGill University, 1984) [unpublished] at 225.

158. M.L. Stojak, Legally Permissible Scope of Current Military Activities in Space and Prospects of Their Future Control (D.C.L. Thesis, McGill University, 1985)[unpublished] at 66-67.

159. C. Covault, "Shuttle Plan Emphasizes Earth Survey" (24 September 1984) AWST 38 at 43.

160. Young, supra, note 157 at 234. SIR-A imaging radar was carried on shuttle mission 2 and was able to see subsurface features beneath the sands of the Sahara desert. SIR-B provides 65-foot resolution which doubled the resolution of SIR-A. SIR-B's higher resolution results from increasing the antenna length and synthetic aperture characteristics. Stereo imaging is also possible using SIR-B. Collected signals by SIR-B are transmitted in digital form to the ground via TDRS which ensures near real-time information. Covault, ibid. at 38-46.

161. "Shuttle Crew Photographed Soviet Sites" (9 January 1984) AWST 19.

162. "Shuttle Crew Photographed Soviet Missile Site" (27 February 1984) AWST 18.

163. "Mission 9 Astronauts Photographed Submarine Fighter Bases at Petropavlovsk" (19 March 1984) AWST 17; Mainichi Shinbun Gaishinbu, ed., Space Strategy and Military Satellites (in Japanese) (Tokyo: Tsukijishokan, 1984) at 22-24.

164. "US Space Shuttle Astronauts Photographed Soviet Flight Test Centre" (26 March 1984) AWST 17.

165. "Shuttle Photographs Nuclear Accident Site" (15 October 1984) AWST 16.

166. Skylab 1 (unmanned launch) and Skylab 2,3 and 4 (manned flight) missions were conducted between May and November of 1973. See e.g., Curtis, supra, note 156 at 178-82.

167. Young, supra, note 153 at 205-06. NASA officials had been denying DoD's requirements for the military use of the Space Station at earlier stages. See e.g., M. Feazel, "Europe Pushes Space Station Role" (18 June 1984) AWST 16.

168. "Weinberger Firm on Military Uses for Space Station" (21 September 1987) 32. DoD was, from the first, less than enthusiastic about President Reagan's Space Station project. "Station Decision Overrode Strong Opposition" (30 January 1984) AWST 16.

169. Canada, for one, expressed its position that some kinds military uses of the space station would not necessarily run counter to Canadian space policy although those involving space weapons testing evidently would. As an acceptable military use, experiments involving arms control verification technologies were expressly cited. P. Mann, "Canada Would Quit Station if Pentagon Demands Prevail" (20 April 1987) AWST 20 at 22; T.M. Foley, "Compromise Eludes US, Canada in Space Station Negotiations" (28 September 1987) AWST 145.

170. See e.g., R.W. Stevenson, "NASA Challenge: Space Station Power", NY Times (20 January 1988) D6; W.J. Broad, "Major Flaw Found in Space Station Planned by NASA" NY Times (19 March 1990) A1 & B8; W.J. Broad, "Wanted on the Space Station: Better Suits, Robots and Parts" NY Times (27 March 1990) C1 & C12; J.R. Asker, "Space Station Redesign Likely: Contractor Hiring Freeze Ordered" (8 October 1990) AWST 63; C. Covault, "White House Ready to Alter Station, Broaden Soviet Ties, Fight for SDI Funds" (22 October 1990) AWST 24; "Congress Moves Toward $13-Billion NASA Budget,Cutting Space Station and Mars Initiative" (22 October 1990) AWST 25; A. Lawler, "Station Redesign Mandated" Space News (22-28 October 1990) 1 and 36.

171. M.W. Browne, "Clean Hydrogen Beckons Aviation Engineers" NY Times (24 May 1988) C1 & C13; C.H. Lavin, "Designing a Plane for the Leap to Space (and Back)" NY Times (3 October 1989) C1 & C14; J.M. Logsdon & R.A. Williamson, "US Access to Space" (1989) 260: 3 Scientific American 34 at 40.

172. Stares, supra, note 120 at 43. Other missions are, e.g., to carry satellite and other space cargo into orbit, to shuttle between the earth and a space station, to carry a load of bombs into enemy territory as fast as ICBMs, and in-orbit interception. See Lavin, ibid. at C1.

173. Lavin, ibid; C.A. Robinson, Jr., "USAF Spurs Spaceplane Research" (26 March 1984) AWST 16; H.J. Coleman, "NASA, Defense Dept. Award Contracts for Aerospace Plane" (14 April 1986) AWST 24; S.W. Kandebo, "Lifting Body Design is Key to Single-Stage-to-Orbit" (29 October 1990) AWST 36; "Teaming Agreement Stresses Equality Among Five NASP Prime Contracts" (29 October 1990) AWST 38; D. Isbell & L. Rains, "New U.S. Aerospace Plane Design Ready by February 1991" Space News (19-25 November 1990) 5.

174. Kautzleben, supra, note 150 at 252.

175. Stares, supra, note 120 at 20. OTA; Salyut: Soviet Steps toward Permanent Human Presence in Space -- A Technical Memorandum, OTA-TM-STI-14 (Washington, D.C.: GPO, 1983) at 31.

176. G.H. Stine, Confrontation in Space (New Jersey: Prentice-Hall, 1981) at 23.

177. Ibid.

178. "Salyut Cosmonauts Support Military Exercises" (28 January 1985) AWST 22.

179. Concerning Mir, see e.g., Young, supra, note 153 at 13-18; "New Cosmonaut Crew Launched to Mir; Station Expansion to Begin in October" (11 September 1989) AWST 39; J.R. Asker, "Crystal Experiments on Mir Signal Soviet Commercial Space Push" (2 April 1990) AWST 28; C. Covault, "Soviet Mir Cosmonauts Await Launch of Large Materials Processing Module" (23 April 1990) AWST 27; Curtis, supra, note 156 at 103-57.

180. Curtis, ibid. at 117.

181. Stares, supra, note 120 at 20.

182. P.B. de Selding, "Soviet Advises Against Freedom" Space News (2-8 July 1990) 3.

183. Curtis, supra, note 156 at 201-09.

184. "USSR's Space Shuttles Expected to Serve Multiple Military Roles" (3 June 1985) AWST 383.

185. J.M. Lenorovitz, "Soviets' Second Buran Orbiter Undergoes Launch Pad Tests" (12 August 1991) AWST 38.

186. Curtis, supra, note 156 at 204.

187. RBV cameras are used when no photographic film can be used. The image is recorded and stored on the vidicom tube, which is scanned by a beam of electron and transmitted either directly, or in real-time, or is stored on tape. B. Jasani & C. Larsson, "Security Implications of Remote Sensing" (1988) 4 Space Policy 46 at 47; W. de Graaff & G.C.M. Reijnen, "Remote Sensing by Satellites" in M. Benko, W. de Graaff & G.C.M. Reijnen, eds., Space Law in the United Nations (Dordrecht: Martinus Nijhoff, 1985) at 4.

188. See e.g., Jasani & Larsson, ibid.

189. Concerning the TM, "Landsat Thematic Mapper Model in Test" (14 July 1980) AWST 117; "Thematic Mapper Prepared for Launch" (3 May 1982) AWST 56. As examples of TM images, "Landsat 4 Gathers Geologic Detail" (31 January 1983) AWST 40 ; "Landsat Images Reveal Rock Types" (20 January 1983) AWST 48; "Landsat 5 Thematic Mapper Covers Gulf Coast" (26 March 1984) AWST 19.

190. F.J. Doyle, "The Utility of Civil Remote-Sensing Satellites for Arms Control Monitoring" in B. Jasani & T. Sakata, eds., supra, note 86, 49 at 52; T. Orhaug, "Technology Requirements for a Satellite Monitoring Agency Focused on Europe" in ibid., 87 at 91; Florini, supra, note 39 at 100.

191. A proposal was made to transfer the Landsat system to the private sector in 1979 and in 1984 the Land Remote Sensing Commercialization Act (Public Law 98-365, HR 5155) was passed. See R. DalBello, "The Land Remote Sensing Commercialization Act of 1984" (1985) 1 Space Policy 289; C.C. Joyner & D.R. Miller, "Selling Satellites: The Commercialization of LANDSAT " (1985) 26 Harvard Int'l L. Rev. 69; N.E. Brender, "Remote Sensing and the First Amendment" (1987) 3 Space Policy 293 at 294.

192. P.M.P. Norris, "Commercial Opportunities in Earth Observation From Space" in N.M. Matte, ed., Space Surveillance for Arms Control and Verification Options (Montreal: CRASL, McGill University, 1987) at 21-22; "EOSAT Replacing Future Landsat with Omnistar" (27 January 1986) AWST 23.

193. Florini, supra, note 39 at 100; "EOSAT to Mount Challenge to Landsat Restrictions" (2 November 1987) AWST 26; nevertheless, the State and Defense Departments have veto power over remote sensing license applications based on national security concerns. See "Pentagon, State

Dept. Granted Veto Over U.S. Remote Sensing Satellite" (July 20 1987) AWST 20.

194. T. Orhaug, supra, note 190 at 90-91.

195. "EOSAT to Mount Challenge to Landsat Restrictions", supra, note 193 at 26.

196. Florini, supra, note 39 at 101.

197. Ibid.; OTA, Commercial Newsgathering from Space: A Technical Memorandum, OTA-TM-TSC-40 (Washington, D.C.: GPO, 1987) at 19.

198. C.P. Fotos, "Commercial Remote Sensing Satellites Generate Debate, Foreign Competition" (10 December 1988) AWST 48; J.R. Asker, "Congress, White House Weigh Overhaul of Landsat Program" (28 October 1991) AWST 23.

199. See J. Gabrynowicz, "The Landsat Act is a Failure" Space News (16-22 July 1990) 15 & 16; "NOAA Chief: Landsat Commercial Success 'Not Possible'" Space News (18-24 July 1990) 1 & 20; R. Cline, "Landsat Has Key Role in U.S. Security" Space News (3-9 September 1990) 23 & 24; as a opposition to that view, see Rep. J. Scheuer, "Stop Undermining Landsat" Space News (15-21 October 1990) 20.

200. L.S. Spector, "Not-so-open Skies" (1990) 6 Space Policy 9 at 13. The number of ground stations around the world increased to 17 as of September 1990. See R. Cline, "Landsat Has Key Role in U.S. Security" Space News (3-9 September 1990) 23.

201. J.M. Lenorovitz, "France's SPOT-1 Satellite Transmits Multispectral Images Following Launch by Ariane" (21 March 1986) AWST 21; "SPOT-1 Earth Resources Satellite Provides High-Resolution Images" (10 March 1986) AWST 136.

202. Renorovitz, ibid. at 22; P. Hart, "State of Remote-Sensing Technology in Europe" in B. Jasani & T. Sakata, eds., supra, note 86, 76 at 81; H. de Santis, "Commercial Observation Satellites and their Military Implications: A Speculative Assessment" (1989) 12:3 The Washington Quarterly 185 at 186.

203. "SPOT Earth Resources Satellite Beginning Commercial Observations"(5 May 1986) AWST 101; C. Builoch, "SPOT States Business" (1986) Interavia 673.

204. "French SPOT Satellite Shows Soviet Northern Fleet Facilities" (2 March 1987) AWST 44.

205. Florini, supra, note 39 at 103.

206. C. Covault, "Soviet Strategic Laser Sites Imaged by French SPOT Satellite" (26 October 1987) AWST 26.

207. C. Covault, "SPOT Photographs Secret Base for USSR Nuclear Submarines" (20 July 1987) AWST 18.

208. "Launch of Spot 2 Delayed by Tape Recorder Problems" (15 January 1990) AWST 29; "SPOT 2 lance par la première fusée Ariane 40" (27 janvier 1990) Air & Cosmos à la p. 37; "La France assure le service SPOT jusqu'en 2001" (3 fevrier 1990) Air & Cosmos à la p. 33; "January Satellite Launch Log" (14-20 February 1990) Flight International 21.

209. "France Prepares to Develop Next Generation SPOT 4/5" (20 October 1986) AWST 103.

210. Spector, supra, note 200 at 14.

211. Ibid. at 9-16; Jasani & Larsson, supra, note 187 at 48; W.A. Kennedy & M.G. Marshall, "A Peek at the French Missile Complex" (1989) 45:7 Bull. Ato. Scientists 20.

212. See e.g., Jasani & Larsson, ibid.

213. ESA consists of eleven full members (Belgium, Denmark, France, the Federal Republic of Germany, Ireland, Italy, the Netherlands, Spain, Sweden, Switzerland, and the United Kingdom), two associate members, Norway and Austria, and an observer, Canada.

214. P. Linton, "Visual Data Analysis for ERS-1" (1992) 34 Spaceflight 62.

215. Ibid.

216. Jasani & Larsson, supra, note 187 at 51. The Department of Energy, Mines and Resources are involved with image-processing programmes such as Multi-Observation Satellite Image Correction Systems (MOSAICS) and Terra Observation Pattern Analysis System (TOPAS). See Ministry of State, Science and Technology, The Canadian Space Program: Plan for 1982/83-1984/85 (MOSST Background Paper 20) (December 1981) at 3 & 11. [hereinafter MOSST 20].

217. Ministry of State, Science and Technology, The Canadian Space Program: Plan for 1981/82-1983/84 (MOSST Background Paper 19) (April 1981) at 18-20. [hereinafter MOSST 19].

218. MOSST 20, supra, note 216 at 10-11.

219. J. Kirton, "Canadian Space Policy" (1990) 6 Space Policy 61 at 67; T.M. Foley, "Canada Approves Development of Scaled-Back Radarsat" (13 July 1987) AWST 51.

220. Kirton, ibid.

221. Curtis, supra, note 156 at 417.

222. S.F. von Welck, "India's Space Policy: A Developing Country in the 'Space Club'" (1987) 3 Space Policy 326; Florini, supra, note 39 at 107; De Santis, supra, note 208 at 186; Jasani & Larsson, supra,note 187 at 51.

223. "Satellite Digest-243" (1992) 34 Spaceflight 89; "Indian Satellite Launched from Baikonur Cosmodrome" (16 September 1991) AWST 27.

224. S. Saito, "Japan's Space Policy: Background and Outlook" (1989) 5 Space Policy 193 at 200.

225. "Satellites to Demonstrate Automatic Capabilities" (28 July 1986) AWST 43; "Japanese MOS-1 Satellite Images Kyushy Island" (23 March 1987) AWST 62; K. Maeda & O. Ryuguji, "Japanese Contribution to Development of Earth Environmental Monitoring System by Using Satellites" (1992) 12 Space Technology 83.

226. "JERS-1 Suffers Antenna Trouble" (1992) 34 Spaceflight 77.

227. "Japanese Relief as JERS-1 Antenna Finally Deploys" (1992) 34 Spaceflight 188.

228. Simpson, Acton & Crowe, supra, note 51 at 117-20.

229. J. Richelson, "Military Intelligence: SPOT is not Enough" (1989) 45: 7 Bull. Ato. Scientists 26 at 26.

230. "Satellite Digest-231" (1990) 32 Spaceflight 246; see also, "Third Israeli Satellite Soon" (1992) 34 Spaceflight 78.

CHAPTER IV

VERIFICATION PROVISIONS IN MULTILATERAL AND BILATERAL ARMS CONTROL AND DISARMAMENT AGREEMENTS

A. MULTILATERAL AGREEMENTS

1. Terms and Definitions

The term "verification" does not have an authoritative definition in the vocabulary of arms control and disarmament. The Oxford English Dictionary defines the term as "the demonstration of truth or correctness by facts or circumstances."[1] The demonstration of "truth or correctness" is, however, far from simple when it comes to the provisions of arms control and disarmament agreements which are often drafted in highly abstract language. As legal documents, they allow sufficient latitude in interpretation. Furthermore, in general, the term "verification" is defined according to the needs of a given time, or an *ad hoc* basis, in the way that serves most effectively the scope and nature of the specific agreement being negotiated.

(a) Verification

For almost two decades after World War II, the literature of disarmament used interchangeably a variety of terms such as "inspection", "safeguards", "control", "international supervision" and "verification".[2] After the goal of general and complete disarmament was abandoned in 1964, specific arms control arrangements were discussed in the international community. Eventually the term "verification" evolved to become an "indispensable", "essential" and "necessary" part of any agreement.[3] In 1978, the Preparatory Committee for the Tenth Special Session of the U.N. devoted to Disarmament (hereinafter SSOD I) requested the Secretariat to prepare a background paper on the subject of verification.[4] Verification was there described as "the process of ascertaining that a commitment laid down in a particular agreement in the field of disarmament or arms limitation is being met."[5] A few years later, a study undertaken by the U.N. Department for Disarmament Affairs defined verification as "a dynamic process for determining whether or not commitments assumed under an international agreement are being fulfilled."[6] Another contemporary study on arms control and disarmament defined verification as "the process of determining that the behaviour of a party is consistent with [its arms limitation] obligations."[7] It should be pointed out that the definitions generally acceptable in multilateral arms control and disarmament agreements would not necessarily be appropriate in bilateral arrangements because the scope of such agreements or level of compliance may not be identical.

The Arms Control and Disarmament Agency of the United States (hereinafter ACDA) states in its annual report to the Congress that "[v]erification is the technical, analytical, legal, and political process by which the United States evaluates compliance with existing arms control agreements and obligations"[8] and "the process of assessing the degree to which compliance with provisions of future arms control agreements can be ascertained and of determining the degree of Soviet compliance with the provisions of current agreements".[9]

The salient characteristic of the official United States definition is the special emphasis placed on the need for verification that is "adequate" and "effective". Throughout the SALT talks[10] in the 1970s, the United States sought arrangements with the Soviet Union that would assure "adequate" verification, defined by Secretary of Defense Harold Brown as "the ability to detect violation large enough to pose a significant military threat, in time for the United States to mount an appropriate response."[11] What would represent "adequate" verification in multilateral disarmament negotiations may be more difficult to ascertain because the requirements for adequacy differ from one country to another and may change in the course of negotiations.

The Reagan Administration emphasized the importance of "effective" verification.[12] Although no precise definition of what would constitute "effective" verification was given, it was considered that the new standard required a higher compliance level, i.e., a one hundred percent chance of detecting a violation.[13] The term "National Technical Means" of verification is often employed in U.S.-Soviet arms control agreements. It is used in connection with "verification systems under which one State uses its means to verify occurrences or situations in another State".[14] The use of this concept reflects the belief on both sides that adequate and effective verification can be achieved through their own national means. After examining postwar Soviet attitudes towards verification problems, an arms control expert has described the Soviet interpretation of verification as follows:

> Verification comprises those legal and proper intelligence activities that are carried out by a state for the exclusive purpose of satisfying itself that other states are in compliance with existing treaties and agreements. This clearly separates verification from both espionage, which is by definition illegal, and routine intelligence gathering, which is carried out whether or not a treaty exists.[15]

(b) Monitoring

Although the terms "verification" and "monitoring" are sometimes used interchangeably, they are distinct activities with different purposes.[16] Monitoring has two aspects. First, monitoring is the starting point of the verification process consisting of several steps.[17] Monitoring represents "the gathering of intelligence, through various surveillance techniques, of other states' military activities."[18] Other steps comprise information processing, analysis, identification, evaluation and response.[19] The other aspect of monitoring is that it can be conducted regardless of arms control and disarmament agreements.[20]

In the context of SALT II,[21] monitoring meant collecting and analyzing information about Soviet weapon systems subject to SALT limits. Thus, it can be said that verification is a decision-making process, subjective and judgmental, based on intelligence from monitoring and other sources. [22]

2. Verification Regimes

The extent of verification required in a specific agreement is dependent upon various factors such as the scope and nature of the agreement, the availability of credible information, technical feasibility and cost.[23] A paper prepared and submitted to the Committee on Disarmament[24] has identified five possible verification regimes as follows: (1) **absolute verification**, being a regime under which all verification methods may be employed;[25] (2) **adequate verification** - since absolute verification is seldom possible, a minimum acceptable degree of uncertainty and risk is sought in both bilateral and multilateral negotiations. In multilateral negotiations, as the number of participating states increases, the number of positions on what constitutes adequate verification is also likely to increase.[26] For instance, the Final Document of SSOD I (July 1978) in para. 31 states that "[d]isarmament and arms limitation agreements should provide for adequate measures of verification satisfactory to all parties concerned in order to create the necessary confidence and ensure that they are being observed by all parties";[27] (3) **limited verification** - this regime is a result of the inadequacy of verification technology available to contracting parties. Failure to reach an agreement on comprehensive test ban derives partly from limitations in verification technology;[28] (4) symbolic (token) verification - because of the lack of appropriate technology or a low probability of compliance, verification capability under this regime is thought to be inadequate;[29] and (5) no verification - a regime in which the agreement contains no verification provisions.[30]

3. Verification Methods

The term verification method refers to the generic approach applied to verify arms control and disarmament agreements. Numerous experts have attempted to categorize verification methods from the time when general and complete disarmament was the ultimate goal. One of the early comprehensive studies by Professor Melman listed six general verification methods: aerial inspection, inspection of budgets, detection of bomb testing, detection of missile testing, radiation inspection (sampling) and examination of scientific personnel.[31]

Professor Feld grouped verification methods into three categories: physical inspection, records inspection and non-physical inspection.[32] Professor Henkin divided investigation methods into two groups: indirect methods comprising voluntary reports by governments, external verification by radar, seismic and acoustic instruments, aerial inspection, wire tapping and registration of scientists; and direct investigation by on-site inspection.[33]

Eight verification methods according to different levels of intrusiveness have been submitted to the Committee on Disarmament and Conference on Disarmament in Geneva by Canada.[34] This Canadian contribution is examined in some detail below.[35]

(a) General On-Site Inspection

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."[36] Such agreements could conceivably range in scope from general and complete disarmament to control of specific weapons system.[37] The principal advantages of general on-site inspection are the great likelihood of discovery of non-compliance and enhanced confidence between the parties to the agreement. The disadvantages include high cost and the difficulties in defining the scope of inspection.[38]

Since general on-site inspection is often unacceptable to many countries, "progressive/zonal on-site inspection" was proposed by Professor Sohn in the early 1960s as a step towards general on-site inspection.[39] The types of weapon systems and related facilities subject to inspection were to be progressively increased ("progressive" element) and the inspected area was to be also gradually enlarged ("zonal" element). The intensity of inspection was also to be progressively increased.[40]

(b) Selective On-Site Inspection

Selective on-site inspection is restricted with regard to access to specific weapon systems and related facilities. The difference between general and selective on-site inspection is understood more as a question of degree than that of kind. Restrictions imposed can take various forms. Inspections may be allowed only for the limited purpose of monitoring compliance with agreements; the access of inspections may be restricted to a particular geographic location; the activities of inspectors may be limited; and the persons the inspectors are allowed to contact may be subject to limitation.[41] The advantage of selective on-site inspection is that this approach is applicable to virtually all forms of agreements other than general and complete disarmament agreements, and the cost and personnel requirements are less formidable than those of general on-site inspection.[42]

(c) Challenge On-Site Inspection

This is a special case of selective on-site inspection, which limits inspection to those situations where a party to a certain agreement suspects the other party's failure to comply with treaty obligations and challenges it to prove its compliance. The accused party would then invite inspectors to verify its innocence.[43] It should be stressed that challenge on-site inspection is different from "verification-by-challenge". The concept of "verification-by-challenge" was briefly addressed in 1966 by Alva Myrdal, the representative of Sweden to the Eighteen Nation Disarmament Conference (ENDC).[44] According to Myrdal, "[v]erification-by-challenge" relies on the interest of a suspected party "to free itself through the supply of relevant information, not excluding an invitation to inspection by an outside party or organ".[45] Hence, in challenge on-site inspection, a party has the right to demand an inspection whereas an inspection would be permitted on a voluntary basis in verification-by-challenge.[46]

(d) Control Posts/Observer/Liaison Missions

The concept of control posts emerged from the NATO-Warsaw Pact confrontation, but the same method would be applicable to other areas of confrontation. Control posts would provide warning of long-term military preparations, large-scale build-ups of troops and impending aggression.[47] As a rule, it is recommended that control posts be established at such locations as airfields capable of handling heavy transports, main roads and railway stations to monitor military traffic.[48] The advantage of control posts is said to be their ability for direct observation of military activities not requiring state-of-the-art sensors.

(e) Remote Sensing in Situ

Sensing devices can be "remote" in three ways. First, the sensor may be distant from the object to be monitored although it is proximate to the personnel operating it (e.g., shipboard or fixed site radar). Second, the sensor may be distant from the object to be monitored and from operating personnel (e.g., reconnaissance satellites). And third, the sensor may be located in close proximity to the object to be monitored while being distant from its controllers. "Remote sensing" usually refers to cases where the sensing device and the object to be monitored are distant from each other.[49] The important characteristic of remote sensing in situ is that sensing devices are left unattended.[50]

Short-range sensing devices are sometimes called "black boxes" because the monitored party does not know what is being recorded.[51] It has been suggested, however, that the country being monitored be provided with a duplicate black box so that it can be reassured about the uses made of black boxes.[52] Examples of short-ranging sensors would be chemical sensors including portable alarm systems for detecting nerve gas, acoustic sensors that detect sounds, vibration sensors that detect movement of traffic, radio frequency detectors, pressure sensitive sensors, magnetic sensors and visible surveillance devices such as photographic equipment, television and infrared sensors.[53]

(f) Remote Sensing

As mentioned earlier, "remote sensing" refers to the system of observation where the sensing device and the object to be monitored are distant from each other. The mainstay of modern remote sensing instrumentation are military intelligence-gathering satellite examined in some detail in Chapter III.

(g) Complaints/Consultation

In responding to alleged violations of arms control agreements, credible demonstration of compliance provides a form of verification. Treatment of complaints with regard to alleged arms control violations varies widely. It is, therefore, rather difficult to generalize about complaints/consultation procedures as a method of verification. Nonetheless, such procedures can be roughly grouped into four types.[54]

(i) Consultation and Cooperation

Any party with a complaint has the right to "consult" with any other party and to demand that such party "cooperate" in order to resolve the complaint. "Cooperation" in this type of procedure is voluntary.[55]

(ii) Consultative Commissions

Procedure regarding consultative commissions require that a committee of the parties meets regularly or on request to solve problems through consultation and cooperation. As is the case with procedures for "consultation and cooperation", it is up to each party to decide whether to cooperate.[56]

(iii) Existing International Organizations

An allegation concerning the violation of treaty obligations could be dealt with using existing international organizations such as the International Atomic Energy Agency, the International Court of Justice, the U.N. Security Council. For strictly regional problems, regional organizations could serve the same functions.[57]

(iv) New International Organizations

In general, two types of international organizations have been proposed for purposes of verification; a specialized body to deal with complaints in only one agreement and an international disarmament organization, the jurisdiction of which could cover a variety of agreements and could also function as a forum for solving crises.[58]

4. Verification Provisions of More Significant Multilateral Arms Control and Disarmament Agreements

In this Section, major multilateral arms control and disarmament agreements are examined, particularly as regards the verification regimes they incorporate and whether such agreements permit space-born verification. Bilateral arms control and disarmament treaties between the United States and the USSR, often more important in the context of the global arms race than their multilateral counterparts, are dealt with in the next Section.

(a) Protocol for the Prohibition of Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare [hereinafter cited as the Geneva Protocol][59]

As mentioned in Section B.4 in Chapter I, at the Washington Disarmament Conference of 1922, the banning of asphyxiating, poisonous or other gases was agreed upon but the resultant treaty failed to enter into force because France refused to ratify it. However, three years later, the provisions of Article V of the Washington Treaty became the so-called Geneva Protocol, the first of more significant agreements in the field of armaments.

The Geneva Protocol prohibits "the use in war of asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices"[60] as well as "the use of bacteriological methods of warfare",[61] and declares that the ban of such gases and methods shall be "universally accepted as a part of International Law, binding alike the conscience and the practice of nations."[62]

Since this Protocol contains no verification provisions of any kind, no on-site inspection, control posts or consultations, two questions must be asked. First, is monitoring of compliance by satellite permissible under the Protocol, and second, is it technically feasible? Since, as will be discussed later in Section C of this Chapter, observation from outer space is lawful, there is no reason to doubt that each contracting party is within its rights to employ satellites to monitor other states' compliance with the Protocol. However, it is doubtful whether it would be technically possible to determine non-compliance by satellite, partly because it is the use, not the manufacture, test, and/or stockpiling of asphyxiating and poisonous gases that is prohibited by this Protocol.

(b) The Antarctic Treaty[63]

The purpose of the Antarctic Treaty is not to resolve territorial claims to Antarctica[64] but to ensure that Antarctica "shall continue forever to be used exclusively for peaceful purposes".[65] The Treaty was the first disarmament agreement concluded after World War II, at the height of the

Cold War. It resulted in the demilitarization of an entire continent. Therefore, it has been hailed as an example of nations exercising foresight and working in concert to prevent conflict before it develops. Based on the premise that to exclude armaments is easier than to eliminate or control them once they have been introduced, the Treaty served as a model, in its approach and provisions, for subsequent arms limitation agreements.[66]

Article I of the Treaty prohibits, inter alia, "any measures of a military nature, such as the establishment of military bases and fortifications, the carrying out of military manoeuvres, as well as the testing of any type of weapons"[67] in the entire area of Antarctica. In order to ensure compliance with the ban on armaments, this Treaty provides for extensive inspection system based on national means of verification (Article VII). Under the Treaty, only original signatories, plus such acceding countries as have demonstrated an interest in Antarctica by conducting substantial scientific research activities there, have the right to designate observers to carry out inspections (these countries are hereinafter referred to as "consultative parties").[68] These observers have "complete freedom of access at any time to any or all areas of Antarctica"[69] including all stations, installations, and equipment, and all ships and aircraft at the point of discharging or loading cargoes or personnel in Antarctica.[70] Aerial inspection may be conducted by consultative parties "at any time over any or all areas of Antarctica"[71] as well.

The Antarctic Treaty also provides that consultative parties meet at suitable intervals for the purpose of discussing measures to promote the principles and objectives of the Treaty. Such measures include "facilitation of the exercise of the rights of inspection".[72]

As mentioned above, the Antarctic Treaty provides for two methods of verification: general on-site inspection and consultation. Unrestricted on-site inspection authorizes any consultative party to employ any lawful verification methods, including satellite monitoring. Satellite monitoring is technologically feasible and can therefore be regarded as a permissible national technical means of verification.

(c) Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water [hereinafter cited as the Partial Test Ban Treaty or PTBT][73]

Parties to the Partial Test Ban Treaty undertake "not to carry out any nuclear weapon test explosion, or any other nuclear explosion" in the atmosphere, outer space or under water or in any other environment[74] if the explosions would cause radioactive debris to escape beyond the borders of the state responsible for the explosion.[75] "[A]ny other nuclear explosion" refers to so-called "peaceful", *i.e.*, non-military explosions.[76]

This relatively short Treaty does not contain any verification clauses, reflecting the thorny process of negotiation and the inability of the United States, the United Kingdom and the USSR to agree on any verification measures beyond those within the capabilities of each contracting party. The ban in these three areas was made a realistic option since verification by the deployment of reconnaissance satellites was feasible. As an arms control expert noted, satellites made it possible, "to overcome the perennial sticking point of nuclear negotiations--inspection. They permitted the United States to monitor the Soviet Union and the Soviet Union to keep foreign inspectors from its soil, at one and the same time."[77]

Satellite verification by state parties to the Treaty is not only permissible but arguably, together with land-based seismic installations, the most important instrument of verification. Currently, more than one hundred and twenty countries are parties to the PTBT, but only a few are capable of detecting nuclear explosions using national technical means. Therefore, it seems reasonable to assume that any contracting state could lawfully obtain data from a future international satellite verification organization which can be characterized as a kind of extended national technical means of verification.

(d) Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies [hereinafter cited as the Outer Space Treaty][78]

The Outer Space Treaty bans the placing in outer space of "any objects carrying nuclear weapons or any other kinds of weapons of mass destruction".[79] This Treaty further prohibits any kind of military activity on the moon and other celestial bodies, including the "establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military maneuvers".[80] Verification provisions to ascertain compliance with the Treaty are found in Articles X and XII. Although its wording is somewhat ambiguous, Article X could be interpreted as providing for on-site inspection: "the States Parties to the Treaty shall consider on a basis of equality any requests by other States Parties to the Treaty to be afforded an opportunity to observe the flight of space objects launched by those States". The phrase "to observe the flight of space objects" appears to leave considerable latitude in interpretation.

Article XII provides for on-site inspection of "[a]ll stations, installations, equipment and space vehicles" on the moon and other celestial bodies on a basis of reciprocity. "Reciprocity" is understood not as a veto but as the right to reject the other party's request only after the requested party has been unlawfully refused the opportunity to inspect by the other party.[81] There seems to be no limitation on the locations subject to inspection since Article I of the Treaty states that "there shall be free access to all areas of celestial bodies". Unlike the Antarctic Treaty, which allows general on-site inspection "at any time", the Outer Space Treaty requires parties to give "reasonable advance notice of a projected visit" (Article XII) to assure safety and to avoid interference with normal operations of the facility. This requirement can be explained by the very different nature of activities in Antarctica and on celestial bodies.

In addition, Article XI of the Outer Space Treaty provides that parties conducting space activities should inform the Secretary-General of the United Nations of the "nature, conduct, locations and results" of such activities, which would facilitate inspection. This Article, however, is of limited utility since states parties are obliged to provide such information only "to the greatest extent feasible and practicable".[82] Each party is free, therefore, to decide unilaterally as to what is "feasible and practicable".

Up to now, intelligence-gathering satellites have been observing targets on the surface of the earth, not in outer space or on the moon. At this time, the technical feasibility of verifying compliance with the Outer Space Treaty by satellite is uncertain; however, improvements in space technology could make this feasible in the near future.

(e) <u>Treaty for Prohibition of Nuclear Weapons in Latin America with Additional Protocols I and II</u> [hereinafter cited as the Treaty of the Tlatelolco][83]

The so-called Treaty of Tlatelolco, the first nuclear weapons-free-zone treaty, has two additional Protocols dealing with matters that concern non-Latin American countries. Protocol I involves an undertaking by non-Latin American countries that have dependent territories in the areas of application of this Treaty; Protocol II involves an undertaking by countries possessing nuclear weapons. Both Protocols require the parties to respect the nuclear weapons-free-zone status of the region.[84]

Under the Treaty of Tlatelolco, states parties undertake to prohibit in their respective territories the testing, use, manufacture, production, acquisition, receipt, storage, installation, deployment and possession of any nuclear weapons.[85] Parties further undertake not to engage in, encourage, authorize or participate in the testing, use, manufacture, possession or control of any nuclear weapons.[86] This Treaty does not provide for "transit" or "transportation" of nuclear weapons.

One of the most important characteristics of this document is the elaborate control system for verifying Treaty obligations, namely, that the devices, services and facilities for peaceful uses of nuclear energy are not used for the purpose of testing or manufacturing nuclear weapons; that none of the activities prohibited in Article 1 are conducted; and that peaceful explosions are carried out in accordance with the Treaty.[87] Two international agencies are involved in Treaty verification: The International Atomic Energy Agency (IAEA) and the Agency for the Prohibition of Nuclear Weapons in Latin America (OPANAL), established by the Treaty.[88] In accordance with the agreement concluded with the IAEA, OPANAL can carry out special inspections (Article 16, paragraph 1(a)). The IAEA, along with OPANAL, may also have access to all the preparations for and to the site of the peaceful explosion (Article 18, paragraph 3).

OPANAL may carry out inspections when any party "suspects that some activity prohibited by this Treaty has been carried out or is about to be carried out"[89] and requests the Council of OPANAL to inspect (challenge on-site inspection) or when any suspected country requests the Council to prove its compliance with its Treaty obligations (verification-by-challenge).[90] For the purpose of such inspections, parties undertake to grant the inspectors "full and free access to all places and all information".[91]

Intelligence-gathering satellites as national technical means of verification could be useful for monitoring the testing, manufacture, production and, of course, the use of nuclear weapons. However, most contracting parties to this Treaty do not as yet possess the necessary space monitoring systems. Under Article 19, paragraph 2, OPANAL is authorized to "enter into relations with any international organization or body, especially any which may be established in the future to supervise disarmament or measures for the control of armaments in any part of the world". Hence, if an international verification agency is set up in the future, the Treaty of Tlatelolco could be lawfully monitored by such an agency.

(f) Treaty on the Non-Proliferation of Nuclear Weapons [hereinafter cited as the NPT][92]

Under the Non-Proliferation Treaty, state parties possessing nuclear weapons undertake not to transfer such weapons or other nuclear explosive devices or control over such weapons or devices to non-nuclear weapon states.[93] Nuclear weapon states parties also undertake not to assist, encourage or induce any non-nuclear weapon state to manufacture or otherwise acquire nuclear weapons or devices.[94] Unless control over nuclear weapons is transferred, their deployment in non-nuclear weapon states is not prohibited by this Treaty, in contrast to the provisions found in the Treaty of Tlatelolco. Non-nuclear weapon states undertake not to receive any nuclear weapons or control over such weapons from any transferor and not to manufacture or receive any assistance in the manufacture of nuclear weapons.[95]

This Treaty has significantly contributed to the safeguard system. As of January 1990, one hundred and two states have concluded safeguards agreements with the IAEA, which apply to nine hundred and twenty facilities and other locations.[96] The purpose of the safeguards system is to ensure that no diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices will take place.[97] A model NPT safeguards agreement was drawn up in 1971.[98] Agreements based on this model, which are essentially identical, now apply to some one hundred countries. IAEA verification starts by the examination of the reports prepared by a contracting country concerning among other things, installation design and nuclear material accounting records, followed by IAEA inspections and ending with a final evaluation.[99] A country's failure to report all nuclear material for exclusively peaceful purposes would constitute a breach of the agreement; however, IAEA inspectors do not have the power to search for unreported material or facilities. Thus, as demonstrated in the case of Iraq, a country bent on circumventing the provisions of the Treaty can relatively easily evade IAEA safeguards.

Satellite monitoring is technically feasible and useful for locating unreported facilities, nuclear testing and preparations for testing. As one example, in 1977 the Soviet Union informed the United States, the United Kingdom, France and West Germany that South Africa was secretly preparing to detonate an atomic explosion in the Kalahari Desert.[100] At the same time United States reconnaissance satellites detected South Africa's preparation as well.[101] Diplomatic initiatives eventually resulted in the South African government announcing that no nuclear explosion test would occur.[102]

(g) Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof [hereinafter, the Seabed Treaty][103]

The contracting parties to the Seabed Treaty have undertaken not to place any nuclear weapons and other weapons of mass destruction as well as "structures, launching installations or any other facilities specially designed for storing, testing or using such weapons" on the seabed beyond a twelve mile coastal zone.[104] Further, the parties have agreed not to assist, encourage or induce any state to carry out prohibited activities and not to participate in such activities in any other way.[105] It would not be a breach of the Treaty, however, if a submarine armed with nuclear warheads hides on the seabed.[106]

Article III of the Treaty contains verification procedures. Each state party has the right to verify compliance with this Treaty "through observations", by national technical means. In order not to prejudice technologically less developed countries, paragraph 5 of Article III provides that "[v]erification pursuant to this article may be undertaken by any State Party using its own means, or with the full or partial assistance of any other State Party, or through appropriate international procedures within the framework of the United Nations and in accordance with its Charter". Although detection of violations of this Treaty by space-based means seems at this time to be very difficult, intelligence-gathering satellites could be lawfully employed either by individual states or by an international organization to monitor compliance with its provisions.[107]

A state party having doubts about any other party's Treaty compliance is allowed to "consult" with such state.[108] If such consultation does not successfully remove the doubts, the parties concerned shall "cooperate" on further procedures for verification, including on-site inspection.[109] When consultation and cooperation fail to remove doubts concerning the fulfilment of Treaty obligations, a state party may refer the matter to the Security Council of the United Nations.[110] While elaborately set forth, the verification procedure of this Treaty seems to offer little beyond rights already existing in international law including the Charter of the United Nations.[111]

(h) Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction[112]

The most significant characteristic of the above-referenced agreement is that it provides for "disarmament", namely, the elimination of an entire category of biological and toxin weapons from the arsenals of the contracting parties. Each party undertakes "never in any circumstances to develop, produce, stockpile or otherwise acquire or retain"[113] biological agents or toxins "of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes"[114] along with weapons, equipment or means of delivery designed to use such agents or toxins.[115] Further, each party is obliged to "destroy, or to divert to peaceful purposes" all agents, toxins, weapons, equipment and means of delivery if it possesses them.[116] This Convention also prohibits parties from transferring such weapons, or assisting, encouraging, or inducing any states or international organizations to manufacture such weapons and delivery means.[117]

Oddly enough, no verification procedures are set forth in this Convention for monitoring the elimination of biological weapons nor safeguards for keeping states from developing such weapons. The parties are not even obliged to announce their compliance with the Convention. One of the reasons that implementing treaty obligations is left to each party in accordance with its constitutional arrangements[118] is that it was generally recognized that verification of non-production is not essential even if it were feasible.[119] Any party that suspects the breach of obligations by another party may lodge a complaint with the U.N. Security Council.[120] Once the Security Council initiates an investigation, states parties are obliged to cooperate,[121] which, it is understood, may include on-site inspection. However, the practical value of this complaints procedure appears highly dubious.[122]

Satellite monitoring of state compliance with this Convention either by individual states or by satellites employed by the Security Council in carrying out its separate investigations would be completely lawful. If an international satellite monitoring agency is set up in the future, its monitoring activities would be in many, but not necessarily all, instances initiated by and conducted in accordance with the decisions of the U.N. Security Council. Technically, however, satellite monitoring would remain only supplementary to other more effective means of verification.

(i) Convention on the Prohibition of Military or any Other Hostile Use of Environmental Modification Techniques [hereinafter cited as the ENMOD Convention][123]

Although use of environmental modification techniques for hostile purposes has not played a major role in military planning, the mere threat of serious harm that could be inflicted by this method of warfare was felt sufficiently compelling to outlaw it. The term environmental modification technique is defined as "any technique for changing - through the deliberate manipulation of natural processes - the dynamics, composition or structure of the Earth ... atmosphere or of outer space".[124] Article I of the Convention prohibits each state party from engaging 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 to any other State Party".[125] States parties also undertake not to assist, encourage or induce any state or organization to engage in environmental modification for military purposes.[126] As is the case with respect to the Biological Weapons Convention, the implementation of this Convention is left to each contracting party;[127] the Convention contains no verification provisions. The consultation and cooperation of states parties is expected to assist in solving any problems concerning the application of the Convention.[128] Such consultation and cooperation may be undertaken through the United Nations and a Consultative Committee of Experts.[129] The Consultative Committee of Experts, a novelty in this field of agreements, shall make "appropriate findings of fact and provide expert views".[130]

Any state party that suspects the breach of this Convention by another party may lodge a complaint with the Security Council. Parties must then cooperate with the investigation that may be initiated by the Security Council.[131]

A state party having reason to suspect that an other state party is acting in breach of its obligations may use its national means, including satellite monitoring, to confirm its suspicions. The same method of verification could be used by any "appropriate international organization" (Article V, paragraph 1), including a future international satellite verification organization.

(j) Agreement Governing the Activities of States on the Moon and Other Celestial Bodies [hereinafter cited as the Moon Agreement][132]

The Moon Agreement, furthering the corresponding provisions of the Outer Space Treaty, effectively demilitarized the Moon and other celestial bodies (for the purpose of this Agreement, the Moon refers to all celestial bodies within the solar system except the Earth). The Moon Agreement prohibits placing nuclear weapons and other weapons of mass destruction in orbits around the Moon or in other trajectories or on the Moon.[133] "[A]ny threat or use of force or any other hostile act or threat of hostile act" is prohibited on the Moon.[134] Further, this Agreement bans the use of the Moon for the purpose of committing hostile acts or to threaten any such acts in relation to the earth, the Moon, spacecraft, the personnel of spacecraft or any other man-made space objects.[135] The Agreement further bans the establishment of any kind of military bases, installations and fortifications, and the testing of any type of weapon and the conduct of military manoeuvres on the Moon.

Article 15, which is similar to Article XII of the Outer Space Treaty, allows each state party to carry out inspections of "all space vehicles, equipment, facilities, stations and installations on the moon", subject to reasonable advance notice. The significant difference with the Outer Space Treaty is the inspection clause which states that each party may conduct such inspections "on its behalf or with the full or partial assistance of any other State Party or through appropriate international procedures within the framework of the United Nations and in accordance with the Charter".[136] The Agreement explicitly authorizes the use of intelligence-gathering satellites both by national means and by those belonging to international organizations.

(k) Convention on the Prohibition or Restrictions on the Use of Certain Conventional Weapons which may be Deemed to be Excessively Injurious or to have Indiscriminate Effects[137]

As a disarmament treaty, the above-referred document does little to lessen the casualties of war; the Convention prohibits and restricts the use of weapons that leave non-detectable fragments in the human body by X-rays (Protocol I), the use of mines, booby traps and other devices (Protocol II) and incendiary weapons (Protocol III). This Convention contains no verification procedures nor clauses on the settlement of disputes. Satellite monitoring of compliance with the Convention does not seem possible, at least not at the present stage of development of space technology.

(l) The South Pacific Nuclear Free Zone Treaty [hereinafter, Treaty of Rarotonga][138]

The states members of the South Pacific Forum, a loose consultative body of nations established in 1971,[139] signed a treaty in 1985 that established the area between the equator and Antarctica and Australia and South America as a "Nuclear-

Free Zone".[140] This Treaty prohibits manufacturing, acquiring, possessing or having control over any nuclear explosive device[141] or receiving any assistance or taking action to assist in the manufacture or acquisition of any nuclear explosive devices.[142] The Treaty and its annexes contain elaborate verification provisions, consisting of: (a) reports to the Director of the South Pacific Bureau of Economic Co-operation and exchange of information among parties (Article 9); (b) consultations among parties and the Consultative Committee convened by the Director at the request of any party on any matter arising in relation to this Treaty (Article 10, Annex 3); and (c) IAEA safeguards to verify the "non-diversion of nuclear material from peaceful nuclear activities to nuclear explosive devices" (Annex 2, paragraph 3). Furthermore, each party has to conclude an agreement with the IAEA the scope and effect of which is at least equivalent to the IAEA model agreement used in connection with the NPT (Annex 2, paragraph 2). The Treaty also provides for a complaint procedure, which includes challenge on-site inspection.

Satellite monitoring of the Treaty of Rarotonga is both lawful and technically feasible. At this time, most parties rely for purposes of verification on the seismic monitoring network being set up in Australia and New Zealand.

(m) Treaty on Conventional Armed Forces in Europe (the CFE Treaty)[143]

Arms control experts concerned with military activities in Europe have long concluded that the only stable alternative to a military stand-off was a cooperative security agreement in which members of NATO and the Warsaw Treaty Organization (WTO) were actively involved. Reflecting the dramatic changes that have swept Eastern Europe since 1989, the Treaty on Conventional Armed Forces in Europe (CFE Treaty) was signed by government leaders representing each member of NATO and the WTO in November 1990. The CFE Treaty establishes ceilings for five categories of armaments--battle tanks, artillery, armoured combat vehicles, combat aircraft and combat helicopters in Europe.[144] The verification package established by the CFE Treaty is perhaps the most complex ever negotiated for an arms control agreement.[145] It covers (1) notification and information exchange (Articles XIII and XVIII and the Protocol on Information Exchange); (2) ground on-site inspections (Article XIV and the Protocol on Inspections); (3) national and multinational technical means (Article XV); (4) aerial inspections (Article XIV (6)); and (5) the Joint Consultative Group (Article XVI and the Protocol on the Joint Consultative Group).

Although not defined in Article XV, national and multinational technical means are assumed to include surveillance satellites as a major method of compliance. Furthermore, what is noteworthy is the reference to multinational technical means that do not yet exist although several multinational systems (such as the International Satellite Monitoring Agency (ISMA)) have been proposed.[146] Satellite monitoring is a very useful method of verifying compliance and is either by national or multinational technical means legally justified within the framework of the CFE treaty.

(n) Comprehensive Test Ban Treaty (draft)

A comprehensive test-ban treaty (hereinafter cited as the CTB) has been discussed in various disarmament forums since the conclusion of the PTBT in 1963. Given that modernization of nuclear weapons is the central purpose of underground nuclear testing, along with checking the reliability of stockpiled or deployed nuclear weapons,[147] it is not surprising that strong opposition to the CTB exists on the part of the military. CTB advocates, however, claim that there are many methods other than testing by which the reliability of stockpiled nuclear weapons can be evaluated and maintained.[148] In addition, invoking Article VI of the NPT, which provides for the parties' obligation to work for nuclear disarmament,[149] CTB supporters stress the importance of strengthening the NPT by eliminating the "elements of hypocrisy and unfairness"[150] seen in the existing nuclear regime. Compared with the danger of proliferation of nuclear weapons, they assert, what is gained from nuclear testing is not worth the risk.

Since the CTB treaty is still in draft from, the negotiating history is worthy of review in order to determine the usefulness of satellite monitoring to confirm compliance. The Eighteen-Nation Disarmament Committee (ENDC) failed to reach agreement mainly due to disagreements over on-site inspection. While the United States and the United Kingdom maintained the necessity of mandatory on-site inspection, the USSR claimed that national technical means were sufficient to verify CTB compliance.[151] In this context, national technical means comprise seismic monitoring, supplemented by satellite surveillance, monitoring of hydro-acoustic waves and airborne radioactivity.[152] Detection means recognition of a seismic event and the location of that event. In contrast, identification refers to the establishment of the nature of the event, that is, if it was an earthquake, tremor, chemical explosion or nuclear explosion.[153] The Soviet Union later agreed on international exchange of seismic data provided that the analysis of data was conducted nationally while the United States insisted that the international data centres conduct analysis of data.[154] Sweden proposed "verification-by-challenge" to mitigate the intrusive and direct nature of mandatory on-site inspection.[155]

Several member states of the ENDC proposed a threshold test ban; India, for example, stated that the agreed threshold should be lowered from a seismic magnitude of 4.75 (the admitted threshold figure that reflected what could be detected and identified by existing national means around 1965) according to the development of seismic equipment, by using "black boxes".[156]

Discussion at the Conference of the Committee on Disarmament (CCD) in the 1970s did not eliminate the opposition to on-site inspection.[157] The problem of how to provide for "peaceful" nuclear explosions in a CTB treaty also plagued the negotiations.[158] In the meantime, however, the two superpowers succeeded in concluding two arms control agreements, the Threshold Test Ban Treaty of 1974 and the Peaceful Nuclear Explosions Treaty of 1976.[159]

At the 1982 session of the Committee on Disarmament, the Reagan Administration rejected altogether the desirability of a CTB in the foreseeable future.[160] The cessation of nuclear tests would have interfered with the massive re-armament program of the United States, especially with President Reagan's Strategic Defense Initiative (SDI). On the other hand, following its announcement of a unilateral testing moratorium in 1985, the Soviet Union indicated its readiness to accept various international cooperative verification measures, including on-site inspection "whenever necessary" or "if need be".[161] At the same time, the USSR continued to hold that national technical means were sufficient to satisfactorily verify compliance with the CTB.[162]

Monitoring by satellite could supplement other measures of verification of the CTB treaty, both technically and legally. If and when an international satellite verification organization is set up, such an organization could be used for CTB monitoring, together with other land-based technical methods.

(o) Chemical Weapons Convention (draft)[163]

The issue of the prohibition of chemical weapons has been the subject of debate and negotiations, most recently in the Conference on Disarmament for almost two decades.[164] The current, intensive, negotiations in the CD were first inaugurated in April 1984, by then Vice President George Bush, who submitted on behalf of the United States a major draft treaty designed to ban entirely the possession, production, acquisition, retention or transfer of chemical weapons.[165] By July 1992 agreement was reached on most issues. Under the draft agreement, the parties undertake not to develop, produce, otherwise acquire, stockpile or retain chemical weapons or transfer directly or indirectly chemical weapons to anyone. The draft also prohibits the use of chemical weapons; it obliges contracting parties to destroy their stockpiles of chemical weapons and their production facilities. A major stumbling block to reaching agreement lies in monitoring commercial facilities where legitimate civilian chemical agents are being manufactured but where also weapons-type chemicals can be produced. By contrast, destruction of stored weapons at dedicated production facilities can be adequately and effectively verified.[166]

Other major unresolved issues are challenge inspections, trade controls in relation to the Convention, the treatment of the old stocks[167] and the composition of the Executive Council of the proposed "Organization for the Prohibition of Chemical Weapons".[168] The purpose of this Organization is to ensure the strict implementation of the Convention. Technical secretariat of the proposed organization is to be responsible for on-site inspections.[169] Two types of inspections are envisaged: routine on-site inspection and challenge on-site inspection. Routine inspections would be carried out to confirm the accuracy of the declarations by possessor states. Declarations would include a list of the precise location of storage facilities, a description of the type of construction and an inventory of their contents, the composition of chemical weapons and the type, size, weight and number of munitions.[170] Each state party and the proposed international verification organization would have to conclude an agreement according to which such routine inspection is to be conducted. Each facility listed will be subject to systematic verification on a routine basis after the initial inspection.[171]

Challenge on-site inspection is to provide parties the opportunity to check ambiguities or suspicions which are not satisfactorily resolved by routine inspections. Although the suspected states could offer alternative measures to resolve the situation, challenge on-site inspection is mandatory, unless the requesting state agrees to other measures.[172]

National technical means of verification (including satellites) are intended to supplement on-site inspections in checking the accuracy of declarations. Such verification means are somewhat eclipsed by the elaborate inspection systems under the draft treaty and might not be especially useful for monitoring production of chemical weapons due to the similarity in appearance between chemical weapons facilities and commercial chemical facilities. Nevertheless, national technical means of verification are expected to double-check the existence and the destruction of prohibited stockpiles and production facilities.[173] Although the current draft convention does not explicitly mention national technical means, it would be useful to include in the final version of the treaty a clause prohibiting interference with such means as provided in the SALT accords.[174]

B. BILATERAL AGREEMENTS

1. Introduction

The principal features of post-war Soviet-American arms competition have been nuclear weapons and their means of delivery (primarily air-, land- and sea-launched missiles). As

Robert McNamara stated when he was Secretary of Defense, the cornerstone of U.S. strategic policy "continues to be to deter deliberate nuclear attack upon the United States or its allies. We do this by maintaining a highly reliable ability to inflict unacceptable damage upon any single aggressor or combination of aggressors at any time during the course of a strategic exchange, even after absorbing a surprise first strike."[175] The key of "mutual assured destruction" (MAD) is, accordingly, to allow both the United States and the USSR to retain a second-strike or retaliatory capability. In this context, first-strike capability implies the ability to eliminate the attacked nation's retaliatory second-strike forces. In effect, as neither of the superpowers could attain first-strike capability,[176] it is the mutual assured destruction capability that provides both nations with the strongest motive to avoid a nuclear war.[177] In addition, the following axiom is worth mentioning when contemplating the doctrine of mutual assured destruction: whatever one side does to improve its defence, the offence will inevitably and soon catch up with less effort.[178] It follows that a strategic nuclear defence at this time is neither technologically feasible nor cost-effective. In a prophetic speech, U.S. Defense Secretary McNamara, in September 1967, said:

> it has been alleged that we are opposed to destroying a large-scale ABM system because it would carry the heavy price tag of $40 billion. Let me make it very clear that the $40 billion is not the issue. The money in itself is not the problem; the pen-

> etrability of the proposed shield is the problem. There is no point in spending $40 billion if it is not going to buy us a significant improvement in our security. If it is not, then we should use the substantial resources it represents on something that will. Every ABM system that is now feasible involves firing defensive missiles at incoming offensive warheads in an effort to destroy them. What many commentators on this issue overlook is that any such system can rather obviously be defeated by an enemy's simply sending more offensive warheads, or dummy warheads, then there are defensive missiles capable of disposing of them. This is the crux of the nuclear action-reaction phenomenon. Were we to deploy a heavy ABM system throughout the United States, the Soviets would clearly be strongly motivated to so increase their offensive capability as to cancel out our defensive advantage. It is futile for each of us to spend $4 billion, $40 billion or $400 billion----and, at the end of all the effort, to be relatively at the same point of balance on the security scale as we are now."[179]

Nevertheless, both superpowers, at enormous expense, continued research in and development of systems designed to neutralize the menace posed by nuclear-tipped ballistic missiles.

2. SALT Accords

Two agreements were signed on May 26, 1972: the ABM Treaty and the Interim SALT I Agreement. The ABM Treaty strictly limits the deployment, testing and the use of ABM systems. The SALT I Interim Agreement imposes quantitative and qualitative limitations on strategic offensive weapons.

(a) Treaty Between the United States of America and the Union of Soviet Socialist Republics Anti-Ballistic Missile Systems [hereinafter cited as the ABM Treaty][180]

For the purposes of the ABM Treaty, an ABM system is defined as follows:

> a system to counter strategic ballistic missiles or their elements in flight trajectory, currently consists of: (a) ABM interceptor missiles, which are interceptor missiles constructed and deployed for an ABM role, or of a type tested in an ABM mode; (b) ABM launchers, which are launchers constructed and deployed for launching ABM interceptor missiles; and (c) ABM radars, which are radars constructed and deployed for an ABM role, or of a type tested in an ABM mode.[181]

Article I, paragraph 2 of the Treaty provides that "[e]ach party undertakes not to deploy such ABM systems for a defense of the territory of its country and not to provide a base for such a defense, and not to deploy ABM systems for defense of an individual region". Under the 1972 Treaty, the parties were allowed two ABM sites,[182] reduced to one site in a 1974 Protocol.

The following activities are forbidden by the ABM Treaty: (i) to develop, test, or deploy ABM systems or components which are sea-based, air-based, space-based or mobile land-based; (ii) to develop, test or deploy ABM launchers for launching more than one ABM interceptor missile at a time from each launcher; (iii) to modify deployed launchers and to provide them with a capability of launching more than one ABM interceptor missile at a time from each launcher; (iv) to develop, test or deploy automatic or semi-automatic or other similar systems for rapid reload of ABM launching;[183] (v) to give non-ABM missiles, non-ABM launchers or non-ABM radars capabilities to counter strategic ballistic missiles or their elements in flight trajectory and to test them in ABM mode; (vi) to deploy radars for the early warning of strategic ballistic missile attack except at locations along the periphery of its national territory and oriented outward;[184] (vii) to transfer ABM systems or their components to other states or to deploy ABM systems or their components outside its national territory;[185] and (viii) to assume any international obligations which would conflict with the ABM Treaty.[186]

On the other hand, the ABM Treaty explicitly or implicitly allows: (i) the development and testing of fixed land-based ABM systems or their components as long as they are located within current or additionally agreed test ranges, where no more than fifteen ABM launchers are permitted;[187] (ii) the modernization and replacement of ABM systems or their components;[188] and (iii) laboratory research of ABM systems that stops just short of development.[189]

Furthermore, in order to ensure fulfilment of the obligations imposed by Article III in the future, the parties undertake to discuss specific limitations on such systems and their components in the event that "ABM systems based on other physical principles and including components capable of substituting for ABM interceptor missiles, ABM launchers, or

ABM radars are created".[190] This phrase became the central point of controversy following the announcement by President Reagan of the Strategic Defense Initiative.

Article XII of the ABM Treaty sets out verification provisions which merit quotation in full:

> 1. For the purpose of providing assurance of compliance with the provisions of this Treaty, each party shall use national technical means of verification at its disposal in a manner consistent with generally recognized principles of international law.
> 2. Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with paragraph 1 of this Article.
> 3. Each Party undertakes not to use deliberate concealment measures which impede verification by national technical means of compliance with the provisions of this Treaty. This obligation shall not require changes in current construction, assembly, conversion, or overhaul practices.

It was in the ABM Treaty and the SALT I Interim Agreement that the term "National Technical Means of Verification" (NTM) made its first appearance. NTMs comprise extensive networks of technological instrumentalities including photo-reconnaissance satellites, aircraft-based systems (such as radars and optical systems), sea-and ground-based systems (such as radars, antennae for electronic communication interception as well as seismic and acoustic sensors).

Even though NTMs function using all possible means of signal intelligence (SIGINT) including Communication Intelligence (COMINT), Electronic Intelligence (ELINT) and Telemetry

Intelligence (TELINT), the most important measures of SALT accords verification are photo-reconnaissance satellites.[191] Without confidence in NTM capabilities, the SALT accords probably would never have been signed. As Soviet arms control commentator V. Viktorov wrote:

> the existence of such advanced means, notably the existing Earth satellites, materially facilitates the achievement of agreement because it eliminates the question of international on-the-ground inspections, which had been a stumbling block in earlier considerations.[192]

Although it is difficult for a satellite to distinguish anti-ballistic missiles from offensive missiles or anti-aircraft SAMs, the technical characteristics of an ABM system makes accurate monitoring from space possible. NTMs function only as a system consisting of highly sophisticated phased-array radars for the detection of intercontinental ballistic missiles (ICBMs), computers and, of course, ABM missiles. Whereas missiles can be concealed or remain undetected, large radar structures (as evidenced in the case of the Krasnoyarsk radar complex) cannot escape detection.

(b) Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics - Measures With Respect to the Limitation of Strategic Offensive Arms [hereinafter, the SALT I Agreement][193]

The SALT I Agreement limited the number of ICBM launchers, SLBM (Submarine Launched Ballistic Missiles) launchers and modern ballistic missile submarines. It should be noted that it is not the missiles themselves but the launchers that are regulated. Such launchers are limited as follows: (i) no new construction of fixed land-based ICBM launchers after July 1, 1972 (although the exact number is not mentioned either in this Agreement or the Protocol);[194] (ii) a quantitative limitation on SLBM launchers and modern ballistic missile submarines. No additional construction is allowed except as replacements for an equal number of ICBM launchers of older types deployed prior to 1964 or launchers on older submarines;[195] and (iii) no conversion from land-based light ICBMs or those of older types deployed prior to 1964 into heavy ICBMs.[196] Within these constraints, modernization and replacement of ICBMs and SLBMs are permitted.[197] Only fixed land-based ICBMs were limited in this Agreement, due to the objection on the part of the USSR to including mobile ICBMs in the Agreement.[198] Heavy bombers are also excluded.

Article V of the Agreement provides for verification measures, which are identical with those found in Article XII of the ABM Treaty. Here again, the limited capabilities of satellites influenced attitudes concerning weapons control and led to controls being placed on launchers rather than on missiles. Both ICBM and SLBM launchers could be monitored with a high degree of confidence because the excavation of silos for ICBMs requires considerable time and heavy equipment. The movement and deployment of ICBMs into such silos are easily detected as well. Similarly, it takes several years to build a large submarine with SLBM launch capability and that makes monitoring easier.

3. **Treaty Between the United States of America and The Union of Soviet Socialist Republics on the Limitation of Underground Nuclear Weapon Tests** [hereinafter cited as the Threshold Test Ban Treaty or the TTBT][199]

Recognizing that there was little likelihood of the USSR and the United States agreeing on a CTB treaty, countries not possessing nuclear weapons began to advocate a threshold test-ban agreement.[200] Eventually, however, agreement between the two superpowers on further restrictions on nuclear testing was reached in 1974.

The Threshold Test Ban Treaty of 1974 (the TTBT) bans any underground nuclear weapon test "having a yield exceeding 150 kilotons at any place under" the jurisdiction or control of a contracting party.[201] Considering that a yield of fifteen kilotons represents the threshold level repeatedly proposed at ENDC and CCD capable of being verified by national technical means, the TTBT permits explosions roughly ten times as strong. Hence, it appears that a yield of one hundred and fifty kilotons was chosen not for reasons of adequate verification but rather for the purpose of further nuclear weapon development.[202]

Article II of the Treaty provides for verification, which is to be carried out by national technical means, as in the

ABM Treaty and the SALT I Interim Agreement.[203] Paragraph 2 of Article II requires that the parties not interfere with each other's national technical means, and Paragraph 3 provides for consultation when questions of compliance arise.

The Protocol attached to the Treaty provides for exchange of seismic data to facilitate verification of compliance. The data to be exchanged include information on the geographical boundaries and geology of the testing areas and on the density and seismic velocity of rock foundations, water saturation and depths of the water table which would influence the seismic signals to be produced by a nuclear explosion.[204]

Article 4 of the Protocol requires that all nuclear weapon tests be conducted "solely within the testing areas" specified in the exchanged data. That information combined with the observation of the size and depth of the cavities made by nuclear explosions makes it possible to detect with considerable accuracy any breach of the Treaty. Satellite monitoring is not only technically feasible but also very effective for monitoring the implementation of this Treaty.[205] In fact, Article II of the Treaty expressly permits satellite monitoring.

Although the TTBT has not yet been ratified, both parties are abiding by its provisions because they feel this is to their mutual benefit.

4. <u>Treaty Between the United States of America and The Union of Soviet Socialist Republics on Underground Nuclear Explosions for Peaceful Purposes</u> [the Peaceful Nuclear Explosions Treaty or the PNET][206]

The Peaceful Nuclear Explosions Treaty (the PNET) is a companion treaty to the TTBT. Since there is essentially no technological distinction between nuclear explosive devices used as a weapon and those used for peaceful purposes, the PNET is indispensable in order to prevent presenting weapon-oriented nuclear explosions as "peaceful nuclear explosions" (PNEs). The PNET governs all underground nuclear explosions conducted at locations outside the weapons test sites[207] and bans any individual explosion having a yield exceeding one hundred and fifty kilotons.[208]

Article IV of the Treaty sets out the provisions for verification measures. In addition to the national technical means of verification similar to those in SALT accords and the TTBT, the Treaty requires each party to allow the other party access to sites of explosions. The Joint Consultative Commission, to be established under Article V, is expected to provide, through consultation and inquiry, information necessary for verification of compliance. Article II of the Protocol details what information on PNE shall be given to the other party, whereas Articles III to VII of the Protocol stipulate the manner in which the designated personnel are to exercise their functions in assuring compliance with the PNET.[209]

Satellite monitoring of this Treaty is technically feasible and useful as an effective supplement to other means of verification. Although the PNET has not been ratified, both parties are currently acting in accordance with this its terms.

5. Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Strategic Offensive Arms [the SALT II Treaty][210]

In accordance with Article VII of the SALT I Agreement, the SALT II negotiations began in November 1972. The goal of SALT II was to conclude a comprehensive treaty significantly limiting strategic offensive weapons systems.[211]

The SALT II Treaty, signed with great pomp in 1979, was not ratified before its scheduled expiry of 1985.[212] However, Presidents Carter and Reagan, as well as General Secretary Leonid Brezhnev, declared that their countries would not violate the unratified Treaty on the condition that the other party would also abide by it.[213] On May 27, 1986 President Reagan announced that the United States would not necessarily continue to comply with the SALT II Treaty because the USSR, he alleged, had repeatedly violated it.[214] This Treaty was eventually replaced by a new START agreement concluded in 1992 which will be discussed later.

Verification provisions of the SALT II Treaty are of some interest. Article XV of the Treaty provides for verification measures that are identical to those of the 1972 SALT accords, *i.e.* compliance is to be monitored by the use of national technical means. Satellites have long been referred to as the primary technical means of verification by the media but it was only on October 1, 1978 that the United States government officially acknowledged its use of photo-reconnaissance satellites.[215] In 1972, the Soviets admitted using satellites to monitor the SALT I accord.[216] Satellites would be highly suitable for monitoring the SALT II Treaty particularly due to the change in orientation of the objects of verification, from weapons to their launchers.[217] An American expert noted that violating ICBM ceilings, for example, would be very hard because U.S. satellites were providing complete photographic coverage of the USSR. Since one foot resolution photographs were available by close-look satellites, any significant attempt to violate the Treaty could be easily detected.[218]

To enhance the NTM and to strengthen the verification regime, Article XVII, paragraph 2(b) provided for data exchange on a voluntary basis within the framework of the Standing Consultative Commission, a provision the SALT I accords did not contain.

6. **Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of their Intermediate-Range and Shorter-Range Missiles** [the INF Treaty][219]

The first disarmament agreement, known as the INF Treaty, was signed in December 1987 and sought to remove from the arsenals of the superpowers an entire category of nuclear weapons.[220] Under this Treaty, each party undertakes to eliminate all ground-launched intermediate-range missiles (with a range of one thousand to fifty five hundred kilometers), shorter-range missiles (with a range of five hundred to one thousand kilometers) and launchers of such missiles as well as support structures and the support systems thereof.[221] Production or flight-tests of such missiles are also prohibited.[222]

The INF Treaty contains a most comprehensive verification system. Article XI provides for: unprecedentedly intrusive on-site inspections, which comprise base-line inspection, to verify the data as of the date of entry into force of this Treaty with respect to the number of missiles, launchers, support structures and support equipment;[223] close-out inspection, to verify elimination of missile operating facilities and missile support facilities within sixty days after the scheduled date of their elimination;[224] short-notice inspection, to check whether existing missiles, launchers and other facilities and equipment correspond to the data specified in the Memorandum of Understanding;[225] portal monitoring inspection, involving continuous observation of the portals of certain missile production facilities for thirteen years after entry into force of the Treaty;[226] and elimination inspections, to observe the process of complete elimination of INF-related systems and confirm the elimination thereof.[227]

As the INF Treaty does not allow "anywhere, anytime" inspections but only challenge on-site inspections of locations listed in the Memorandum of Understanding[228] and because it seems uncertain whether such on-site inspections would function as a stabilizing factor,[229] monitoring compliance with the INF Treaty heavily relies on the national technical means of verification specified in Article XII. A senior arms control adviser of the Reagan administration, Paul Nitze, admitted in an interview, that little besides NTM actually would be required to verify the banning of the deployment of all INF-related systems.[230] U.S. Defense Secretary F. Carlucci also stated that NTM would play a leading role in verifying compliance with the Treaty.[231]

C. THE LEGAL STATUS OF RECONNAISSANCE SATELLITES

The legal status of artificial satellites became the subject of debate soon after the U.S. and the USSR announced in 1954 their intention to launch earth-circling satellites as one of the projects of the International Geophysical Year

(IGY) sponsored by the International Council of Scientific Unions (I.C.S.U.).[232] An early commentator, Andrew Haley, General Counsel of the American Rocket Society, opined that since there did not exist the clear distinction between air space and outer space, states could have protested against such satellite prcgrams, or demanded a new international agreement based on the Chicago Convention,[233] which no state did. Hence, Mr. Haley deduced in a paper presented to that society in 1954 that the failure of nations to object against the planned launching of satellites implied a tacit agreement that satellite passage over their territory was lawful. He added that this agreement would make difficult any future attempts to assert rights in space above the atmosphere.[234] Professor Myres S. McDougal also saw in the lack of objections against orbiting satellites the "tacit acceptance by the governments of many states".[235] The Dutch expert, Professor D. Goedhuis regarded outer space as "res communis" and supported the analogy of outer space to the high seas; freedom of innocent passage through space in his opinion should be authorized under international law.[236] Incidental satellite passage through sovereign air space was not regarded as a violation of the Chicago Convention based on the understanding that a satellite is not an "aircraft" within the meaning of the Chicago Convention.[237]

Following the launchings of Soviet (in 1957) and American (in 1958) satellites the basic principles of international space law were quickly established mainly through U.N. General Assembly resolutions and the practice of states. Among United Nations resolutions, A/Resolution 1721(XVI) adopted in 1961 was of critical importance since it expressly confirmed that outer space is free for exploration and use by all states in conformity with international law and not subject to national appropriation. Two years later, U.N. Assembly Resolution 1962 (XVIII) re-asserted unambiguously the freedom of outer space as the fundamental principle of space law. This Resolution was incorporated almost in its entirety in 1967 in the Outer Space Treaty.[238] The key provision of the resolution read:

> 1. The exploration and use of outer space shall be carried on for the benefit and in the interests of all mankind.
> 2. Outer space and celestial bodies are free for exploration and use by all States on a basis of equality and in accordance with international law.
> 3. Outer space and celestial bodies are not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

It was not surprising that no country protested the passage of satellites designed for scientific purposes only. Their usefulness to mankind was universally understood and appreciated. However, satellite technology quickly progressed from purely scientific programs to more practical uses such as communications and reconnaissance. Nevertheless, the right of overflight of communication satellites was never challenged.[239]

It was reconnaissance satellites and remote sensing satellites that gave rise to questions as to their legality. From the outset, the USSR urged a ban on all space-based intelligence gathering. Thus, in 1962, the Soviet Union submitted a "Draft Declaration on the Basic Principles Governing the Activities of States Pertaining to the Exploration and Use of Outer Space" to the U.N. Committee on the Peaceful Uses of Outer Space (COPUOS), Paragraph 8 of which stated "the use of artificial satellites for the collection of intelligence information in the territory of foreign states is incompatible with the objectives of mankind in its conquest of outer space".[240] The United States, in response, emphasized that observation from space was an internationally beneficial activity perfectly in conformity with established international law and that distinguishing intelligence collection from other forms of observation was impossible. In addition, the United States stated that even military reconnaissance was a legitimate activity since it was useful for international peace and security. The non-aggressive character of military surveillance satellites was compatible with the "peaceful uses" of outer space.[241]

The use of nuclear detection satellites was mentioned in the nuclear test ban draft treaty submitted by the United Kingdom and the United States delegations in 1961.[242] Although such provisions were not included in the final Test Ban Treaty, according to Jenks, the legality of this kind of satellite use could not be challenged because it was "a normal incident of the right of every party to the Treaty to satisfy itself that the provisions of the Treaty are being scrupulously observed."[243] Similarly, the use of missile warning satellites was considered within the right of self-defence, referred t- in Article 51 of the U.N. Charter.[244]

The question remained, accordingly, whether orbiting intelligence-gathering satellites such as photographic reconnaissance satellites, electronic reconnaissance satellites and ocean reconnaissance satellites would fall within the notion of "peaceful uses" of outer space. Related to this is the problem of whether intelligence activities are legal or illegal under international law. The highly respected jurist Wilfred Jenks has stated that such activities are not illegal in international law even though they may be subject to heavy municipal law penalties when conducted within the territory of a state.[245] Avoiding a categorical answer, he added:

> all that can be said with confidence is that no agreement exists on any special rule governing the use of intelligence satellites and that the use of such satellites therefore is governed by the general rules of international law relating to intelligence activities.[246]

Intelligence agents (spies) are classified by Oppenheim as agents lacking diplomatic or consular character.[247] Spies are sent abroad in order to collect military and political secrets, and

> although it is not considered wrong morally, politically, or legally to do so, such agents have, of course, no recognized position whatever according to International Law, since they are not official agents of States for the purpose of international relations. Every State punishes them severely if they are caught committing an act which is a crime by the law of the land, or expels them if they cannot be punished. A spy cannot legally excuse himself by pleading that he only executed the orders of his Government, and the latter will never interfere, since it cannot officially confess to having commissioned a spy.[248]

The majority of publicists limit the illegality of espionage to activities involving agents trespassing through the territory of other states.[249]

Legal experts in former socialist states maintained the illegality of reconnaissance satellites until well into the mid-1960s. Their criticism of such satellites seldom achieved a precise legal characterization as Professor I. Vlasic has mentioned.[250] Rather, their legal reasoning was that since spying is illegal and incompatible with international law, it makes no difference from what altitude over the territory of other states such activity is conducted. For example, Soviet legal expert G. Zhukov stated in the early 1960s that "the main things are <u>object and results</u> of espionage irrespective of altitude and secrecy".[251]

In addition to state practices demonstrating that intelligence activities are not illegal under international law, the practical fact that effective unilateral control of reconnaissance satellites cannot be achieved has supported the argument in favour of the legality of such satellites. For instance, Professor Vazques has concluded that there is no other way than to admit "the new circumstances and adapt to them".[252] Although theoretical effective control over reconnaissance satellites would include physical interception or multilateral pre-launch inspection, neither of these actions could possibly be implemented.[253] Pre-launch inspection systems would have been unacceptable not only to the USSR but also to the United States;[254] and distinguishing military and civilian satellites after being launched was too difficult at that time. Hence, short of banning all satellite activities or expressly permitting interception or incapacitation of suspected reconnaissance satellites as a measure of permissible self-defence, there was no other effective means of preventing space espionage.

At the start of the 1970s, as Soviet use of reconnaissance satellites increased, criticism by socialist scholars began to diminish to eventually disappear altogether. In 1978, when President Carter officially admitted the role of space-based surveillance systems, the reaction of other states, especially that of developing countries was one of concern, even though their response was more muted than expected. Today, the legality of reconnaissance satellites is no longer challenged since the activities of such satellites have been rooted deeply enough in international society and have rightly been deemed to be highly useful for maintaining international peace.

CHAPTER IV - ENDNOTES

1. Oxford English Dictionary, vol. 19, 2d ed. (Oxford: Clarendon Press, 1989) at 539.

2. See e.g., U.S. Dep't of State, Documents on Disarmament 1945-1959, vols. 1 & 2 (Washington, D.C.: GPO, 1960); A. Karkoszka, Strategic Disarmament,Verification and National Security (London: Taylor & Francis, 1977) at 11-15.

3. See e.g., UN GAOR, Preparatory Committee for the Special Session of the General Assembly Devoted to Disarmament, UN Doc. A/AC.187/101 (8 February 1978) at 1.

4. UN GAOR, Preparatory Committee for SSOD I UN Doc. A/AC.187/109 (17 April 1978) [hereinafter UN Doc. A/AC.187/109] at 2.

5. ibid. at 15.

6. Department for Disarmament Affairs, Reduction of Military Budgets: Refinement of International Reporting and Comparison of Military Expenditures, UN Doc. A/S-12/7 (1983) Sales No. E.83 IX.4 at 26 [hereinafter UN Doc. A/S-12/7].

7. Department of External Affairs of Canada, Verification in All Aspects: A Comprehensive Study on Arms Control and Disarmament Verification Pursuant to UNGA Resolution 40/152 (o), (April 1986) [hereinafter Verification in All Aspects].

8. ACDA, Annual Report to Congress 1986 (Washington, D.C.: GPO, 1987) at 59; ACDA, Annual Report to Congress 1987 (Washington, D.C.: GPO, 1988) at 69; ACDA, Annual Report to Congress 1988 (Washington, D.C.: GPO, 1989) at 55.

9. ACDA, Annual Report to Congress 1985 (Washington, D.C.: GPO, 1986) at 2.

10. See, infra, section B of this Chapter.

11. US Congress. Senate Committee on Foreign Relations, The SALT II Treaty Hearings, 96th Cong. 1st Sess. July 16-19, 1979 Part. 2 at 241.

12. S.D. Goldman, P.E. Gallis & J.M. Voas, Verifying Arms Control Agreements: The Soviet View (CRS Report No. 87-316F) (Washington D.C.: GPO, 1987) at 1.

13. Ibid. at 6. The U.S. intelligence community assigns "confidence levels" reflecting what it perceives to be its ability to detect prohibited activity. Low confidence level refers to a 10 to 50 percent chance of detection, while moderate confidence level indicates between a 50 and 75 percent chance of detection. A high confidence level corresponds to a 90 to 100 percent assurance of detection. Intelligence forecasts about confidence levels tend to be intentionally conservative. See e.g., R.A. Scribner & K.N. Luongo, Strategic Nuclear Arms Control Verification: Terms & Concepts (Washington, D.C.: AAAS, 1985) at 10; M. Krepon, Arms Control: Verification (New York: Foreign Policy Association, 1984) at 6.

14. UN Doc. A/AC.187/109, supra, note 4 at 18.

15. See e.g., A.S. Krass, "The Soviet View of Verification" in W.C. Potter, ed., Verification and Arms Control (Lexington, Massachussets: D.C. Heath, 1985) 37 at 38.

16. Goldman, Gallis & Voas, supra, note 12 at 3.

17. A.S. Krass, Verification: How Much is Enough? (London: Taylor & Francis, 1985) at 7.

18. Goldman, Gallis & Voas, supra, note 12 at 3.

19. Krass, supra, note 17 at 7-10. Whereas the explanation of verification steps emphasizes the unilateral character of the process, verification is also a co-operative process. Examples include e.g., exchange of data, consultative commission, and prior notification for certain types of military activities.

20. S.D. Goldman, Verification: Soviet Compliance with Arms Control Agreements (CRS Report No. IB 84131) (Washington, D.C.: GPO, 1985) at 1.

21. See infra, section B of this Chapter.

22. S.M. Meyer, "Verification and Risk in Arms Control" (1984) 8:4 Int'l Security 111 at 112-13.

23. UN Doc. A/AC.187/109, supra, note 4 at 17; Verification is All Aspects, supra, note 7 at 18.

24. Department of External Affairs of Canada, A Conceptual Working Paper on Arms Control Verification, 2d ed., (Arms Control Verification Studies No.1) by F.R. Cleminson & E. Gilman (January 1986) [hereinafter Cleminson & Gilman]. The first edition of this working paper was submitted to the Committee on Disarmament as CD/183 in June 1981, and also simultaneously published by the Operational Research and Analysis Establishment, Department of National Defense of Canada, as ORAE Report No.79, in August 1981. In accordance with a recommendation of the General Assembly (A/Res/37/99KIII), the Committee on Disarmament was established in 1978, which became the Conference on Disarmament in 1984.

25. Ibid. at 5.

26. United Nations Institute for Disarmament Research [hereinafter UNIDIR] and Department of External Affairs of Canada, The Verification Issue in United Nations Disarmament Negotiations by E. Morris, UNIDIR/87/14, Sales No. GV, E.87.0.4. at 2 [hereinafter UNIDIR/87/14]; Cleminson & Gilman, ibid.

27. Final Document of the Tenth Special Session of the General Assembly, GA Res. A/S-10/2 (13 July 1978). This Final Document is reproduced in World Armaments and Disarmament: SIPRI Yearbook 1979 (London: Taylor & Francis, 1979) 524.

28. Cleminson & Gilman, supra, note 24 at 5.

29. Ibid.

30. Ibid.

31. S. Melman, "General Report" in S. Melman, ed., Inspection for Disarmament (New York: Columbia Univ. Press, 1958)3 at 12-55.

32. Physical inspection comprises the so-called on-site inspection and surveillance by airborne and satellite sensors. Non-physical inspection is sometimes called "psychological inspection" (by L.B. Sohn), which covers a wide range of information obtained by people. This category would even include the knowledge verified by lie detectors applied to the highest ranking politicians (such as the President of the United States) and scientists. See B.T. Feld, "Inspection Techniques" (1960) 89 Daedaulus 860 at 865-68. Concerning such non-physical inspection, Professor Henkin stated: "[S]kepticism and

near-despair about the effectiveness and practicability of extensive inspection have evoked ingenious and perhaps silly suggestions...it has been suggested that the President of the United States (and the chiefs of other states) submit periodically to a lie detector test or be given "truth serum" and be required to answer questions about the extent of national armaments and the nature of national war plans." [emphasis added] L. Henkin, Arms Control and Inspection in American Law (Westpoint, Connecticut: Greenwood Press, 1958) at 186.

33. Henkin, ibid. at 47-83. Later, Professor Henkin, with Professor Bloomfield listed seven types of verification methods: (1) external verification - unilateral (e.g. satellites); (2) external verification - cooperative (e.g. agreement not to jam); (3) existing internal verification; (4) invitation to witness destruction or divestment of declared items; (5) significantly increased internal verification (more intense level of territorial inspection); (6) access to declared facilities; and (7) inspection of undeclared sites. Since the last category was unacceptable, the notion of progressive inspection was invented. See L.P. Bloomfield & L. Henkin, "Inspection and the Problem of Access" in R.J. Barnet & R.A. Falk, eds., Security in Disarmament (Princeton, New Jersey, Princeton Univ. Press, 1965) 107 at 111-16.

34. Operational Research and Analysis Establishment (ORAE), Department of National Defense of Canada, Compendium of Arms Control Verification Proposals (ORAE Report No. R73) (June 1980) (this report was submitted simultaneously to the Committee on Disarmament in June 1980 as CD/99); ORAE, Department of National Defense of Canada, A Quantitative Working Paper on the Compendium of Arms Control Verification Proposals (ORAE Report No. 76) (July 1980) (this report was simultaneously submitted to the Committee on Disarmament in July 1980 as CD/127). The second edition of the Compendium of Arms Control Verification Proposals was published in March 1982 (ORAE Report No.R81) (this report was submitted to the Committee on Disarmament as CD/275) and its third edition was published in June 1987 (ORAE Extra-Mural Paper No. 42, vols. 1-3).

35. Among the eight verification methods, collateral analysis is not examined. Concerning Collateral Analysis, see ORAE Extra-Mural Paper No. 42, vol. 3, ibid. at 117-35.

36. Cleminson & Gilman, supra, note 24 at 6.

37. Ibid.

38. ORAE Extra-Mural Paper No. 42, supra, note 34 vol.1 at 161.

39. L.B. Sohn, "Territorial Arms Control: A Proposal" in E.W. Lefever, ed., Arms and Arms Control (New York: Praeger, 1962) 209; L.B. Sohn, "Zonal Disarmament and Inspection: Variations on a Theme" (1962) 18: 7 Bull. Ato. Scientists 4; L.B. Sohn, "Progressive Zonal Inspection: Basic Issues", in S. Melman, ed., Disarmament: Its Politics and Economics (Boston: The American Academy of Arts and Science, 1962) 121. Detailed concept on progressive/zonal on-site inspections, see ORAE Extra-Mural Paper 42, vol. 2, supra, note 34 at 99-118.

40. Ibid.

41. ORAE Extra-Mural Paper No. 42, vol. 1, supra, note 34 at 231; Cleminson & Gilman, supra, note 24 at 6-7.

42. ORAE Extra-Mural Paper No. 42, vol. 1, ibid.

43. Ibid.

44. A. Myrdal, The Game of Disarmament: How the United States and Russia Run the Arms Race rev'd ed. (New York: Pantheon Books, 1982) at 301.

45. Ibid.

46. ORAE Extra-Mural Paper No.42, vol. 1, supra, note 34 at 232.

47. ORAE Extra-Mural Paper No. 42, vol. 2, supra, note 34 at 119-21.

48. Cleminson & Gilman, supra, note 24 at 7-8.

49. ORAE Extra-Mural Paper No. 42, vol. 2, supra, note 34 at 189.

50. Ibid. at 159.

51. Ibid.

52. E. Fubini, "Reconnaissance and Surveillance as Essential Elements of Peace" in B.T. Feld, et al., Impact of New Technologies on the Arms Race (Cambridge, Massachussetts: MIT Press, 1971) 152.

53. ORAE Extra-Mural Paper No. 42, vol. 2, supra, note 34 at 160.

54. ORAE Extra-Mural paper No. 42, vol. 3, supra, note 34 at 215.

55. Ibid. at 216, 222 & 228-29.

56. Ibid. at 216-21 & 254-56; S. Graybeal & M. Krepon, "Making Better Use of the Standing Consultative Commission" (1985) 10:2 Int'l Security 183.

57. ORAE Extra-Mural Paper No. 42, vol. 3, ibid. at 216 & 223; P. Cassell, "Establishing Violations of International Law: 'Yellow Rain' and the Treaties Regulating Chemical and Biological Warfare" (1985) 35 Stanford L.R. 259.

58. ORAE Extra-Mural Paper No. 42, vol. 3, ibid. at 216 & 259-312.

59. Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, 17 June 1925, L.N.T.S. No. 2138, 26 U.S.T. 571, T.I.A.S. No. 8061, [hereinafter Geneva Protocol] (entered in force 8 February 1928). Before World War II, this Protocol was ratified by many countries including all the great powers except the United States and Japan. Japan ratified it in 1970, the U.S. in 1975. Concerning the negotiation process of this Protocol, see e.g., ACDA, Arms Control and Disarmament Agreements : Texts and Histories of Negotiations (Washington, D.C.: GPO, 1982) at 9-13 [hereinafter Arms Control and Disarmament Agreements].

60. Geneva Protocol, ibid.

61. Ibid.

62. Ibid.

63. The Antarctic Treaty, December 1 1959, 402 U.N.T.S. 702, 12 U.S.T. 794, T.I.A.S. No. 4780 (entered into force 23 June 1961). For the purpose of this Treaty, Antarctica covers the area south of 60 degree South Latitude, including all ice shelves (art. VI).

64. By the 1950s, seven nations claimed sovereignty over Antarctica: Argentine, Australia, Chile, France, New Zealand, Norway, and the United Kingdom.

65. The Antarctic Treaty, Preamble.

66. Arms Control and Disarmament Agreements, supra, note 59, at 19.

67. The Antarctic Treaty, art.I, para.1.

68. Ibid. art. VII, para. 1, art. IX, para. 2. The original signatories are named in the Preamble to the Treaty: Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, the United Kingdom, the USSR and the United States. As of January 1990, 39 states have become parties to the Treaty. In addition to the original signatories, Brazil, China, Finland, the German Democratic Republic, the Federal German Republic, India, Italy, Korea, Peru, Poland, Spain, Sweden and Uruguay (13 states) have been accorded the status of consultative parties.

69. Ibid. art. VII, para.2.

70. Ibid. para. 3.

71. Ibid. para. 4.

72. Ibid. art. IX, para. 1(d).

73. Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, 5 August 1963, 14 U.S.T. 1313, T.I.A.S. No. 5433, 460 U.N.T.S. 43, reprinted in 21 I.L.M. 899 [hereinafter Partial Test Ban Treaty] (entered into force 10 October 1963). It took eight years of negotiations to conclude a Partial Test Ban Treaty. See e.g., G.T. Seaborg & B.S. Leb, Kennedy Khrushchev and the Test Ban (Berkley: Univ. of California Press, 1981); Arms Control and Disarmament Agreements, supra, note 59 at 34-40; M. Kurosawa, Modern International Law on Disarmament (in Japanese) (Niigata: Nishimura Shoten, 1986) at 53-61; G.A. Greb, "Survey of Past Nuclear Test Ban Negotiation" in J. Goldblat & D. Cox, Nuclear Weapon Tests: Prohibition or Limitation? (Oxford: Oxford Univ. Press, 1988) 95.

74. PTBT, art. 1, para. 1.

75. Ibid. art. 1, para. 1(b) does not rule out underground nuclear weapon test explosions, but imposes certain conditions on the manner of such explosions.

76. ACDA, Document of Disarmament 1963 (Washington, D.C.: GPO, 1964) at 251, 297, 307, 343-46 & 408; Kurosawa, supra, note 73 at 58.

77. Greb, <u>supra</u>, note 73 at 102.

78. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205, 1967 Can. T.S. No. 19 [hereinafter Outer Space Treaty] (entered into force 10 October 1967).

79. Outer Space Treaty, art. IV.

80. <u>Ibid.</u>

81. Kurosawa, <u>supra</u>, note 73 at 212.

82. Outer Space Treaty, art. XI.

83. Treaty for the Prohibition of Nuclear Weapons in Latin America, 14 February 1967, 33 U.S.T. 1792, T.I.A.S. No. 10147, 634 U.N.T.S. 281 [hereinafter Treaty of Tlatel-olco] (entered into force 22 April 1968).

84. All five nuclear-weapon states ratified Protocol II and the United Kingdom, the Netherlands and the United States ratified Protocol I. France has not yet ratified the Protocol. Concerning nuclear-weapons-free zone concepts, see <u>e.g.</u>, A. Rapacki, "The Polish Plan for a Nuclear-Free-Zone Treaty" (1963) 39 Int'l Affairs (London) 1; A. Skowronski, "Legal Problems Relating to Denuclearization in the Polish Plans for an Atom-Free Zone and for Freezing Nuclear Armaments in Central Europe" (1967) 1 Polish Yearbook of Int'l L. 45; UNGA Res. 1603A (XXIV); UNGA Res. 2832 (XXVI).

85. Treaty of Tlatelolco, art. 1, para.1 (a)(b).

86. <u>Ibid.</u> para. 2. Under this Treaty, the nuclear explosion is permissible on condition that they are carried out exclusively for peaceful purposes (Article 18).

87. Treaty of Tlatelolco, art. 12.

88. <u>Ibid.</u> arts. 7 and 13. Concerning the operation of OPANAL, see <u>e.g.</u>, A.S. Paris, "OPANAL and the Treaty of Tlatelolco" (1988) 11:1 Disarmament: A Periodic Review of the United Nations 86.

89. Treaty of Tlatelolco, art. 16, para. 1(b)(i).

90. <u>Ibid.</u> para. (b)(ii).

91. Ibid. para. 4.

92. Treaty on the Non-Proliferation of Nuclear Weapons, 1 July 1968, 21 U.S.T. 483, T.I.A.S. No. 6839, 729 U.N.T.S. 161 [hereinafter NPT] (entered into force 5 March 1970).

93. NPT, art. I.

94. Ibid. The assistance and encouragement from nuclear weapon states to nuclear weapon states, and from non-nuclear weapon states to nuclear weapon states are not banned by this Treaty.

95. Ibid. art. II.

96. J. Jennekens, "IAEA Safeguards: What They Are and What They Do" (1990) 13:3 Disarmament: A Periodic Review by the United Nations, 89 at 97.

97. NPT, art. III.

98. The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons" Document INFCIRC/153, June 1972.

99. For a succinct explanation of IAEA verification, see e.g., External Affairs and International Trade Canada, Canada and International Safeguards: Verifying Nuclear Non-Proliferation (Verification Brochure No. 5) (January 1990).

100. B. Jasani, "Military Satellites" in World Armaments and Disarmament: SIPRI Yearbook 1978 (London: Taylor & Francis) 69 at 73.

101. Ibid. at 74-79.

102. Ibid. at 73.

103. Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof, 11 February 1971, 23 U.S.T. 161, T.I.A.S. No.7337, 955 U.N.T.S. 115 [hereinafter Seabed Treaty] (entered into force 18 May 1972).

104. The Seabed Treaty, art. I, para. 1.

105. Ibid. para. 3.

106. "Report by Secretary of State Rogers to President Nixon on the Seabed Treaty", Documents on Disarmament 1971 (Washington, D.C.: GPO, 1972) at 356.

107. The Seabed Treaty did not contain international verification provisions due to the strong opposition of the United States and the USSR as "premature and wasteful of resources". See SIPRI Yearbook of World Armaments and Disarmament (Stockholm: Almqvist & Wiksell, 1969) at 183; UN Brochure, Seabed - A Frontier of Disarmament United Nations Publication (1976), at 16.

108. The Seabed Treaty, art. III, para. 2.

109. Ibid.

110. Ibid. art. III, para. 4.

111. E.D. Brown, Arms Control in the Hydrosphere: Legal Aspects (Washington, D.C.: Woodrow Wilson Int'l Centre for Scholars, 1971) at 96.

112. Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, 10 April 1972, 1015 U.N.T.S. 163, 26 U.S.T. 583, T.I.A.S. No. 8062 (entered into force 26 March 1975).

113. Biological Weapons Convention, art. I.

114. Ibid. para. 1.

115. Ibid. para. 2.

116. Ibid. art. II.

117. Ibid. art. III.

118. Ibid. art. IV.

119. J. Goldblat, "Chemical and Biological Disarmament", in World Armaments and Disarmament: SIPRI Yearbook 1972 (Stockholm: Almqvist & Wiksell, 1972) 501 at 505.

120. Biological Weapons Convention, art. VI, para. 1.

121. Ibid., art. VI, para. 2.

122. Goldblat, supra, note 119 at 506.

123. Convention on the Prohibition of Military or any Other Hostile Use of Environmental Modification Techniques, 18 May 1977, 31 U.S.T. 333, T.I.A.S. No. 9614, 610 U.N.T.S. 151 [hereinafter the ENMOD Convention] (entered into force 5 October 1978).

124. ENMOD Convention, art. II. Illustrative phenomena that could be caused by the use of environmental modification techniques include earthquakes, tsunamis, an upset in the ecological balance of a region, changes in weather patterns, changes in ocean currants, changes in the ozone layer and changes in the state of the ionosphere. See Understanding Regarding the Convention, understanding relating to Article II.

125. Understandings Regarding the Convention defines "wide-spread" as "encompassing an area on the scale of several hundred square kilometres"; "long-standing" as "lasting for a period of months, or approximately a season"; and "severe" as "involving serious or significant disruption or harm to human life,natural and economic resources or other assets".

126. ENMOD Convention, art. I, para. 2. Environmental modification for peaceful purposes is not prohibited under this Convention (Article III, paragraph 1).

127. Ibid. art. IV.

128. Ibid. art. V, para. 1.

129. Ibid. paras. 1 and 2.

130. Annex to the ENMOD Convention, para.1.

131. ENMOD Convention, art. V, paras. 3 and 4. Taking note of the facts that there is no requirement to resort to either Consultative Committee of Experts or the Security Council in this Convention and that the veto power of two member states of the Security Council (China and France), which are not contracting parties to this Convention, might be potentially problematic, it was proposed at the first review conference that all states parties consider the fact-finding report of the Consultative Committee of Experts before the Security Council dealt with the matter. This proposal did not get enough support. See K. Korhonen, "The ENMOD Review Conference: The First Review Conference of the ENMOD Convention" (1985) 8: 1 Disarmament: A Periodic Review by the United Nations 133 at 139-140.

132. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 5 December 1979, UN GAOR, A/Res/34/68 [hereinafter Moon Treaty] (entered into force 11 July 1984).

133. The Moon Agreement, art. 3, para. 3.

134. Ibid. para. 2.

135. Ibid.

136. Ibid. art. 15, para. 1.

137. Convention on the Prohibition or Restrictions on the Use of Certain Conventional Weapons Which may be Deemed to be Excessively Injurious or to Have Indiscriminate Effects, 10 October 1980, UN Doc. A/CONF.95/15 Annex 1, Appendix A-D (entered into force 10 April 1981)

138. The South Pacific Nuclear Free Zone Treaty, 6 August 1985, 24 I.L.M. 1440 [hereinafter, Treaty of Rarotonga] (entered into force 11 December 1986). For a concise explanation of this treaty, see e.g., E.L. Gibbs, "In Furtherance of a Nuclear-Free Zone Precedent: The South Pacific Nuclear Free Zone Treaty" (1986) 4 Boston Int'l L.J. 387; G.E. Fry, "The South Pacific Nuclear-Free Zone", in World Armaments and Disarmament: SIPRI Yearbook 1986 (Oxford: Oxford Univ. Press, 1986) 499.

139. Members of the South Pacific Forum include Australia, the Cook Islands, Fiji, Kiribati, Nauru, New Zealand, Niue, Papua New Guinea, the Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa. The Federated States of Micronesia have observer status.

140. This Treaty establishes a "nuclear-free zone" not "nuclear-weapons-free zone", since it covers all "nuclear explosive devices" as well as the dumping of radioactive wastes.

141. Treaty of Rarotonga, art. 3(a).

142. Ibid. paras. (b) and (c).

143. The Treaty on Conventional Armed Forces in Europe is cited in World Armaments and Disarmament: SIPRI Yearbook 1991 (Oxford: Oxford Univ. Press, 1991) 461 ff.

144. CFE Treaty, especially, arts. I, IV, V and XI.

145. External Affairs and International Trade Canada, 15 The Disarmament Bulletin (1990) at 2.

146. Infra, Chapter 5.

147. J. Goldblat, "What it would take to ban testing" (1988) 44: 8 Bull. Ato. Scientists 25; E. Arnett, "The Comprehensive Test Ban Debate" (1988) Issue Paper by AAAS Program on Science, Arms Control and National Security No. 88-7.

148. See e.g., F. York, "The Great Test-Ban Debate" (1972) 227: 5 Scientific American 15; S. Fetter, "Stockpile Confidence Under a Nuclear Test Ban" (1987) 12:3 Int'l Security 132.

149. Article VI of the NPT provides: "[e]ach of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control".

150. York, supra, note 148 at 23.

151. UNIDIR/87/14, supra, note 26 at 65-70.

152. Ibid. Concerning seismic monitoring of underground nuclear testing, see e.g., Ministry of External Affairs of Canada, Seismic Verification (Verification Brochure No. 1) (Ottawa: Minister of Supply and Service Canada, 1986); L.R. Sykes & J.F. Evernden, "The Verification of a Comprehensive Nuclear Test Ban" (1982) 247:4 Scientific American 47; External Affairs and International Trade Canada,"Focus on Seismic Verification" (1989) 11 The Disarmament Bulletin 23.

153. Seismic Verification, ibid., at 21 & 40.

154. UNIDIR/87/14, supra, note 26 at 69 & 93.

155. Ibid. at 66-67.

156. Ibid. at 68. Apart from India, countries such as the United Arab Republic (ENDC/PV.224, 1965 at 9-10), Burma (ENDC/PV.277, 1966, at 13-14), Nigeria (ENDC/PV.327, 1967 at 22) and Japan (ENDC/PV.424, 1969 at 17-22) proposed threshold test ban as a first step to CTB.

157. UNIDIR/87/14, supra, note 26 at 71-75. Two superpowers, however, agreed to accept ten tamper-proof, unarmed seismic stations on their territory; Arnett, supra, note 148 at 5.

158. Ibid.

159. See, infra, sec. B 3 and 4 of this Chapter.

160. UNIDIR/87/14, supra, note 26 at 79; Arnett, supra, note 147 at 4.

161. UNIDIR/87/14, ibid. at 82 & 90.

162. Ibid. at 79-82.

163. For the text of the draft-convention on chemical weapons and an excellent and comprehensive commentary, see T. Bernauer, The Projected Chemical Weapons Convention: A Guide to the Negotiations in the Conference on Disarmament (UNIDIR Publication, 1990) at 261.

164. The prohibition of both biological and chemical weapons was dealt with collectively in the ENDC. Since the banning of chemical weapons is more difficult, it was decided that biological and chemical weapons would be considered in a separate treaty. From 1976 to 1980, multilateral talks had been eclipsed by bilateral Soviet-USA talks, which stalled during deteriorating detente. They were resumed after 1984.

165. For the full text of Bush's address and a summary of U.S. draft, see, "U.S. Proposes Banning Chemical Weapons", Dep't of State Bull. (June,1984) at 40.

166. F.R. Cleminson, "Verification of Compliance in the Areas of Biological and Chemical Warfare" in W.C. Potter, ed., Verification and Arms Control (Lexington, Massachussets, Lexington Books, 1985) 125 at 133.

167. See e.g., UNIDIR, Verification: The Soviet Stance: Its Past, Present and Future by M. Kokeyev & A. Androsov, UNIDIR/90/34, UN Publication Sales No. GV.E.90.0.6(1990) at 81-94; Cleminson, ibid., note 165 at 128-33; J. Boulden, Toward a Chemical Weapons Convention: Proceedings of a Conference Entitled "Implementing a Global Chemical Weapons Convention" held in Ottawa, October 7-9, 1987 (Aurora Paper 9) (Ottawa: The Canadian Centre for Arms Control and Disarmament, 1989) at 20-21.

168. See e.g., UNIDIR, The Future Chemical Weapons Convention and Its Organization: The Executive Council (Research Paper No. 5) by T. Bernauer, UNIDIR/89/19, UN Publication Sales No. GV.E.89.0.7 (May 1989) at 1.

169. Ibid. 169.22

170. Boulden, supra, note 167 at 12.

171. Ibid. at 17; S.J. Lundin, "Routine Inspection" in J. Boulden, ed., supra, note 167, 40.

172. N.P. Smidovich, "Challenge Inspection" in Boulden ed., supra, note 167, 50.

173. Boulden, supra, note 167 at 15-16; Lundin, supra, note 171 at 40-41.

174. Boulden, ibid. at 16.

175. R.S. McNamara, The Essence of Security: Reflections in Office, (New York: Harper & Row, 1968) at 52;, see also A.C. Enthoven & K.W. Smith, How Much is Enough? Shaping the Defense 1961-1969, (New York: Harper & Row, 1971) at 174.

176. See e.g., R.S. McNamara, Blundering into Disaster : Surviving the First Century of the Nuclear Age (New York: Pantheon Books, 1986) at 154-55, Appendix IV, Growth of U.S. and Soviet Strategic Nuclear Missile and Bomber Forces, 1945-1990.

177. McNamara, supra, note 175 at 53-56.

178. L. Freedman, The Evolution of Nuclear Strategy (New York: St. Martin's Press, 1981) at 251.

179. McNamara,supra, note 175 at 64.

180. Treaty Between the United States of America and the USSR on the Limitation of Anti-Ballistic Missile Systems, 26 May 1972, 23 U.S.T. 3435, T.I.A.S. No. 7503, 864 U.N.T.S. 39, reprinted in 11 I.L.M. 784 [hereinafter ABM Treaty].

181. ABM Treaty, art.II para.1.

182. Ibid., art.III.

183. Ibid. art. V. The agreed Statements regarding the ABM Treaty also provides that both parties understand that art. V.5 includes obligations not to develop, test, or deploy ABM interceptor missiles of more than one independently guided warhead (Agreed Statements [E]). Common understanding regarding the same treaty also delineates that a prohibition of deployment of mobile ABM systems and components would rule out the deployment of ABM launchers and radars that are not permanent fixed types (Common Understandings C. Mobile ABM Systems). See Agreed Statements, Common Understanding, and Unilateral Statements Regarding the Treaty Between the United States and the USSR on the Limitation of Anti-Ballistic Missiles.

184. ABM Treaty, art. VI.

185. Ibid. art. IX.

186. Ibid. art. X.

187. Ibid. art. IV & art. V.

188. Ibid. art. VII.

189. Smith, "Legal Implications of a Space Based Ballistic Missile Defense" (1985) 15 Cal. W. Int'l L.J. 52 at 52.

190. Agreed Statements [D] regarding the ABM Treaty.

191. R.A. Scribner, T.J. Ralston & W.D. Metz, The Verification Challenge: Problems and Promise of Strategic Nuclear Arms Control Verification (Boston: Birkhauser, 1985) c. 3.

192. Quoted in M. Russel, "Military Activities in Outer Space: Soviet Legal Views" (1984) 25 Harvard Int'l L.J. 153 at 178.

193. Interim Agreement Between the United States of America and the USSR on Certain Measures with Respect to the Limitation of Strategic Offensive Arms, 26 May 1972, 23 U.S.T. 3462, T.I.A.S. No. 7504, (entered into force 3 October 1972, expired 3 October 1977) [hereinafter the SALT I Agreement].

194. SALT I Agreement, art.I.

195. Ibid. art III. The Protocol to this Treaty provides that the United States may have no more than 710 SLBMs and no more than 44 modern ballistic missile submarines, and that the Soviet Union may have no more than 950 SLBMs and

no more than 62 modern ballistic missile submarines. The interpretation of "under construction" is different as between the two parties. N.K. Calvo-Goller & M.A. Calvo, The SALT Agreements: Contents-Application-Verification (Dordrecht: Martinus Nijhoff, 1987) at 34.

196. SALT I Agreement, art.II. Neither this agreement nor the Protocol puts a number on permitted heavy launchers. Moreover, there is no definition of heavy launchers. Examples of light launchers of the USSR, are the SS-11 and SS-13, older types being the SS-7 and SS-8, and heavy ICBM is the SS-9. The Unilateral Statement by the US delegation read: "[t]he United States would consider any ICBM having a volume significantly greater than that of the largest light ICBM now operational on either side to be a heavy ICBM." See, Agreed Statements, Common Understandings, and Unilateral Statements Regarding the Interim Agreement Between the United States and the USSR on Certain Measures With Respect to the Limitation of Strategic Offensive Arms, 26 May 1972. Unilateral Statements D. "Heavy" ICBMs.

197. SALT I Agreement, art. IV.

198. Senate Armed Service Committee Hearings on SALT I, June--July 1972, in R.P. Labrie, SALT Handbook: Key Documents and Issues 1972-1979 (Washington, D.C.: American Enterprise Institute for Public Policy, 1979) at 109-10.

199. Treaty Between the United States of America and the USSR on the Limitation of Underground Nuclear Weapon Tests,3 July 1974, [hereinafter the Threshold Test Ban Treaty or TTBT].

200. See supra, sec. A.4.(n) of this Chapter.

201. TTBT, art. 1, para. 1.

202. T.A. Halsted, "Why No End to Nuclear Testing" (1977) 19:2 Survival 60 at 62. Seismologists report that 25-30 carefully sited seismic stations within the two countries could detect and identify muffled nuclear explosions down to a few kiloton yields. With the help of high-frequency seismometers down to below one kiloton is to be detected and identified. See F.N. von Hippel, H.A. Feivlson & C.E. Paine, "A Low Threshold Nuclear Test Ban" (1987) 12:2 Int'l Security 135 at 137.

203. TTBT, art. II, para. 1.

204. Protocol to the Treaty Between the United States of America and the USSR on the Limitation of Underground Nuclear Weapon Tests, art. 1, paras. a and b.

205. A United States experiment using a cavity de-couping technique shows that a cavity 50 meters in radius could fully muffle a five-kiloton explosion. If a cavity were created in a stiffer medium, such as granite, de-coupling techniques are believed to muffle an explosion several times larger than the one used in the experiment. See e.g., Seismic Verification, supra, note 153 at 38-40.

206. Treaty Between the United States of America and the USSR on Underground Nuclear Explosions for Peaceful Purposes, 28 May 1976, [hereinafter the PNET].

207. PNET, art. III, para. 1(a).

208. Ibid. para. 2(a).

209. See e.g., R.W. Heim & D.R. Westvolt, "The New Test Ban Treaties: What Do They Mean? Where Do They Lead?" (1977) 1:3 Int'l Security 170 at 174-75; Halstead, supra, note 202 at 63.

210. Treaty Between the United States of America and the USSR on the Limitation of Strategic Offensive Arms, 18 June 1979, [hereinafter the SALT II Treaty].

211. Concerning the objectives of the SALT II Agreement, see e.g., P.H. Nitze, "The Strategic Balance Between Hope and Scepticism" (1974) 17 Foreign Policy 136 at 138.

212. SALT II Treaty, art. XIX, para. 1.

213. See e.g., M. Kurosawa, "On SALT Compliance" (in Japanese) (1990) 23:3 J.L. & Politics 1 at 30.

214. Ibid. at 30-31; regarding the SALT compliance, see e.g., R.J. Einborn, "Treaty Compliance" (1981) 45 Foreign Policy 29; C.S. Gray, "Moscow is Cheating" (1984) 56 Foreign Policy 141; M. Krepon, "Both Sides are Hedging" (1984) 56 Foreign Policy 153; G. Duffy, "Administration Redefines Soviet 'Violations'" (1986) 42:2 Bull. Ato. Scientists 13. As a comprehensive survey of SALT verification, see W.C. Potter, Verification and SALT: The Challenge of Strategic Deception (Boulder, Colorado: Weatview Press, 1980).

215. S.A. Cohen, "SALT Verification: The Evolution of Soviet Views and their Meaning for the Future" (1980) 24 Orbis 657 at 661-62.

216. Ibid.

217. S.N. Graybeal & M. Krepon, "The Limitation of On-Site Inspection" (1987) 43:10 Bull. Ato. Scientists 22 at 23.

218. L. Aspin, "The Verification of the SALT II Agreement" (1979) 240:2 Scientific American 38 at 40.

219. Treaty Between the United States of America and the USSR on the Elimination of their Intermediate-Range and Shorter-Range Missiles, 8 December 1987, 27 I.L.M. 84 (entered into force 1 June 1988) [hereinafter INF Treaty]. The Treaty of Berlin (among the USSR, East Germany, and Czechoslovakia) and the Brussels Treaty (among the USA, Belgium, Italy, the Netherlands and the U.K.) were signed on the same day, 11 December 1987, in order to eliminate intermediate-and shorter-range missiles in basing countries in Europe. Both treaties are cited in UNIDIR/88/19, Verification Problems of the Washington Treaty on the Elimination of Intermediate-Range and Shorter-Range Missiles (Research Paper No. 2) by S. Sur, UN Publication Sales No. G.V.E.88.0.7 at 47-54.

220. Negotiations started in November 1981, but it broke off in November 1983 when NATO began its intermediate range nuclear forces deployments. It was not until March 1985 that negotiations resumed. See e.g., C. Sekiba, The Superpowers on the Merry-Go-Round (Tokyo: Simul, 1988); T. Risse-Kappen, The Zero Option: INF, West Germany and Arms Control (Boulder, Colorado: Westview Press, 1988); Committee on Int'l Security and Arms Control, National Academy of Science, Reykjavik and Beyond: Deep Reductions in Strategic Nuclear Arsenals and the Future Direction of Arms Control (Washington, D.C.: National Academy Press, 1988); J. Dean, "The INF Negotiations" in World Armaments and Disarmament SIPRI Yearbook 1988 (Oxford: Oxford Univ. Press, 1988) 375.

221. INF Treaty, art. IV and V.

222. Ibid. art. VI.

223. INF Treaty, art. XI, para. 3. M. Mecham, "INF Signing Begins Three-Year Missile Destruction Plan" (6 June 1988) AWST 19; T.M. Foley, "UN, Soviet Missile Experts Begin INF Treaty Inspections" (11 July 1988) AWST 25; E.H.

Kolcum, "Soviet Inspectors to Assess Two Canaveral Pershing Sites" (11 July 1988) AWST 26.

224. INF Treaty, art. XI, para. 4.

225. Ibid. para. 5. M. Mecham, "Pact Would Allow Soviet Officials to Inspect US Missile Plants" (30 November 1987) AWST 16. Memorandum of Understanding states that the USSR would eliminate 826 deployed and non-deployed IRMs (470 are deployed)and 926 SRMs, and that the United States would eliminate 689 IRMs (429 deployed) and 179 SRMs. The Memorandum also refers to about 100 Soviet facilities and more than 30 facilities in the United States and on the territory of five European basing countries (Belgium, Italy, the Netherlands, West Germany and the United Kingdom). The Memorandum of Understanding is cited in Documents and Materials USSR-US Summit: Washington, December 7-10,1987 (Moscow: Novosti Press Agency, 1987) 137.

226. INF Treaty, art. XI, para. 6. Concerning the equipment to be used for Votkinsk portal monitoring inspection, see e.g., T.M. Foley, "Los Alamos, Sandia Labs Fuelling Growth in Verification Technology" (16 May 1988) AWST 47.

227. INF Treaty, art. XI, para. 7.

228. See e.g., "Memorandum Details Methods of Verifying Treaty Compliance" (14 December 1987) AWST 21; "Hercules Prepares for INF Verification Inspections" (14 December 1987) AWST 23.

229. See e.g., M. Krepon, "High Stakes in INF Verification" (1987) 43:5 Bull. Ato. Scientists 14 at 16; Graybeal & Krepon, supra, note 217 at 24-25; T.A. Connolly,"Does the Constitution Limit On-Site Inspection?" (1988) 18:5 Arms Control Today 8; S.R. Bowman et al., Assessing the INF Treaty (CRS Report 88-211F) (Washington, D.C.: GPO, 1988) at 49-53.

230. J. Mendelsohn, "INF Verification: A Guide for the Perplexed" (1987) 17:7 Arms Control Today 25 at 27-28.

231. M. Kurosawa, "Legal Structure of INF Treaty Part II" (in Japanese) (1989) 21:3 Hosei Riron (J.L. & Politics) 49 at 79.

232. See e.g., A.G. Haley, Space Law and Government, (New York: Appletion-Century-Crofts, 1963) at 62-67; see also, J. Morenoff, World Peace Through Space Law, (Charlottesville, Virginia: Michie, 1967) at 174-75.

233. Convention on International Civil Aviation, 7 December 1944, 15 U.N.T.S. 295, 61 Stat. [hereinafter Chicago Convention]. Article 8 of the Chicago Convention provides that unmanned aircraft should not be flown over the territory of a contracting state without its consent. Also, Article 30 of this Convention provides that the use of radio transmitting apparatus in the territorial air of each party shall be in accordance with the regulations prescribed by that state. Article 36 states that each contracting party can prohibit the use of photographic apparatus in aircraft over its territory.

234. Haley, supra, note 232 at 62; J.C. Cooper wrote:

> "he seemed to suggest that the areas of space above the atmosphere to be used by the satellite might be subject to some sovereign control of the subjacent states, but that failure of any state to object to the International Geophysical Year satellite program at the time of its announcement was all that was required in order to make the completion of the program possible."

See, I.A. Vlasic, ed., Explorations in Aerospace Law: Selected Essays by John Cobb Cooper 1946-1966, (Montreal: McGill Univ. Press, 1968) at 274.

235. M.S. McDougal, H.D. Lasswell & I.A. Vlasic, Law and Public Order in Space (New Haven: Yale Univ. Press, 1963) at 203.

236. D. Goedhuis, "The Question of Freedom of Innocent Passage of the Space Vehicle of One State Through the Space Above the Territory of Another State Which is not Outer Space" (1960) 2 Colloquium L. Outer Space 42 at 42-43; see also, D. Goedhuis, "Conflicts of Law and Divergencies in the Legal Regimes of Air Space and Outer Space" (1963) R.C.A.D.I., vol. 2 264 at 295-96.

237. "Aircraft" is defined in Annexes 6, 7 and 8 of the Chicago Convention as: "[a]ny machine which can derive support in the atmosphere from the reactions of the air." See also, S.M. Beresford, "Surveillance Aircraft and Satellites: A Problem of International Law" (1960) 27 J. Air L. & Com. 107 at 108.

238. Question of the Peaceful Uses of Outer Space, 13 December 1958, UN GAOR 13th Sess., Supp. No. 18, at 5-6, UN Doc. A/4090, Res. 1348 (1958) [also see D.J. Djonovich, ed., United Nations Resolutions, vol.7 (New York: Oceana, 1974) at 99-100]. International Co-Operation in the

Peaceful Uses of Outer Space, 12 December 1959, UN GAOR 14th Sess., Supp. No. 16, at 5-6, UN Doc. A/4354, Res. 1472 (1959), International Co-Operation in the Peaceful Uses of Outer Space, 20 December 1961, UN GAOR 16th Sess., Djonovich, ibid. vol. 8, at 238-39, Res. 1721 (1961), International Co-Operation in the Peaceful Uses of Outer Space, 14 December 1962, Djonovich, ibid. vol. 9, at 99-101, Res. 1802 (1962), Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, 13 December 1963, Djonovich, ibid. vol.9, at 205-06, Res. 1962 (1963).

239. B.A. Hurwitz, The Legality of Space Militarization, (North-Holland: Elsevier Science, 1986) at 83.

240. United States Arms Control and Disarmament Agency, Documents on Disarmament 1962 (Washington, D.C.: GPO, 1963) 871.

241. G.M. Steinberg, Satellite Reconnaissance: The Role of Informal Bargaining (New York: Praeger, 1983) 59-63.

242. Draft Treaty on Test Ban April 18, 1961. See C.W. Jenks, Space Law, (London: Stevens & Sons, 1965) at 51-52 & 307.

243. Jenks, ibid. The US announced that it had orbited nuclear detection satellites irrespective of the absence of the treaty provision. See Jenks, ibid. at 52.

244. Ibid. at 308.

245. Ibid. at 305.

246. Ibid.

247. H. Lauterpacht, ed., International Law: A Treatise by L. Oppenheim, 8th ed., vol. 1-Peace, at 859.

248. Ibid. at 862.

249. I. Delupis, "Foreign Warships and Immunity for Espionage" (1984) 78 A.J.I.L. 53 at 67.

250. I.A. Vlasic, "Principles Relating to Remote Sensing of the Earth from Space" in N. Jasentuliyana & R.S.K. Lee, eds., Manual on Space Law, vol. 1, 303 at 308.

251. G. Zhukov cited in G. Gal, "Some Legal Aspects of the Uses of Reconnaissance Satellites". Paper prepared for presentation at the 5th Congress of the International

Institute of Space Law (IISL) at 5 and published in (1963) 5 Colloquium L. Outer Space; similar views are developed in Cohen, supra, note 215 at 658 to 668; see also, G. Gal, Space Law (Leiden: Sijthoff, 1969) at 180.

252. M.S. Vazquez, Cosmic International Law (Detroit: Wayne State Univ. Press, 1965) at 170.

253. Joseph R. Soraghan, "Reconnaissance Satellites: Legal Characterization and Possible Utilization for Peacekeeping" (1967) 13 McGill L.J. 458 at 483.

254. For instance, Secretary of Defense McNamara confirmed the nonexistence of a "missile gap" based on the satellite photographs at an off-the-record meeting. Such photos were extensively used during the Cuban Missile Crisis as well, although President Kennedy showed the Soviets pictures taken by U-2 aircraft in order to keep the true capability of U.S. satellites secret.

CHAPTER V

AN INTERNATIONAL SATELLITE MONITORING AGENCY (ISMA): A MAJOR ATTEMPT AT INTERNATIONALIZATION OF VERIFICATION BY SATELLITE

A. INTRODUCTION

As outlined in previous Chapters, advances in space technology have achieved such a high level of precision that currently the two superpowers make extensive use of satellites for monitoring compliance with their bilateral arms control agreements. In contrast, the absence of such a means of surveillance appears to block the development of the disarmament process on the multilateral plane. This is evident by the many resolutions of the United Nations stressing how essential it is for disarmament agreements to be subject to vigorous and efficacious international monitoring. It is, therefore, not surprising that many arms control experts claim that reconnaissance satellites should be available multilaterally to advance disarmament efforts and strengthen international security.[1]

In this Chapter, the feasibility of establishing an international organization for the purpose of information gathering by satellites will be examined. This study is undertaken taking into account technical, legal, financial and political aspects of the concept.

Concerning the first aspect, since the technical feasibility of a space-based arms control monitoring system itself is well documented in Chapter III, this Chapter will restrict itself to the possible problems an international organization would face in acquiring needed technical facilities. To date, the French proposal of 1978 calling for an International Satellite Monitoring Agency (ISMA) is the only formal proposal for an international organization submitted to and extensively discussed at the United Nations. Arms control experts have presented various ideas regarding such organizations since World War II. Therefore, first, major proposals for a satellite agency both governmental and non-governmental will be addressed briefly in order to understand the evaluation of the concept of satellite monitoring systems. This Chapter will then consider the technical, legal, financial and political implications of an ISMA proposal based on the evolution report prepared by a United Nations Group of Experts. Arms control experts who have examined the Experts' report, approaching the issue from the different political perspectives, have disagreed on the feasibility of an ISMA. Therefore, in conclusion, a tentative evaluation of an ISMA will be made taking note of its political implications.

B. VARIOUS CONCEPTS ADVANCED BEFORE THE ISMA PROPOSAL OF 1978

Colonel R.S. Leghorn, an American Air Force reconnaissance specialist, proposed a satellite reconnaissance agency under the aegis of the United Nations as early as 1955.[2] President Eisenhower's "open skies" proposal and the reply by Soviet Premier Bulganin made Leghorn think that it was impractical to provide continuous surveillance of the Soviet Union by aircraft and that satellite monitoring would be much more effective for that purpose.[3] Although artificial satellites were still only in the planning stage at that time, Leghorn was well-informed enough as a DoD officer as to the possibility of a satellite monitoring system.[4]

In 1958, less than a year after Sputnik I, Senator Hubert H. Humphrey, during a Senate debate, proposed a satellite surveillance system under the auspices of the United Nations.[5] He repeated the same proposal in 1971 on the Senate floor in his remarks urging an ABM freeze.[6]

The first official proposal containing reference to satellite reconnaissance was made in 1958. Responding to President Eisenhower's "Open Skies" proposal, Soviet Premier Nikolai Bulganin stated that the Soviet Union would consider aerial inspections within a prescribed distance in either direction from the demarcation line between the NATO and Warsaw Pact forces in Europe. President Eisenhower in turn suggested technical talks be held on partial disarmament measures, including prevention of surprise attack.[7] The conference on technical talks was held in the summer of 1958 in Geneva during which an International Disarmament Organization (IDO) was proposed.[8] The IDO, under U.N. control, would monitor surprise attack through the use of reconnaissance satellites which would be placed into orbit at an altitude of two hundred kilometers and which would have five meter resolution.[9]

Although an IDO proposal failed to come to fruition, reflecting the strong tensions of the cold war era, the concept of an international monitoring system by satellite was resurrected at the "Open Space and Peace Symposium" held by the Hoover Institution in 1963, where several types of satellite monitoring systems under U.N. control were proposed.[10] Various proposals (too numerous to discuss in detail in the context of the present study) based on basically the same idea were published during the two decades before the ISMA proposal and thereafter by scientists, legal experts, politicians and international non-governmental organizations such as the Pugwash Movement.[11]

An American legal commentator, J.R. Soraghan, described three types of possible monitoring systems: (1) the complete transfer of a unilateral space reconnaissance system to an international organization; (2) concurrent use of unilateral and multilateral space reconnaissance systems; and (3) unilateral space reconnaissance systems solely, under which nations retain full control of satellite systems but disseminate the information gained to the international community.[12] Soraghan concluded after the examination that the second proposal, the concurrent use of satellite monitoring by individual countries and an international organization, as more realistic than the other two concepts.[13]

In the same year, J. Morenoff, another American publicist, proposed a United Nations Reconnaissance Agency (UNRA) in his book *World Peace Through Space Law*.[14] The UNRA would not only monitor arms control agreements and international crises by satellites, but would also act as a judiciary organ. He expected that the activities of a UNRA would lead to the elimination of a unilateral surveillance program.[15]

Swedish disarmament expert and 1982 Nobel Peace Prize laureate Alva Myrdal proposed in 1974 the International Disarmament Control Organization (IDCO) within the United Nations in her article "The International Control of Disarmament".[16] She advocated staged development of the IDCO. First, before the Organization was to be established, each nation would have to endeavour to publish all the arms control and disarmament information obtained from national means of detection and verification concerning both itself and other states.[17] Next, the IDCO would be set up to play a modest role as an "intermediary" or a "clearinghouse"[18], meaning that the IDCO would only receive and disseminate information but would not collect it itself.[19] Later, in the third stage, when any suspicion would arise about a specific nation's arms control treaty compliance, a "verification-by-challenge" procedure would be conducted among the constituents of the Treaty through the good offices of the IDCO. If verification-by-challenge would not lead to a satisfactory result, expert groups from the IDCO would engage in field investigations; but, Myrdal underlined that not the IDCO, but the U.N. Security Council should act as a judiciary organ.[20] She strongly maintained that "the separation of the investigative and jurisdictional functions, referring them to different organs, must be made clear and explicit".[21]

Alva Myrdal also proposed an International Verification Agency (IVA), the scope of functions of which would be almost the same as that of the IDCO, in her book, *The Game of Disarmament*.[22] Myrdal insisted that an IVA should have the character not of being independent as a specialized agency of the United Nations, but rather of being dependent as are the central organs of the United Nations. She recommended, therefore, that an IVA have semi-independent status such as that of the U.N. Environmental Program (UNEP).[23] Taking note of the statement made by the U.S. representative at a U.N. Working Group on Remote Sensing of the Earth by satellites in which the United States promised to provide other nations with the data the United States received from its remote sensing satellites, she envisaged the possibility of utilizing national satellite surveillance systems for collecting information for the IVA.[24] She firmly believed that:

> International access to data from satellite monitoring will come to be an absolute necessity for a truly serious work of verification of disarmament agreements, and also a valuable early warning on changes in the world's armament picture and the deployment of military forces.[25]

Around the time of Myrdal's study, in 1975, three experts,[26] A. Chayes, W. Epstein and T. Taylor proposed an international satellite monitoring agency at the twenty-fifth Pugwash Conference in Tokyo.[27] The details of their proposal were presented at the twenty-sixth Pugwash Conference on Science and World Affairs. They proposed a "consortium of about a dozen non-nuclear weapon states, with representation from all geographical areas and social systems".[28] Possible candidates for that satellite consortium included Canada, West Germany, Japan, Sweden, Yugoslavia, Poland, Mexico, Venezuela, Nigeria, Tanzania and Singapore.[29] Such a satellite consortium would transmit the information acquired to the United Nations and through the United Nations all countries would be able to receive information on an unrestricted basis in a processed and analyzed form.[30] According to their idea, the two superpowers were supposed to launch reconnaissance satellites on behalf of the consortium until the planned consortium procured its own launch capability.[31] Pugwash conferences have also discussed and analyzed the U.N. ISMA proposal; and their evaluation of the ISMA is discussed later in this Chapter.

C. THE INTERNATIONAL SATELLITE MONITORING AGENCY

1. Background of the ISMA Proposal

The study of an International Satellite Monitoring Agency was conducted in accordance with the following schedule of events. At the first Special Session of the General Assembly devoted to Disarmament (SSOD I), held in May and June 1978, French President Giscard d'Estaing in his address proposed the setting up of an International Satellite Monitoring Agency (ISMA).[32] Later, on May 30, the French delegation submitted a note verbale (A/S-10/AC.1/7)[33] to which a memorandum regarding an ISMA was attached. That memorandum described the French proposal as follows.[34] The Agency should be established as a specialized agency of the U.N. and be responsible for collecting, processing and disseminating information acquired by satellites. Staged development was envisioned for an ISMA: in the first stage, the Agency would rely on data collected by the satellites of those states possessing them and in the later stage, the ISMA would acquire its own satellites. Two major functions for the ISMA were envisaged: (1) participation in monitoring the implementation of international arms control and disarmament agreements; and (2) investigation of specific crisis situations, a responsibility that could be shared with the Security Council. Disputes arising between states or between states and the Agency would be subject to arbitration unless settled by other peaceful means. At the end of the Session, Paragraph 125(d) of the Final Document of the SSOD I (Res. A/S-10/2), referring to an ISMA proposal was adopted.[35]

During the Thirty-third Regular Session, France introduced a draft resolution in the First Committee, on November 21, 1978, requesting the Secretary-General to obtain the views of member states on A/S-10/AC.1/7 (the French Memorandum) and to undertake a preliminary study of the technical, legal and financial implications of establishing an ISMA.[36] That draft resolution was adopted with the record of one hundred and seven in favor, none against and eighteen abstentions (including the United States and the USSR).[37] On December 14, 1978, at the plenary General Assembly session, Resolution A/33/71J was adopted which restated the French draft resolution with one hundred and twenty-one states in favor, none against, and eighteen abstentions (including the United States and the USSR).[38] Resolution A/33/71J requested the Secretary-General to obtain the views of member states on the French proposal and to conduct a study on the technical, legal and financial implications of an ISMA with the assistance of a Group of Experts who were to be appointed by the Secretary-General.

The Group of Experts' preliminary conclusion was submitted to the Thirty-Fourth Session of the General Assembly on October 18, 1979 (A/34/540).[39] The conclusion of the preliminary study on technical implications was that civilian remote sensing satellites could substitute for existing area-surveillance missions by the superpowers whereas close-look missions, which would be especially important for monitoring crisis situations, could not be accomplished by civilian satellites.[40] Nevertheless, the Group of Experts concluded that remote sensing satellites were generally useful for monitoring existing arms control agreements.[41] Concerning the legal implications of the concept of an ISMA, more detailed study was required especially as to the nature of the ISMA and legal principles relating to acquisition and dissemination of data. These issues had been the subject of discussion in the context of remote sensing at the U.N. COPUOS since 1972.[42]

The views of thirty-eight member states on the ISMA proposal already had been submitted to the General Assembly on August 27, 1979.[43] Basically, all nations other than Cuba and the United States favoured the idea of an ISMA (the USSR was silent) although the expressed difficulties to be surmounted were different. Many of the thirty-eight countries such as Argentina, Bolivia, Denmark, the Dominican Republic, Greece, India, Kenya, Mauritius, Pakistan, Qatar, Turkey, Uruguay and Venezuela simply supported such an agency without any particular reservations, while several nations, although supportive of the general idea of an ISMA, expressed concern about potential problems. Such countries included Belgium, Canada, Egypt, Finland, Japan, Peru, Spain and the United Kingdom. Canada was concerned about the organizational structure and costs of the proposed ISMA,[44] whereas Japan emphasized the difficulty of establishing an agency against the will of the United States and the USSR.[45] The United Kingdom showed concern about the high operating cost and access by member states to acquired data by satellites.[46] By contrast, Cuba was adamantly opposed to the ISMA because it regarded such monitoring system as constituting an interference in its internal affairs.[47] The United States disapproved of an ISMA for the following reasons: (1) the establishment of decision-making procedures in the Agency would be extremely difficult due to the nature of state sovereignty;[48] (2) disputes over judgments about compliance with disarmament agreements could erode public confidence concerning their verifiability and that, in turn, could adversely affect the arms control process;[49] (3) it would be too difficult to agree on a reasonable degree of control and restrictions on access to monitoring data;[50] (4) the ISMA would face serious technical problems due to the fact that the interpretation of acquired data would be very complex task, requiring experience with a variety of types of information from many different sources, which the ISMA would have to process;[51] (5) the overall cost of the Agency would be prohibitively expensive, possibly equal to the entire U.N. budget at the time;[52] and (6) it would be unrealistic to expect space powers to provide such an Agency with raw data that would be critical to their own arms control verification.[53]

On December 11, 1979, the General Assembly adopted Resolution A/34/83E entitled "Monitoring of Disarmament Agreements and Strengthening of International Security" by one hundred and twenty-four votes in favor to none against and eleven abstentions (including the United States and the USSR).[54] The Resolution requested that an in-depth study by the Group of Experts be conducted and that the report be submitted in time for the U.N. Second Special Session devoted to disarmament to be held in 1982.

The Group of Experts submitted to the Preparatory Committee for the SSOD II on August 6, 1981 their study on "The Implications of Establishing an International Satellite Monitoring Agency" (ISMA Report).[55] The ISMA Report constitutes one of the finest reports on the question of verification of disarmament agreements ever produced at the U.N. and its contents are still worthy of careful analysis eleven years after the Report first appeared.

2. The Contents of the ISMA Report

(a) Technical Implications of an ISMA

What are the technical requirements to adequately perform the two kinds of ISMA tasks, namely: (1) monitoring of compliance with arms control agreements; and (2) monitoring of international crisis situations? As indicated in Chapter IV, monitoring by satellite is generally technologically feasible to verify the compliance by the parties to present arms control and disarmament agreements. The documents examined in Chapter IV are listed below together with their suitability for satellite monitoring:

Multilateral arms control and disarmament agreements:

(1) The Geneva Protocol of 1925: technical feasibility is doubtful;

(2) The Antarctic Treaty: technically feasible;

(3) The Partial Test Ban Treaty: technically feasible;

(4) The Outer Space Treaty: uncertain, but could be feasible in the foreseeable future;

(5) Treaty of Tlatelolco: technically feasible;

(6) The Non-Proliferation Treaty: technically feasible;

(7) The Seabed Treaty: currently almost impossible;

(8) The Biological Weapons Convention: satellite monitoring useful only as supplementary to other more effective means;

(9) The ENMOD Convention: technically almost impossible;

(10) The Moon Agreement: currently almost impossible;

(11) Certain Conventional Weapons Convention: impossible;

(12) Treaty of Rarotonga: technically feasible;

(13) The Conventional Forces in Europe Treaty: technically feasible;

(14) The Comprehensive Test Ban Treaty (draft): feasible;

(15) The Chemical Weapons Convention (draft): feasible as a supplementary means;

Bilateral Agreements between the USA and the USSR:

(1) The ABM Treaty: feasible;

(2) The SALT I Interim Agreement: feasible;

(3) The Threshold Test Ban Treaty: feasible;

(4) The Peaceful Nuclear Explosion Treaty: feasible;

(5) The SALT II: feasible;

(6) The Intermediate-Range Nuclear Forces Treaty: feasible.

In sum, there are a considerable number of agreements wherein satellite monitoring of compliance is technically feasible. In addition, as discussed in Chapter III, the capabilities of civilian remote sensing satellites are rapidly catching up to that of military satellites. This development contributes to confidence in a future ISMA.

Monitoring of international crises, however, is more challenging than monitoring of compliance with arms control agreements because such monitoring depends on close-look satellite imagery with a resolution of one meter or less and requires rapid processing and analysis of data.[56] Nevertheless, considerable progress in the development of civilian satellites capable of meeting these mission requirements is expected. Moreover, an ISMA can also be expected to make available necessary data derived from the military satellites of member states.[57] Thus, the Group of Experts has concluded:

> From a technical point of view observations from satellites for the purpose of information gathering related to verification of compliance with treaties and for crisis monitoring is both possible and feasible. The technical facilities for an International Satellite Monitoring Agency (ISMA), including the satellites necessary to carry out the needed missions, could be acquired in stages; for instance, Phase I could comprise only an image processing and interpretation centre, Phase II could comprise data-receiving stations that could receive appropriate data from observation satellites of various States and in Phase III where the Agency could have its own space segment comprising a number of satellites.[58]

(b) Legal Implication of an ISMA

(i) The legality of establishing an ISMA

Since activities of an ISMA could extend to both the earth and outer space, they would be governed by international law including the Charter of the United Nations and international space law.[59] As already stated in the previous section on the background of an ISMA proposal, the purpose of an ISMA is to advance disarmament efforts and to strengthen international security. Hence, establishing an ISMA is fully consistent with the U.N. Charter, particularly with Article 1 thereof under which member states undertake to "take effective collective measures for the prevention and removal of threats to the peace".[60] Also, as considered in Section C of Chapter IV, basic principles of international space law, such as the freedom of exploration and non-appropriation of space by any state, acquired the status of customary international law in the early 1960s through U.N. resolutions, which were incorporated in the fundamental treaty of international space law, the Outer Space Treaty of 1967.

Article VI of the Outer Space Treaty contemplates space activities carried out by an international organization: "[w]hen activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization." In addition, several provisions of subsequently concluded space treaties explicitly or implicitly provide for the participation of international organizations in space activities, including Article 6 of the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (The Rescue Agreement of 1968),[61] Article XXII of the Convention on International Liability for Damage Caused by Space Objects (the Liability Convention of 1972),[62] Article VII of the Convention on Registration of Objects Launched into Outer

Space (the Registration Convention of 1975) [63] and Article XVI of the Moon Agreement (1979).

The legality of orbiting satellites, even military reconnaissance satellites, was settled by the end of the 1960s, at the latest. As the satellite technology for remote sensing of the earth's surface advanced, however, the issue of legality was resurrected. As Professor Vlasic rightly has pointed out, the main point "soon became apparent that the principal concern of states in relation to remote sensing was not so much the lawfulness of the observation activity conducted from space, which few contested, as the question of the disposition of data gathered by remote sensing satellites".[64] Although an analysis of the Outer Space Treaty reveals few clear provisions that could be interpreted as restricting either the freedom of sensing of earth's environment or the freedom of dissemination of data acquired, the differences in interpretation of the text of the Outer Space Treaty persisted.[65]

The lengthy negotiations relating to the creation of a legal regime to govern remote sensing commenced with the adoption of U.N. General Assembly Resolution 2600 (XXIV) in 1969 and ended with the unanimous approval, by the U.N. General Assembly without a formal vote, of the fifteen Principles on Remote Sensing in 1986.[66] These Principles[67] reflecting the enormous practical progress of remote sensing technologies and the growing awareness of the benefits to be derived from civilian remote sensing activities, served to thwart the considerably restrictive proposals supported mostly by developing countries. Despite overcoming such efforts, these Principles have not crystallized into a formal agreement. However, in view of accumulated practices during the U.N. negotiations, most of the Principles can be regarded as having already acquired the status of customary international law. The provisions of these remote sensing Principles relevant to the activities of a future ISMA, therefore, merit consideration.

Remote sensing is narrowly defined in the Principles as "the sensing of the Earth's surface from space by making use of the properties of electromagnetic waves emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural resources management, land use and the protection of the environment" (Principle I). This definition makes no reference either to monitoring compliance with arms control agreements or monitoring international crises, reflecting the jurisdiction of COPUOS which does not include arms control and disarmament issues.[68] During the course of negotiations of the Principles, remote sensing was more widely defined as "observation of a target by means of a device known as a sensor which is separated from a target by a given distance" (U.N. Doc. A/AC.105/312, 1983), a definition broad enough to include ISMA activities.

Since the Remote Sensing Principles are the only existing concrete international rules governing the rights and the duties of sensing states and sensed states and which take into account the difference between "primary data", "processed data" and "analyzed information", they must be carefully considered in establishing the legal regime to govern a future ISMA.

Principle I provides:

> (b) The term "primary data" means those raw data that are acquired by remote sensors borne by a space object and that are transmitted or delivered to the ground from space by telemetry in the form of electromagnetic signals, by photographic film, magnetic tape or any other means;
>
> (c) The term "processed data" means the products resulting from the processing of the primary data, needed in order to make such data usable;
>
> (d) The term "analyzed information" means information resulting from the interpretation of processed data, inputs of data and knowledge from other sources.

How to control acquired data and analyzed information would be one of the most difficult questions to be addressed by a future ISMA. Having as a reference the definitions of primary data, processed data and analyzed information will facilitate the formulation of a regime for the dissemination of information. With regard to access to primary and processed data as well as information about sensed states, Principle XII provides that following the production of such data, the sensed state is accorded rights of access on a non-discriminatory basis and at reasonable cost. The sensed state also is to have access to available analyzed information on the same basis. Therefore, although Principle XIII stipulates consultation with sensed states in certain situations and Principles II, IX, XII and XIII affirm the special needs and interests of developing countries, it seems safe to conclude that the legality of remote sensing activities and the rather liberal regime of dissemination of data and information acquired are accepted as in accord with international law.

During the negotiations, in 1985, Cuba questioned whether the Principles should include a provision prohibiting the use of remote sensing for military purposes. However, this suggestion did not attract enough support to be incorporated in the Principles.[69] It follows that, at a minimum, remote sensing activities serving military purposes are not explicitly prohibited. Alternatively, it can be argued that, based on the definition of remote sensing, military activities do not fall within the remote sensing regime contemplated by the 1986 Principles and would not be governed thereby. In either case, there appears to be no reason why an ISMA's monitoring activities should be impeded by the 1986 remote sensing Principles.

An ISMA can be established under existing international space law.[70] This was also the unambiguous conclusion of the Group of Experts, summed up in the ISMA Report:

> there are no provisions in general international law, including space law, that would entail a prohibition for an international governmental organization such as ISMA to carry out monitoring activities by satellite.[71]

(ii) The Legality of Monitoring Compliance with Arms Control and Disarmament Agreements by an ISMA

Could an ISMA legally monitor multilateral and bilateral arms control and disarmament agreements? In other words, does each such agreement allow an international agency to be involved with monitoring activities? Suggested answers based on the study in Chapter IV and the ISMA Report, concerning the legality of employing an ISMA for monitoring relevant arms control agreements, follow.

Multilateral arms control and disarmament agreements:

(1) Geneva Protocol of 1925

As there are no provisions concerning verification, logically, such agreement could probably be monitored by national technical means. To the extent that it is technically useful, individual contracting states could have recourse to an ISMA as if it were their national technical means provided that the constitutive act of the ISMA so stipulates.[72]

(2) The Antarctic Treaty

Since only consultative parties have a right of inspection, without amending this Treaty, the participation of an ISMA in providing monitoring services would be difficult to legally justify. The Antarctic Treaty can, however, be amended only "by unanimous agreement" of the consultative parties (Article XII, paragraph 1). The ISMA Report, therefore, in order not to considerably delay or even prevent the implementing of an ISMA, suggested another approach; that satellite verification may be considered as a national technical means by any consultative party.[73] If this approach is adopted, by explicitly stipulating in the constitutive act of an ISMA the right of any member state to have recourse to the ISMA as if it were its own national technical means of verification, the thorny amendment obstacle could be surmounted.[74]

(3) <u>Partial Test Ban Treaty</u>

The Partial Test Ban Treaty contains no verification provisions. However, a view of the negotiating process of this Treaty supports the conclusion that using satellite monitoring as a national technical means was implicitly recognized. Taking note of the fact that most of the state parties to this Treaty lack the technological capabilities to employ their own national technical means, the ISMA Report maintains that each party ought to be allowed to have recourse to the Agency as its national technical means.[75] In such a case, the ISMA's constitutive act has to enable its members to resort to the ISMA as their national technical means.

(4) The Outer Space Treaty

An ISMA may be used as a national technical means by its members for on-site inspections as provided in Article XII.

(5) Treaty of Tlatelolco

The IAEA and OPANAL deal with verifying compliance with the Treaty of Tlatelolco. As Article 19, paragraph 2, empowers OPANAL to "enter into relations with any international organization or body, especially any which may be established in the future to supervise disarmament or measures for the control of armaments in any part of the world", an ISMA could be authorized to monitor compliance with this Treaty if the General Conference of OPANAL, consisting of all the contracting parties, so decides.[76] It is not clear as to whether the provisions of this Treaty permit each contracting party to take recourse to an ISMA as if it were its own national technical means. The ISMA Report concluded by observing that the ISMA's activities would possibly have to be limited to the territory of states that have concluded bilateral agreements with the ISMA.[77]

(6) The Non-Proliferation Treaty

Article III of the Non-Proliferation Treaty prescribes an international safeguard system in which the IAEA is assigned the central role. Since the IAEA is the only body authorized to carry out verification measures, the following conditions would be necessary to enable the participation by an ISMA in the verification process: (1) the ISMA would have to provide *ad hoc* information on unreported facilities through informal channels (American and Soviet reconnaissance satellites already provide the IAEA with such information). A formal legal tie would be required, otherwise the ISMA's participation would be very limited; (2) the IAEA would need to enter into a special arrangement with the ISMA, by which the ISMA would be the legally recommended body providing verification services. Article XVI(A) of the Statute of the International Atomic Energy Agency allows the IAEA to conclude agreements with international organizations the functions of which are relevant to those of the IAEA. Since such agreements could be concluded by majority vote of the nations attending the General Conference (Article V(C) of the IAEA Statute), entering into an agreement with the ISMA would not be difficult; (3) the amendment of the NPT to enable the ISMA to fully participate in the verification process. Article VIII of the NPT requires a majority of votes of all the parties to the Treaty, including all of the nuclear weapon-states party and all other parties that are members of the Board of Governors of the IAEA. An easier course of action would be for the IAEA to enter into an agreement with the ISMA; (4) Article II of the NPT seems implicitly to authorize each contracting party to employ its own national technical means to ensure that non-nuclear states fulfil their Treaty obligations.

Thus, to the extent that the ISMA's constitutive act allows the Agency to be used as a national technical means of its members, any non-nuclear-state party to the NPT may have recourse to the ISMA. To sum up, it is quite possible for an ISMA to be of service in the IAEA verification process either through the IAEA entering into an agreement with the ISMA or by an amendment of the NPT permitting such service.

(7) The Seabed Treaty

From a legal point of view, an ISMA is most suitable in the verification process of the Seabed Treaty because Article III, paragraph 5, provides that "[v]erification pursuant to this article may be undertaken by any State Party using its own means, or with the full or partial assistance of any other State Party, or through appropriate international procedures within the framework of the United Nations and in accordance with its Chapter".[78] Nevertheless, as the Group of Experts has concluded, verifiability of Seabed Treaty violations by satellite would be difficult.[79]

(8) Biological Weapons Convention

The Biological Weapons Convention contains no verification provisions. As mentioned in Chapter IV, satellite monitoring of compliance either by individual states or by the U.N. Security Council would be quite lawful based on Article V (referring to consultation and cooperation of states parties) and Article VI (the right of the Security Council to initiate investigations on the basis of a complaint lodged by any state party). Hence, an ISMA would fully participate in the verification process of this Convention without the need for any amendment thereto. However, satellite monitoring would remain only supplementary to other means of verification due to current technological limitations.

(9) ENMOD Convention

There are no provisions in the ENMOD Convention concerning verification. Instead, Article V offers problem solving measures that are similar to those provided in the Biological Weapons Convention, that is, mutual consultation and the lodging of complaints with the Security Council. Consultation and cooperation may be undertaken "through appropriate international procedures within the framework of the United Nations and in accordance with its Charter. These international procedures may include the services of appropriate international organizations, as well as of a Consultative Committee of Experts" (Article V, paragraph 1). Also, the U.N. Security Council may initiate an investigation based on the complaint by any state party. Therefore, the Security Council, the Consultative Committee of Experts as well as any state party may request the assistance of an ISMA. However, there is considerable doubt as to the current technological capability of satellites to detect man-induced hostile environmental changes.

(10) The Moon Agreement

Article 15 of the Moon Agreement provides that each party may conduct inspections of another party's installations, stations and facilities "on its behalf or with the full or partial assistance of any other State Party or through appropriate international procedures within the framework of the United Nations". Since, an ISMA can reasonably be considered to be an "appropriate international procedure", there would be no need for an amendment of the Moon Agreement to accommodate the use of an ISMA.[80]

(11) Conventional Weapons Convention

Since satellite monitoring of compliance with the Conventional Weapons Convention does not seem possible, little will be gained by a legal analysis of the role of an ISMA.

(12) Treaty of Rarotonga

Under the terms of the Treaty of Rarotonga, each party has the right of conducting national technical means of verification to support any complaint lodged with the Director of the South Pacific Bureau for Economic Co-operation as a basis of requesting consultation with the Director. Although not explicitly provided for, in keeping with the spirit of the Treaty, each state as well as the Consultative Committee could seek the assistance of an ISMA to monitor compliance with the Treaty. The amendment of the Treaty would probably not be required. As regards the IAEA's use of the ISMA, it would be necessary either that the IAEA enter into an agreement with the ISMA or that Annex 2 of this Treaty be amended permitting the IAEA to use the ISMA.

(13) The CFE Treaty

Other than on-site inspections, aerial inspections are regarded as being very important to the CFE Treaty verification regime. Insufficient time for negotiation prevented the inclusion of provisions specifying the means of effecting the verification process and it was decided that the issue would be pursued in follow-on negotiations in time for implementation.[81] Undoubtedly, NATO will rely to a great extent on information obtained from reconnaissance satellites. There appears to be no reason why any member state of this Treaty could not designate an ISMA as one of the instruments of verification if the ISMA's constitutive act provides that it could be used as a national technical means by any member.

(14) The Comprehensive Test Ban Treaty (draft)

The lack of confirmed texts of drafts makes the evaluation of the permissibility of an ISMA to monitor compliance with the terms of the Comprehensive Test Ban Treaty difficult. Nevertheless, as is the case with the Threshold Test Ban Treaty, an ISMA may function as the national or international instrument of verification of the Comprehensive Test Ban Treaty.

(15) The Chemical Weapons Treaty (draft)[82]

The almost completed draft of this Convention provides for the establishment of the "Organization for the Prohibition of Chemical Weapons" for the purpose of ensuring the implementation of the Convention and providing for international verification of compliance with its provisions. Although the proposal for an explicit provision on national technical means has been dropped, NTM may still constitute a limited means to double-check the information on compliance collected by the Organization. NTM could also play an important role in "triggering" requests for challenge inspection. NTM and international verification may, therefore, complement each other. Even in the absence of a specific reference to NTM in the Convention, there is no reason to doubt that these means could be used by the parties if they were employed in accordance with international law. Satellites as national technical means of verification could supplement on-site inspections pursuant to the terms of the Convention.

Although the draft Convention does not explicitly provide for NTM, each party may call on an ISMA as its national technical means of monitoring activities, assuming the constitutive act of the ISMA so provides.

(16) Other future multilateral disarmament agreements are currently envisaged, such as the proposals for the setting up of nuclear weapon-free zones in Africa (U.N.G.A. Resolution 1603A) and South Asia (U.N.G.A. Resolution 2832), in efforts to control the use of radiological weapons,[83] and in topics currently being examined by the U.N. Disarmament Committee for "effective international arrangements to assure non-nuclear-weapon States against the use or threat of use of nuclear weapons".[84] If these proposals and discussions crystallize

into agreements in the future, an ISMA could provide an effective means of monitoring state compliance with such agreements.

Bilateral arms control and disarmament agreements:

To date, both nuclear superpowers have been reluctant to allow an international organization to interfere in their verification process and have preferred to rely on their own sophisticated national technical means. Due to recent fundamental changes in the relations between former hostile military blocs, this attitude may well change. Taking note of the fact that the best customer of Earth Observation Corporation (EOSAT), the company in the U.S. established to assume commercial operation of certain LANDSAT satellites, is the American intelligence community, it is likely that both the United States and the USSR would use an ISMA's monitoring capabilities once it is established.

(iii) The Legality of Monitoring International Crises by an ISMA

The legal regime required for crisis monitoring by satellites is no different than that needed for monitoring compliance with arms control agreements.[85] The legality of both activities is based on the legality of earth observation and the applicability of present international space law to the establishment of an ISMA. One probable difference, however, is that states might show much greater resistance to crisis monitoring than the monitoring of arms control agreements.[86] The type of crisis monitoring by satellites envisaged would include: verification of compliance with cease-fire agreements; surveillance of demilitarized zones; provision of evidence of border violations or preparations for aggression; and any other mission that member states or the United Nations might assign to the ISMA.[87]

Since Article 34 of the U.N. Charter empowers the Security Council to "investigate any dispute, or any situation which might lead to international friction or give rise to a dispute, in order to determine whether the continuance of the dispute or situation is likely to endanger the maintenance of international peace and security", the Security Council may request the ISMA to monitor crisis situations.[88] The General Assembly also has the power of investigation based on Articles 10 and 11(2) of the U.N. Charter, for example, as well as its established practices. It would be a clear advantage to the United Nations to have access to state-of-the-art monitoring technology to conduct its peace-keeping missions. An ISMA could be a very significant instrument for the United Nations in its mission to maintain peace.

(iv) The Constitutive Act of an ISMA

The four different possible relationships between an ISMA and the United Nations are envisaged by the ISMA Report: (i) a specialized or other related agency of the U.N.; (ii) a subsidiary organ of the General Assembly based on Article 22 of the U.N. Charter; (iii) a subsidiary organ of the Security Council based on Article 29 of the U.N. Charter; and (iv) an independent organization without any formal links to the U.N.[89]

With respect to the first alternative, a specialized or other related agency of the U.N., the Group of Experts concluded that a specialized agency would not be a desirable form for an ISMA because the functions of the ISMA are contemplated to exceed the scope of the U.N. Economic and Social Council (ECOSOC).[90] By way of example, although the IAEA is not formally a specialized agency of the U.N., its relationship agreement was concluded not with the ECOSOC but with the General Assembly to which it reports. The IAEA is, therefore, treated substantially as if it were a specialized agency.[91] Since the functions of the IAEA are closely related to international security matters, the Security Council does, however, have some power over the IAEA. While it did not expressly state so, the Group of Experts seemed to prefer an IAEA-type of arrangement for a future ISMA owing to the similarity of functions between the IAEA and the ISMA.[92]

An ISMA, as a subsidiary organ of the General Assembly, in contrast, has two potential disadvantages: one is that, usually, subsidiary organs of the General Assembly are set up based on U.N. General Assembly resolutions. This means that the constitutive instrument of an ISMA probably would be a G.A. resolution.[93] An arrangement such as this would be inconvenient for an ISMA when it is considered that all the major existing international organizations have come into being by means of a convention or treaty. The Group of Experts was of the opinion that "with a highly sensitive mission, affecting the security interests of States, its establishment through any less formal legal instrument would be inappropriate."[94] They concluded that, as a major international organization, the ISMA should be established through a convention with more than one annex in which detailed provisions concerning organizational, financial and personnel matters would be delineated.[95]

The second disadvantage is that if an ISMA were to be a subsidiary of the General Assembly, the allocation of power between the ISMA and the Security Council might be problematic in view of the uncertainty present in the text of the U.N. Charter regarding the relative responsibilities over security matters between the General Assembly and the Security Council.[96] As a subsidiary of the Security Council, constituted by Security Council resolution, the ISMA's authority would, possibly be adversely affected by the threat of a Security Council veto.[97] The Group of Experts gave no support to the last alternative - the establishment of an ISMA as a wholly independent organization.

In order to enable an ISMA to participate in the verification process of arms control and disarmament agreements, the ISMA's constitutive act must explicitly stipulate the circumstances in which the Agency would be able to monitor compliance with agreements and monitor specific situations. Based on the examination in this Chapter of an ISMA's possible involvement in the monitoring of various multilateral arms control agreements, such involvement should be detailed in the future convention. Several specific circumstances of an ISMA's involvement are set forth as follows: (i) upon request by an international organization which has the right of verification. Examples would be OPANAL in the Treaty of the Tlatelolco and the IAEA in the NPT and the Treaty of Rarotonga;[98] (ii) upon request by a principal organ of the United Nations, such as the Security Council and the General Assembly (the Biological Convention and the ENMOD Convention are examples for this case);[99] (iii) upon request by a member state of the ISMA over its territory. Such request would most likely arise in the case of an international crisis to demonstrate the state's innocence of an alleged violation of an arms control agreement to which it is a party (the NPT and the Treaty of Tlatelolco could serve as examples); (iv) upon request by a member of the ISMA to monitor the territory of another state or other states (the ISMA would be used in this case as if it were the national technical means for the member state). From the preceding analysis, the Geneva Protocol of

1925, the Antarctic Treaty (by a consultative party), the PTBT, the Seabed Treaty, the Biological Convention, the ENMOD Convention and the Treaty of Rarotonga would permit such employment of the Agency. In general, if the text of a certain convention is ambiguous as to how national technical means of verification by state parties can be accomplished, the use of an ISMA for such purposes should be carefully considered. If both requesting and monitored parties are ISMA member states and they have already given the ISMA comprehensive consent to be monitored, there would be no problem in the involvement by the ISMA. In the event both states are parties to the ISMA but have not granted the ISMA the general mandate to monitor their own territories, a special agreement between the ISMA and the state would be required.[100] If a country to be monitored is not a party to the ISMA, it goes without saying that a specific agreement between that country and the ISMA would be a *sine qua non* for monitoring. The legal basis for monitoring crisis situations could derive either from a general grant provided for in its constitutive act where all parties to a dispute are members of the ISMA, or in the absence of such a grant, from a special agreement with the states involved in a dispute. It is desirable, accordingly, to draft a constitutive act of the ISMA that enables the Agency to monitor the territory of all member states whenever a crisis situation breaks out;[101] (v) the monitoring by an ISMA upon request by a member state of areas not subject to the sovereignty of any state, such as the high seas or outer space, would not be problematic if the constitutive act of the ISMA so provides,[102] except in the case of the Antarctica; (vi) requests for monitoring by an ISMA by states that are not members would appear impossible in the case of arms control agreements. However, the ISMA could make its services available in crisis situations in which no member states are involved;[103] (vii) actions taken by an ISMA using its own initiative also could be possible, depending on its constitutive act.[104]

The ISMA's constitutive act also has to provide for a dissemination regime of data and information gathered by satellites. This question largely relies on the organizational structure of the future ISMA. The treaty establishing the ISMA should also contain provisions for the settlement of disputes and other operating measures, the specific details of which greatly depend on future negotiations.

(c) Financial Implications of an ISMA

The Group of Experts concluded:

> As regards the financial implications, a variety of technical options are possible, leading to a broad range in cost estimate ; a summary of the estimates made by the Group is to be found in the body of the report. Whatever the assumptions on which the estimates are based, even in Phase III, which is the most complete and most expensive phase, an ISMA would cost the international community each year well under 1 per cent of the total annual expenditure on armaments.[105]

The cost of implementing and operating an ISMA is, therefore, modest when compared with its potential benefits.

D. THE PROGRESS OF THE ISMA PROPOSAL AFTER THE ISMA REPORT

The Second U.N. Special Session on Disarmament II (SSOD II) was held in June and July in 1982 during which a review of the ISMA Report was planned as part of its agenda (agenda item 9).[106] However, the General Assembly chose not to discuss the ISMA Report, deciding instead to refer it to the Thirty-seventh Regular Session for further consideration. Nevertheless, at the SSOD II, Italy and Japan submitted informal proposals regarding the creation of ISMA-like international verification organizations.[107] France also presented a paper on June 29, 1982 entitled "Implications of Establishing an International Satellite Monitoring Agency".[108] France proposed that the General Assembly:

> (a) Take note of the report and the study of the experts on the implications of establishing an international satellite monitoring agency (A/AC.206/14);
> (b) Take note of the conclusions set out in the study with regard to the feasibility of establishing an international satellite monitoring agency;
> (c) Request the Secretary-General to report on practical arrangements for implementing the conclusions on the institutional aspects of the proposal dealt with in section V of chapter 2 of the study; and
> (d) Include the item in the provisional agenda of its thirty-eighth session.[109]

The French proposal (A/S-12/AC.1/55) was confirmed as a draft resolution at the First Committee of the Thirty-seventh Session on November 19, 1982.[110] That draft resolution was co-sponsored by thirty-five states including Canada, India, Italy, Pakistan, Turkey and Yugoslavia and entitled "Monitoring of International Disarmament Agreements and Strengthening of International Security (Proposal for the establishment of an International Satellite Monitoring Agency)".[111] After minor changes were made, the draft resolution was voted on (as draft Resolution K)[112] by the General Assembly with one hundred and twenty-six nations in favor, nine against (including the USSR) and eleven abstentions (including Cuba and the United States).[113] This resolution, now, Resolution 37/78K,[114] requests, among other things, the Secretary-General "to take the necessary steps to have the [Experts'] report reproduced as a United Nations publication in order to ensure that it receives the widest possible dissemination", and also "[r]equests the Secretary-General to report to the General Assembly, at its thirty-eighth session, on the practical modalities for implementing those conclusions with respect to the institutional aspects of the draft examined in chapter II, part V, of the study".[115] The report was duly published in five official languages of the United Nations under the title "The Implications of Establishing an International Satellite Monitoring Agency".[116]

On October 5, 1983, during the Thirty-eighth Session of the General Assembly, the U.N. Secretary-General in connection with the possible establishment of an ISMA reported as follows:

> 7. Consequently, in the view of the Secretary-General, the General Assembly would have to decide upon a process and a legal framework which could result in the establishment of an ISMA.
> 8. Furthermore, the Secretary-General also notes that, as far as chapter II, part V, of the report dealing with some institutional aspects of ISMA is concerned, there are several indications that most of those aspects would have to be left to be settled by the envisaged negotiations between the participating States.
> 9. In addition, the Secretary-General believes that, should the General Assembly decide to indicate the process to establish an ISMA, it could also identify the specific terms of the responsibilities of the Secretary-General, in the framework of those negotiations .[117]

The responsibility to advance the ISMA proposal, which was partly imposed on the Secretary-General by Resolution 37/78K, therefore, was returned to the forum of the General Assembly and individual member states.

Subsequent to these preliminary initiatives, insufficient attention was paid to the practical modalities for establishing an ISMA either by the First Committee or the General Assembly of the United Nations. Some interesting proposals were, however, presented later on at the Geneva Conference on Disarmament in 1985. For instance, the delegation of Argentina urged the Conference to take account of "the French proposal for an international satellite monitoring agency, where establishment would, as has been determined, be technically, legally and financially possible".[118] Later in the same year, the delegation of West Germany stated:

> The involvement of international verification organizations is therefore an urgent requirement for such future international legislation. Despite the considerable cost such mechanisms may entail the projected International Satellite Monitoring Agency, planned and developed by France, or -- in a regional context -- the European Space Agency might be called upon to take on practical responsibilities in this field.[119]

The delegation of Australia also noted that "verification of compliance with existing and future outer space agreements should be done by an independent international agency along the lines, for example, of the projected International Satellite Monitoring Agency".[120] Similar opinions were expressed by the delegations of Poland (CD/PV.402, 2 April 1987), Sri Lanka (CD/PV.404, 9 April 1987), Japan (CD/PV.419, 7 July 1987), Pakistan (CD/PV.413, 16 July 1987), the German Democratic Republic (CD/PV.425, 28 July 1987), India (CD/PV.-450, 22 March 1988) and Sweden (Ad Hoc Committee, 22 March 1988).[121]

At the third Special Session of the United Nations General Assembly devoted to Disarmament (SSOD III), the delegations of Bulgaria, Czechoslovakia and the USSR jointly submitted a working paper (A/S-15/AC.1/15, 3 June 1988), recommending the creation of an international satellite verification agency:

> [i]n order to provide the international community with reliable and comprehensive information on compliance with multilateral treaties and agreements in the areas of disarmament and the reduction on international tension, and also to monitor the military situation in area of conflict, it would be possible in pursuance of the idea put forward by France to establish an international space monitoring agency which in future would become an integral part of the international verification agency. The Conference on Disarmament should be instructed to begin detailed negotiations on the establishment of the international space monitoring agency, including programming and material technical facilities for its work. The Soviet Union would be prepared to consider the question of launching satellites belonging to the agency from Soviet carrier rockets on mutually acceptable terms.[122]

The necessary political will, which had been lacking until recently, seems steadily growing along, especially as a result of dramatic political changes in Eastern Europe. In consequence, the prospects for the establishment an international verification agency based on satellite technology seem promising.

E. POLITICAL FACTORS

As examined in previous sections in this Chapter, the establishment of an ISMA is technically, legally and even financially possible, although there are still substantial obstacles to be overcome. What has been lacking is appropriate political determination. As early as 1980, two years after the French proposal for an ISMA, one of the most respected non-governmental organizations concerned with global disarmament, commonly known as Pugwash, concluded at its thirty-fourth symposium:

> 1. An international satellite monitoring system (ISMOS) is technologically feasible at the present time, given the necessary political will and economic resources for such an undertaking. From a realistic viewpoint, however, substantial technical, political, legal, organizational and financial obstacles would have to be overcome ...
> 4. At best, some years would be required before a highly effective satellite monitoring system could be mounted and be made fully operational. To hasten this process, further steps and studies should be undertaken as soon as possible, and in parallel, to promote this proposal both within and outside the UN framework. The eventual incorporation of ISMOS into the UN system is envisaged.[123]

The Pugwash Movement, both at the Pugwash Symposium and the Pugwash Conference on Science and World Affairs, has been pursuing vigorously the establishment of a space-based monitoring system. A statement of the thirty-fourth Pugwash Conference in 1984 indicates the interest taken in such a system: "[a]n international agency for monitoring by satellite, or compliance with arms control agreements, supplementing national means of verification, has been investigated in a preliminary way and deserves further study."[124] The ISMA proposal received a great deal of attention not only from disarmament-oriented organizations but also from scientist groups, which confirmed the technical feasibility of an ISMA at the Airborne and Space-based Radar Session of the Military Microwave Conference in 1984.[125]

In contrast, some arms control specialists are adamantly opposed to the idea of an ISMA for a variety of reasons, including the following: (1) satellite monitoring for verification purposes inevitably results in the collection of data useful for targeting and evaluating the armaments of other countries; (2) an ISMA would be unable to decide effectively such significant matters as which countries to be monitored, how often (routinely or only in exceptional circumstances) as well as the extent to which the data acquired should be released to the public; (3) photo-interpretation is too demanding a task for an ISMA to conduct without the years of experience the United States and the USSR have had; (4) it is impossible for an organization within the United Nations to judge and to impose an effective penalty on a sovereign state; (5) the establishment of a system at a minimum level of technical capability would never be cost effective.[126] However, it is important to note that, although opponents of an ISMA who claim that insurmountable obstacles to its establishment currently exist, do not question that the satellite monitoring that has been used extensively by both superpowers has contributed enormously to stabilizing international relations. Whereas some of the objections raised against an ISMA were valid during the Cold War, today they have lost most if not all of their validity.

CHAPTER V - ENDNOTES

1. See e.g., B. Jasani, "Use of Space Technology for Preventing Wars" (1984) [unpublished] at 1.

2. P.J. Klass, Secret Sentries in Space (New York: Random House, 1971) at 219-20.

3. R.S. Leghorn, "The Approach to a Rational World Security System" (1957)18:6 Bull. Ato. Scientists 195, at 195-99.

4. Ibid.

5. Klass, supra, note 2 at 220.

6. Ibid.

7. Congressional Quarterly Special Report, History of Disarmament in the Postwar Years: A Comprehensive Chronology of International Negotiations, Events and Organizations (Washington, D.C.: GPO, 1964) at 8.

8. Ibid. at 9.

9. W.H. Dorn, Peace-Keeping Satellites: The Case of International Surveillance and Verification (1987) 10:5 & 6 Peace Research Reviews (Dundus, Canada: Peace Research Institute) at 87-88.

10. F.J. Ossenbeck & P.C. Kroeck, Open Space and Peace: A Symposium on Effects of Observation (Stanford: Hoover Institution, 1964).

11. Two American scientists, B. Murry and M. Davies proposed a satellite monitoring agency under the control of the U.N. in 1972. They envisaged satellites placed into an orbit of some 200 km altitude and several meter resolution. See, M.E. Davies & B.C. Murry, "Space Observations, Disarmament and United Nations" (1972) Astronautics and Aeronautics at 60; S. Courteux, "Les 'Satellites bleus' au services de la paix et du desarmement" (1981) 24 German Yearbook of I.L. 242 at 242. Former United States Air Force Lt. Colonel Kurz established War Control Planners Inc. in the early 1960s and has been proposing various measures both within and independent of the United Nations to monitor international situations by satellites. After the ISMA proposal of 1978, he has been

campaigning to set up of an ISMA through his news letters titled Checkpoint. With regard to his activities, see D. Deudney, "Unlocking Space" (1983) 53 Foreign Policy 91 at 110; H.G. Kurz, "A Call for Order in Chaotic Times" The Washington Star (20 November 1980); H.G. Kurz, "The French Initiative and Its Space Policy for Humankind" (1983) [unpublished].

12. J.R. Soraghan, "Reconnaissance Satellites: Legal Characterization and Possible Utilization for Peacekeeping" (1967) 13: 3 McGill L.J. 458, at 487-88.

13. Ibid.

14. J. Morenoff, World Peace Through Space Law (Charlottesville, Virginia: Michie, 1967).

15. Ibid. at 300-302.

16. A. Myrdal, "The International Control of Disarmament" (1974) 231: 4 Scientific American 21.

17. Ibid. at 21 and 29.

18. Ibid. at 29.

19. Ibid. at 29-30.

20. Ibid. at 30-31.

21. Ibid. at 31.

22. A. Myrdal, The Game of Disarmament, rev'd ed. (New York: Pantheon, 1982).

23. Ibid. at 308-09.

24. Ibid. at 310 and 405.

25. Ibid. at 311.

26. With respect to the Pugwash Movement, see e.g., E. Rabinowitch, "Pugwash--History and Outlook" (1957) 13: 9 Bull. Ato. Scientists 243.

27. S. Courteux, supra, note 11 at 242-43.

28. A. Chayes, W. Epstein & T. Taylor, "A Surveillance Satellite for All" (1977) 23: 1 Bull. Ato. Scientists 7, at 7.

29. _Ibid._

30. _Ibid._

31. _Ibid._

32. Before that, on 24 February 1978, France proposed the establishment of an ISMA to the Preparatory Committee for the SSOD I. See, UNGAOR, 33d Sess., 46th Mtg., UN Doc. A/C.1/33/PV.46 (1978).

33. UN GAOR, 10th Spec. Sess., A/S-10/AC.1/7 (1978) Memorandum from the French Government Concerning an International Satellite Monitoring Agency, June 1, 1978; A/S-10/AC.1/7 is cited in G.C.M. Reijnen, "The Prevention of an Arms Race in Outer Space" in M. Benko, W. de Graaff & G.C.M. Reijnen eds., _Space Law in the United Nations_ (Dordrecht: Martinus Nijhoff, 1985) Annex VIII at 224-29; A/S-10/AC.1/7 is also cited in H.H. Almond,"The French Proposal for and International Satellite Monitoring Agency" (1982) 25 Colloquium on L. Outer Space Annex II at 180-83.

34. _Ibid._

35. 33 UN GAOR Supp. (No.4) (10th Spec. Sess.) at 3, UN Doc. A/S-10/2 (1978).

36. UN GAOR, 10th Spec. Sess., 46th Plen. Mtg., UN Doc. A/C.1/33/PV.46 (1978). (France formally introduced three draft resolutions in documents, one of which, A/C.1/33/L.13/Rev.1, "Monitoring of Disarmaments and Strengthening of Security" was a joint proposal of eighteen nations.

37. UN GAOR, 33rd Sess., UN Doc. A/33/461 (1978) at 6 para. 28.

38. A/33/71J December 14, 1978.

39. UN GAOR, 34th Sess., UN Doc. A/34/540 (1979) [hereinafter UN Doc. A/34/540].

40. UN Doc. A/34/540, at 6-7.

41. _Ibid._ at 7.

42. _Ibid._ at 8.

43. UN GAOR, 34th Sess., UN Doc. A/34/374 (1979) [hereinafter UN Doc. A/34/374]; see also, R.S. Jakhu & R. Trecroce, "International Satellite Monitoring for Disarmament and Development" (1980) 5 Annals of Air & Space L. 509.

44. UN Doc. A/34/374, at 8 para. 6.

45. Ibid. at 16, para. 3; some of Soviet experts, however, endorsed the multinational space-based monitoring systems, though not mentioning the name ISMA directly. See I. Kotlyarov, "International Space Monitoring for Peace" (1979) 22 Colloquium L. Outer Space 165.

46. Ibid. at 26, para. 4.

47. Ibid. at 9, para. 2.

48. Ibid. at 27, para. 3.

49. Ibid. at 27, para. 4.

50. Ibid. at 28, para. 5.

51. Ibid. at 28, para. 6.

52. Ibid. at 28, para. 7.

53. Ibid.

54. UN GAOR, 34th Sess.,97th Ple. Mtg., at 1791-92, UN Doc. A/34/PV.97 (1979). Later, three other nations wished to have their vote recorded as having been in favor.

55. The Experts Group submitted their study A/AC.206/14 to the Secretary-General on June 10, 1981. UN GAOR Preparatory Committee for the 2d Spec. Sess. devoted to Disarmament, UN Doc. A/AC.206/14 (1981) [hereinafter ISMA Report]. In 1983, The ISMA Report was offered for sale under the title of The Implications of Establishing an International Satellite Monitoring Agency, Sales No. E831X.3. Page numbers are different between the 1981 ISMA Report and 1983 publication. Therefore, paragraph numbers will be used as references in this thesis.

56. Ibid. ISMA Report, para. 168.

57. Ibid. para. 127.

58. Ibid. para. 17.

59. Ibid. para. 287.

60. Ibid. para. 282.

61. Agreement of the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 22 April 1968; 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119 (entered into force 3 December 1968) [hereinafter The Rescue Agreement].

62. Convention on International Liability for Damages Caused by Space Object, 29 March 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762, 961 U.N.T.S. 187, [hereinafter the Liability Convention] (entered into force 9 October 1973).

63. Convention on Registration of Objects Launched into Outer Space, 14 January 1975, 28 U.S.T. 695, T.I.A.S. No. 8480, 1023 U.N.T.S. 15, [hereinafter the Registration Convention] (entered into force 15 September 1976).

64. I.A. Vlasic, "Principles Relating to Remote Sensing of the Earth from Space" in N. Jasentuliyana & R.S.K. Lee, eds., Manual on Space Law, vol. 1 (New York: Oceana, 1979) 303 at 309.

65. See e.g., S. Gorove, "Earth Resources Survey Satellites and International Law" (1973) 1 J. Space L. 80; L. Frieden, "Newsgathering by Satellites: A New Challenge to International and National Law at the Dawn of the Twenty-First Century" (1988) 25 Stanford J. Int'l L. 103.

66. Despite the wide difference of opinion on the right to sense the earth's surface, the U.N. Secretariat Background Paper in 1973 supported the regime "to freely observe everything and anything in another country so long as it carries out its observations from beyond the limits of national sovereignty" (A/AC.105/118). See J.-L. Magdelenat, "The Major Issues in the 'Agreed' Principles on Remote Sensing" (1981) 9: 1 & 2 J. Space L. 111 at 115. With regard to the U.N. negotiations on the remote sensing regime, see e.g., H. DeSaussure, "Remote Sensing by Satellite: What Future for an International Regime" (1977) 71 American J. Int'l L. 707; C.Q. Christol, "Remote Sensing and International Law" (1980) 5 Annals Air & Space L. 375; M. Robinson, "The United Nations as an International Forum for Developing Consensus" in N.M. Matte & H. DeSaussure, eds., Legal Implications of Remote Sensing from Outer Space (Leyden: A.W. Sijthoff, 1976) 187; D.M. Polter, "Remote Sensing and State Sovereignty" (1976) 4 J. Space L. 99.

67. Principles Relating to Remote Sensing of the Earth from Space GA Res. 41/65, U.N. GAOR, 41th Sess., Supp. No. 53, p. 155, U.N. Doc. A/Res/41/65 (1986).

68. G.P. Slope, "Mediasat, Gray Reconnaissance, and the New United Nations Principles" (1987) 30 Colloquium L. Outer Space 385.

69. UN Doc. A/AC.105/C.2/SR.423 (1985) at 7; cited in C.Q. Christol, "Remote Sensing and International Law" (1988) 16: 1 J. Space L. 21 at 32.

70. See ISMA Report, supra, note 55, paras. at 287-99.

71. Ibid. para. 303.

72. Dr. Vlasic, legal consultant to the Experts Group was of the opinion that "the document does allow for a role in the verification process by an agency such as ISMA". See I.A. Vlasic, Draft Report of Chapter Two: Legal Implications, SMA/WP/22, 13 August 1980, para. 31.

73. ISMA Report, supra, note 55 para. 320.

74. Ibid. para. 335.

75. Ibid. paras. 321-23.

76. Treaty of Tlatelolco, art. 9.

77. ISMA Report, supra, note 55 para. 337.

78. Ibid. para. 343-44.

79. Ibid. para. 344.

80. Ibid. paras. 328-29.

81. External Affairs and International Trade Canada, "Success in Vienna: CFE Treaty Signed" (1990) 15 The Disarmament Bulletin 1 at 3.

82. See T. Bernauer, The Projected Chemical Weapons Convention: A Guide to the Negotiations in the Conference on Disarmament (UNIDIR Publications, 1990).

83. ISMA Report, supra, note 55 para. 353.

84. Vlasic, supra, note 72 para. 30.

85. ISMA Report, supra, note 55 para. 359.

86. Vlasic, supra, note 72 para. 86.

87. ISMA Report, supra, note 55 para. 358.

88. Ibid., para. 359.

89. Ibid. paras. 365-73.

90. Specialized agencies are international organizations established in economic, social, cultural, educational, health and other related fields, largely independent but work with the United Nations through the coordinating machinery of the ECOSOC.

91. Statute of the IAEA, art. III B.4.

92. ISMA Report, supra, note 55 para. 374.

93. Vlasic, supra, note 72 para. 104.

94. ISMA Report, supra, note 55 para. 375.

95. Ibid.

96. Vlasic, supra, note 72 para. 100; concerning the tendency of the General Assembly to enlarge its role over security matters, see e.g., E. McWhinney, United Nations Law Making: Cultural and Ideological Relativism and International Law Making for an Era of Transition (New York: Holms & Meier, 1984) at 91-96.

97. ISMA Report, supra, note 55 para. 372.

98. Ibid. para. 401.

99. Ibid. para. 400.

100. Vlasic, supra, note 72, para. 135.

101. ISMA Report, supra, note 55, para. 404.

102. Ibid. para. 406.

103. Ibid. para.407.

104. Vlasic, supra, note 72 para. 140. ISMA Report does not contain this category. As an example, Dr. Vlasic states a surveillance, even in Phase I, in the areas res communis omnium .

105. ISMA Report, <u>supra</u>, note 55, para. 19.

106. U.N. Doc. A/S-12/10 Add.1 (1982) at 9.

107. Italy submitted a working paper titled "Institution of an International Body for the Verification of Disarmament Agreement" on 25 June 1982. UN GAOR 12th Spec. Sess., UN Doc. A/S-12/AC.1/19/Rev.1 (1982); Japan also submitted a working paper on 28 June titled "Strengthening of the Role of the United Nations in the Field of Verification". UN GAOR 12th Spec. Sess., UN Doc. A/S-12/AC.1/43 (1982).

108. UN GAOR 12th Spec. Sess., UN Doc. A/S-12/AC.1/55 (1982).

109. <u>Ibid.</u> at 2.

110. UN GAOR 37th Sess., UN Doc. A/C.1/37/L.55 (1982).

111. <u>Ibid.</u> at 1.

112. UN GAOR, 37th Sess., UN Doc. A/37/662 (1982).

113. UN GAOR, 37th Sess., Plen. Mtg. at 1638 UN Doc. A/37/-PV/98 (1982).

114. <u>Ibid.</u> at 64.

115. <u>Ibid.</u>

116. Sales No. E. 83 IX3; see, <u>supra</u>, note 55.

117. UN GAOR 38th Sess. at 2-3, UN Doc. A/38/404 (1983).

118. Arms Control and Disarmament Division of the Department of External Affairs of Canada, ed., Conference of Disarmament Prevention of Arms Race in Outer Space--Final Records (PV) 1985 (Ottawa: Department of External Affairs, 1986) at 25-30, CD/PV 296 (1985).

119. UN CDOR, Plen. Sess. at 16, UN Doc. CD/PV.318 (1985); see also CD/905 CD/OS/WP.28 (1989) at 19.

120. UN CDOR, Plen. Mtg. at 15, UN Doc. CD/PV/329 (1985).

121. CD/905/ CD/OS/WP.28 (1989) at 19.

122. UN Doc. A/S-15/AC.1/15 (1985) para. 6.

123. Council of the Pugwash Conference on Science and World Affairs, 34th Pugwash Symposium, An International Agency for the Use of Satellite Observation Data for Security Purposes (1980), 17:4 Pugwash Newsletter at 97.

124. Statement of the 34th Pugwash Conference on Science and World Affairs, Bjorkliden, Sweden, 9-14 July 1984; cited in "Monitor and documentations" (1985) 1 Space Policy 114.

125. See e.g., L.J. Cantafio, "Space-Based Radar for the United Nations' International Satellite Monitoring Agency" (1984) 27:12 Microwave Journal 115.

126. See e.g., L. Freedman & J.A. Schear, "International Verification Arrangements" (1986) 2 Space Policy 16; Operational Research & Analysis Establishment (ORAE), Department of National Defense of Canada, The Arms Control and Crisis Management Potential of International Satellite Monitoring Agency (ISMA) by R. Ranger, December 1984.

CHAPTER VI

RECENT DEVELOPMENTS IN MULTILATERAL SATELLITE MONITORING SYSTEMS: PROPOSALS AND IDEAS

Several concepts regarding multilateral satellite agencies have been the subject of discussion since the ISMA study. However, the ISMA proposal is far more important than any other similar ideas, having been elaborately studied by selected governmental experts appointed by the Secretary-General of the United Nations. These new concepts are considered under the categories: (i) United Nations initiatives, (ii) regional initiatives; and (iii) private initiatives.

A. PROPOSALS FOR AN AGENCY GLOBAL IN SCOPE

1. USSR

(a) World Space Organization

In a letter dated August 15, 1985 the Minister for Foreign Affairs of the USSR requested the Secretary-General of the United Nations to include a supplementary item in the agenda of the Fortieth Session.[1] The item dealt with international co-operation in the peaceful exploitation of outer space based on non-militarization and envisioned the possibility of setting up a world space organization responsible for scientific investigation, the utilization of space technology and "monitoring the observance of agreements which have already been concluded, with a view to preventing an arms race in space."[2] The USSR recommended the convening of an international conference to consider such a world space organization (hereinafter referred to as the WSO).[3] A draft resolution for that purpose was appended to the letter setting forth the characteristics of the WSO:

> 2. Expresses its conviction that, under conditions in which the non-militarization of outer space is effectively ensured, a major practical step in the peaceful exploitation of space and development of international co-operation in that field would be the setting up of a world space organization to harmonize, co-ordinate and unite the efforts of States in respect of peaceful space activities, including the provision of assistance in that field to developing countries, and also to facilitate the necessary monitoring of compliance with agreements which have already been concluded or will be concluded with a view to preventing an arms race in outer space.[4]

The proposed WSO was intended to conduct both civilian and military missions and pursue disarmament efforts. Unlike the ISMA, its scope was so wide as regards areas of space activities that its actual role was rather ambiguous.

At the General Assembly of the Fortieth Session, then Foreign Minister Mr. Eduard Shevardnadze addressed the importance of joint efforts in both basic and applied areas of space exploitation and formally introduced the WSO proposal, emphasizing such co-operation could best be carried out within the framework of the WSO.[5] Mr. Shevardnadze described the proposal as "star peace", countering the "star wars" concept pursued by the United States.[6] Later in the same session, Mr. Shevardnadze again promoted his "star peace" concept,[7] although the WSO was not named.[8] The Soviet draft resolution (U.N. Doc. A/C.1/40/L.1) was subsequently replaced by another resolution with less dramatic wording.[9] However no particular action was taken by the General Assembly.

A letter by then chairman of the Council of Ministers of the USSR, Mr. Nikolai Ryzhkov, to the Secretary-General dated July 13, 1986[10] described in greater detail schemes for the phased development of the WSO.[11] The first phase (institutional in nature and lasting five years) is to study the entire agenda of space problems at an international conference and also to initiate the WSO. The second phase (material preparation, during the first half of the 1990s) would establish an agenda of priority initiatives, such as the protection of the terrestrial biosphere. The third phase (implementation) would emphasize international co-operation in all areas of space activities.[12]

The distinctiveness of the proposed WSO lies in its comprehensive character. Despite many proposed instrumentalities of international co-operation, there does not yet exist an organization that covers all domains of space-related activities. Adding to the duties delineated in draft resolution A/40/192, the WSO proposed by Mr. Ryzhkov was also to be of assistance to the progressive development of space law and to assume some of the responsibilities incumbent on the U.N. Secretary-General.[13]

The attitude of the United States towards the WSO proposal was negative, given its traditional preference for independent national efforts versus a strongly centralized organization, even in civilian activities, and its reluctance to share its military space capabilities with other nations. The understanding of the State Department and the Congress was that the WSO concept was merely an exercise in propaganda aimed against the United States Strategic Defense Initiative program and also a duplication of other existing space organizations.[14] Furthermore, the idea proposed by the USSR of associating the WSO with the disputed Krasnoyarsk radar, the existence of which was then being challenged as a "material breach" of the ABM Treaty by the U.S. Department of Defense, was strongly criticized. Foreign Minister Shevardnadze had proposed at the U.N. General Assembly that the radar could be turned into an international space research centre.[15] The proposal was detailed by the Soviet representative to the United Nations, Vladimir Petrovsky, as follows:

> The Soviet Union proposes to create on the basis of the Krasnoyarsk radar a centre for international co-operation for the peaceful uses of other space, and to include this in a world space organization system. We state here that we look forward to consultations with scientists of all countries who are interested in this project.
> That is our concrete response to Western concerns regarding the Krasnoyarsk radar. However, our concerns regarding the construction of United States radars in Greenland and Great Britain still

> remain. Experts view the construction of those radars as direct violations of the anti-ballistic missile treaty. We expect a constructive response to our initiative.[16]

However, even in the USSR, experts such as Dr. Roald Sagdeyev, the former Director of Soviet Research Institute, were not enthusiastic about the idea of tight management of all space missions by a centralized agency.[17] In any case, no tangible action has been taken since the proposal was obviously far too ambitious, well ahead of its time and therefore of scant attraction to the international community.

Refusing to be discouraged by the cold reception of its proposal, in February 1988, the USSR again proposed that the WSO operate on a permanent footing.[18] In that proposal, the WSO would have the objectives both of development and disarmament, with emphasis placed on development.[19] The planned scope of missions and the power of the new WSO were somewhat diluted compared with the 1985 proposal. The proposed WSO of June 1988[20] contained provisions for the verification of compliance with agreements as one of its functions:

> 1. WSO shall create a system of international verification of compliance with agreements to prevent the extension of an arms race into outer space.
> 2. To this end, it shall use the technical resources which may either belong to it or be placed at its disposal or leased to it by Member States.
> 3. On the basis of a special agreement with the United Nations, the WSO verification system may also be used to monitor compliance with other agreements on the limitation and cessation of the arms race.[21]

Its inter-relationship with the United Nations is not nearly as elaborate as that of the ISMA, as set forth in ISMA report, and remains vague. Having failed with their own WSO proposal, the Soviets have since announced their support for the ISMA.[22]

(b) International Space Inspectorate

Before the WSO charter was tabled at the Committee on the Peaceful Uses of Outer Space (COPUOS), the Soviet delegation proposed an international space inspectorate system in March 1988,[23] taking note that "[o]n-site inspection directly before launch is the simplest and most effective method"[24] to make sure that objects to be launched and stationed in space are not weapons of any kind. The launching state would be obliged to submit information about forthcoming launches to the International Space Inspectorate, including the place, date and time of launch, the type of launch vehicle and the parameters of the orbit. The Inspectorate would then send instructions to one of the permanent inspection teams positioned at all launching sites to hold an inspection. The launching state would be required to co-operate in the course of an on-site inspection by the permanent inspection team.[25] Also, a state party would have the right to request the International Space Inspectorate to obtain clarification from any state party regarding a situation which could be considered unclear as a result of concerns over the undeclared launch of a space object.[26] In case a requesting state considered the clarification insufficient, an ad hoc inspection would be held.[27] A suspected state would be "bound to afford the ad hoc inspection team the opportunity to carry out such an inspection without delay",[28] thus implying that the right of refusal is denied.[29]

In the same year, the German Democratic Republic tabled a proposal for a structured discussion on the prevention of an arms race in outer space at the Conference on Disarmament (CD),[30] which considered both an international space inspectorate and an ISMA, possibly within the framework of a WSO, as a basis for future negotiation.[31] The Soviet proposal on an International Space Inspectorate was considered at that time "premature and too ambitious in its scope."[32]

The International Space Inspectorate was also mentioned in the Report of the CD's Ad Hoc Committee on Prevention of an Arms Race in Outer Space during three consecutive years (CD/786 (24 August 1987) paragraphs 42-44, CD/870 (12 September 1988) paragraphs 43 and 44, CD/954 (24 August 1989) paragraph 63) as one of the concepts of international monitoring systems in line with, for example, the ISMA, the WSO and the Canadian Paxsat.[33]

(c) Resurrected ISMA

As discussed in Chapter V, the USSR had been opposed to the idea of an ISMA along with the United States. However, on

October 17, 1988, the Soviet Union reversed itself at the Third Special Session dedicated to Disarmament (SSOD III) by endorsing the ISMA concept.[34] Its working paper on the establishment of an ISMA submitted to the Ad Hoc Committee on Prevention of an Arms Race in Outer Space[35] was almost a condensed version of the original ISMA Report except for some new features such as the possibility of an ISMA mission for monitoring natural disasters and other emergencies,[36] the expressed promise that Soviet rockets and launching sites would be available for monitoring,[37] and the reassurance that any "Report on monitoring carried out by the Agency would be factual in nature and would not contain any conclusions regarding compliance or non-compliance with treaties or agreements, or accusations against any State regarding action taken by it".[38] The Report of the Ad Hoc Committee in 1989 contained the summary and implications of the "new" ISMA[39] along with other multilateral monitoring proposals.

As can be seen, between 1985 and 1988, the USSR had tabled three different proposals: (i) the WSO; (ii) an International Space Inspectorate; and (iii) an ISMA. The International Space Inspectorate was to ensure that no weapons would be deployed in space and part of the task of the WSO and an ISMA was to be the detection of breaches of arms control and disarmament agreements in space or the control of weapons already stationed in space. No new initiatives have been undertaken by the Soviets since 1988, almost certainly due to the disintegration of the Soviet Union and total uncertainty about the future of its once flourishing space program.

2. **France**

After introducing its proposal for an ISMA at SSOD I, France again proposed during SSOD III in June 1988, the implementation of the first phase of an envisaged ISMA under the name of the Satellite Image Processing Agency (hereinafter referred to as SIPA),[40] taking note of the constraints preventing the initiation of the phased development of the ISMA. SIPA would collect, process and disseminate the data obtained by existing civilian satellites to the member states, which would obtain the benefit of the updated data in the three areas of disarmament, crisis control and prevention and handling of disasters and major natural risks.[41]

SIPA would be comprised of: (a) a data processing subsystem (the DPS), which would convert raw data in to usable form; (b) a data management subsystem (the DMS), which would be responsible for reproduction of data, data storage, archiving and cataloguing and the security of data; (c) a data analysis subsystem (the DAS), which would convert non-analysed data into information by photo-interpretation and computer enhancement interpretation; and (d) a data dissemination subsystem (the DDS). Dissemination would be either restricted or unrestricted dependent on agreed policy.[42] It was also expected that SIPA activities would include the training of photo interpreters. SIPA would also serve as a research centre to identify new satellite requirements for disarmament monitoring and eventually to determine whether specific satellites would need to be developed for each type of arms control agreement or whether multi-purpose satellites could meet the requirements for all kinds of outer space monitoring.[43]

From the description of SIPA in its working paper, one can imply that France has not given up the idea of a full-fledged ISMA and that it regards SIPA more as a first step towards an ISMA than a goal in itself. This is confirmed in the Report of the Ad Hoc Committee on Prevention of an Arms Race in Outer Space issued at the end of its 1989 session:

> According to that proposal, such an agency would appear as the first phase of an International Satellite Monitoring Agency.[44]

Nevertheless, in its current form, SIPA should be seen primarily as a confidence-building device, rather than the embryo of a verification system universal in scope.[45]

3. Six-Country Peace Initiative

Argentina, Greece, India, Mexico, Sweden and Tanzania, which are signatories of the Delhi Declaration of January 28, 1985[46] and the Stockholm Declaration of January 21, 1988,[47] introduced a draft resolution to the SSOD III[48] calling for a study of the establishment of an International Monitoring Centre (hereinafter referred to as the IMC) whose character was similar to that of phase I of the proposed ISMA. The IMC would collect, analyze and interpret images from remote sensing satellites and disseminate information to participating states to supply evidence on compliance with arms control agreements and train personnel especially from developing countries. Eventually, the IMC would become a disarmament agency similar in organization to the IAEA.[49] Adding to disarmament tasks, the IMC would be expected to serve as an information clearing-house with regard to global development including environmental matters.[50]

B. REGIONAL INITIATIVES

1. Canada's Paxsat

The Paxsat concept emerged from several years of study by the Research Program of the Department of External Affairs of Canada, together with a team of experts from government, universities and industry.[51]

Paxsat presupposes the existence of significant multilateral arms limitation agreements. It would not serve as a monitoring institution for U.S.-USSR bilateral arms control agreements, nor would it deal with crisis monitoring or space development.[52] Paxsat would be treaty-specific, *i.e.*, it would be used only with respect to agreements to which it expressly applied, as part of an overall verification process for agreements. The treaty being verified would establish the requisite political authority for the verification mechanism and its operation.[53]

The Paxsat system would act neither as an arbitrator nor as an umpire of superpower disputes, but would be used as a part of an overall verification process in multilateral agreements. It also would not depend on superpower participation or their space technology, but would rely on remote sensing technology of participating states parties to the agreement. Of course, such a system would not exclude the participation of both superpowers.[54]

Paxsat would not have to be created in conjunction with the United Nations. While a detailed institutional plan is not set forth in the government-issued brochure it seems that the Paxsat concept it conceived as a regional system.

<u>**Two Category Approach: Paxsat A and Paxsat B**</u>

Paxsat A: Space-to-space remote sensing. The Paxsat A feasibility study focused on the question as to whether it was possible to verify an outer space arms control regime through a space-based system:

1) Can space observation of an object in space determine the role and function of the object, particularly regarding a weapon system?; and
2) Would the operational requirements permit a viable spacecraft design for the Paxsat 'A' mission?[55]

Tentative affirmative answers to those questions have been given by experts. Considering the cost of designing, launching and operating a spacecraft, its capabilities and function must be highly optimized. The most effective procedure would be to design a spacecraft which could co-orbit and keep station with the target; an alternative procedure for monitoring space objects would be a "fly-by" by the Paxsat spacecraft.[56] Paxsat is to have a radar sensor, on board computer and, preferably, gas analyzers and radiation detectors.[57] All such components are available within the civilian technology of non-superpower countries.[58] To minimize fuel consumption, an option would be to launch Paxsat only when a political decision has been made as to the possible breach of the treaty concerned.

Paxsat B: Space-to-ground remote sensing. The Paxsat B feasibility study focused on space-based remote sensing for verifying conventional weapons in a regional context -specifically, Europe. To make the research realistic, a specific well-defined region was selected - Europe. The study concluded that the arms control agreements likely to be agreed upon in Europe will require a multitude of verification methods, including verification by satellite.[59] The study concluded that the current or planned resolution of civilian satellites is not sufficient to meet all the requirements of Paxsat B missions.[60] Enhanced civilian satellites, such as Radarsat to be launched in 1994, could provide 'detection' level data.[61] In addition to optical and infrared sensors, synthetic aperture radar (SAR) is required due to frequent cloud-cover over Europe. The Verification Research Unit of the Arms Control and Disarmament Division of the External Affairs Department hosted a seminar for NATO officers in connection with the negotiations on the Conventional Forces in Europe (CFE) agreement in Vienna, in 1989.[62] The potential contribution of Paxsat B to CFE was discussed and the conclusion was reached that a "space-based verification system holds considerable potential as a contributing element to a multi-layered CFE verification package".[63]

Two Reports of the Ad Hoc Committee on Prevention of Arms Race in Outer Space, in 1987 (CD/786), in 1988 (CD/870) and 1989 (CD/954) mentioned the Paxsat concept as a possible contribution to international verification procedures.[64] The Paxsat study concludes with the assertion that "[the] technology base exists in non-superpower nations from which the full Paxsat 'B' system could be developed for the mid-to-late 1990s."[65]

2. Regional Satellite Monitoring Agency

(a) General European Trends

In December 1982, the United Nations General Assembly voted for the draft resolution requiring for "the Secretary-General to report on practical arrangements for implementing the conclusions on the institutional aspects of the proposal"[66] by one hundred and twenty-six nations voted in favour, nine against (the USSR and the Eastern bloc countries) and eleven abstained (including the United States).[67] At the next session, the Secretary General reported that it was the responsibility of individual states and of the General Assembly to seek the practical modalities for the creation of an ISMA.[68] That suggestion has not been implemented.[69] The subject has been, however, discussed at other fora, mostly in Europe.

Usually three reasons are given as the principal obstacles to setting up an ISMA: (i) institutional, (ii) political, and (iii) methodological.[70] They can be summarized as follows: (a) the superpowers' reluctance to abandon their monopoly in the field of space technology that makes it possible to verify armament situations (a political obstacle); and (b) the difficult questions of the modalities of data acquisition and dissemination (institutional and political obstacles).[71] An additional reason could be increasingly global "transparency" through the proliferation of space technology and the commercial use of remote sensing satellites such as Landsat and SPOT. However, the pace of these trends is different all over the world. It has been steadily progressing in Europe with the help of two well-organized intergovernmental organizations, the European Space Agency (ESA)[72] and, until the dissolution of the Warsaw Pact, the Interkosmos Council.[73] Moreover, European countries, particularly in the West, are well aware that joint European satellite verification is of great political significance and help in enhancing European security.

> It would enable Europe to monitor treaty compliance and crisis behaviour and it would give Europe a voice in appropriate discussions. European nations cannot expect to be involved in East-West discussions or be signatories of multilateral treaties without an independent capability for monitoring treaty compliance.[74]

Based on the established infrastructure, ongoing dialogue within the Conference on Security and Cooperation in Europe (CSCE) has provided European states the opportunity to consider as a possible alternative to an ISMA, the Regional Satellite Monitoring Agency, or RSMA.

(b) The Council of Europe

The Parliamentary Assembly of the Council of Europe has already endorsed the ISMA proposal as a most effective instrument in its report to the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (the so-called UNISPACE 82, held in August 1982).[75] The thirty-fourth ordinary session of the Parliamentary Assembly of the Council of Europe, convened in January 1983, adopted a resolution on UNISPACE 82 (Resolution 788), on future European space programs (Resolution 789) and a recommendation on the proposal for an ISMA (Council of Europe Recommendation 957).[76]

> 10. Recommends that the Committee of Ministers, on the occasion of their forthcoming exchange of views on United Nations matters with the participation of experts, review that state of action on the propo-

> sal for the setting-up of an international satellite monitoring agency, and examine possibilities for renewed initiatives in this direction, either individually or collectively, or in association with non-European industrialized or developing countries having a space technology.[77]

Recommendation 957 shows flexibility in the selection of its institutional options for initiatives, including both RSMA (regional and inter-regional) and ISMA (international) alternatives.[78]

In April of the following year, the Parliamentary Assembly of the Council of Europe at its North-South Conference, confirmed its intention to pursue joint planning of projects with developing countries such as an ISMA (commonly referred to as the Lisbon Declaration, para. 11). The Declaration had two purposes: disarmament and development, the latter to be assured through the strengthening of scientific and technological capacity and ensuring world-wide access to satellite-obtained information for developing countries.[79]

(c) <u>The "European Space Community" Proposal</u>

In February 1984, French President François Mitterand suggested the setting-up of a European space community to strengthen Europe military defence through "a manned space station allowing Europe to observe, transmit and consequently avert all possible threats in combination with other emerging technologies".[80] The June 1984 summit meeting of the EEC resulted in the establishment of a special working group on the subject, although the Mitterrand proposal did not attract a great deal of sympathy within the European community.[81] While the proposal received limited support, little was done since then, and reportedly, even France became unenthusiastic about the proposal.[82] It would appear, as already indicated, that France has decided to fully support the ISMA concept.

(d) Western European Union

On June 21, 1984, the Assembly of the Western European Union (WEU)[83] adopted Recommendation 410[84] on the military use of space which supported "initiatives to exploit space technology, to bring about confidence-building measures such as the proposed international satellite monitoring agency and determined to use Europe's space capabilities in order to reduce the risk of war by eliminating the advantage of surprise through surveillance satellite systems".[85] The Assembly recommended that the Council

> 4. [i]nitiate a study of an Agency for the Control of Armaments and the confidence and security-building measures that could be taken in Europe following the establishment of either an **international satellite monitoring agency or Western European oceanic and terrestrial surveillance satellite systems** and in the light of the study examine what might be entrusted to the Agency for the Control of Armaments with a view to participating in verification that these measures are being respected.[86]

and further recommended that the Council

> 7. [p]ropose a European surveillance and reconnaissance programme adapting and refining the sensor technologies in the existing CNES SPOT project and the ESA ERS-1 project.[87]

Here, the establishment by the WEU of a satellite surveillance system was considered as one possibility together with the alternative of an international agency. Although there has been no noticeable follow up, the determination to create a monitoring agency has never diminished.

The Assembly of the WEU held an inter-parliamentary conference in 1989 during which its President Chalen Goerns gave an address on the use of space to promote peace, emphasizing the significance of possessing independent, space-based observation technology and a monitoring capability to foster progress towards disarmament.[88] He opined that it was increasingly likely that important multilateral treaties will be concluded, initially, as to space itself and then as to nuclear weapons of all kinds, chemical weapons in specific regions and the limitation of conventional weapons in specific regions such as Europe.[89] Therefore, "[s]pace-based remote sensing would then have an essential role to play in the verification process",[90] and

> [i]n the absence, for the present, of a consensus in the UN support of an international satellite monitoring agency, it falls to those most implicated in the possibility of an arms control agreement on conventional weapons, i.e., the Europeans, to take the necessary steps to ensure the development of their own means of verification.[91]

While documents issued by ESA and the WEU show confidence in the technological as well as industrial capabilities of Europe to establish and operate a satellite monitoring agency, the institutional framework was not outlined clearly enough.

Consequently, legal and institutional aspects require examination. Potential organizations that could be in charge include ESA, the Council of Europe, the WEU or the Independent European Programmes Group (IEPG).[92]

(i) ESA

Article II of the Convention for the Establishment of a European Space Agency[93] stipulates that ESA is to provide for and promote European space research and operation of space applications for exclusively peaceful purposes.[94] Accordingly, military programs are excluded from ESA activities. Thus, ESA cannot deal with any projects that pertain to the military, nor can it be involved with policy analysis that has to do with the relations between military and civilian space activities, or with the civilian spin-offs of military projects.[95]

The ESA executive's view is that their organization could be involved in building monitoring satellites, at least at the stage of technological development.[96] ESA could proceed with a feasibility study; but it does not appear to be within the mandate of ESA under its constitution to take the initiative for an RSMA. Although four permanently neutral countries - Austria, Ireland, Sweden and Switzerland are members of ESA, it is considered that the Agency could proceed with a study as long as all member states agree and the study is not relevant to weapons development or aggressive military uses of space. It appears that satellite monitoring would fall within the category "peaceful purposes".[97]

(ii) The Council of Europe

Economic and defense matters are not within the mandate of the Council of Europe. Rather, the Council's responsibilities are to review matters in social, cultural, scientific, legal and administrative fields as well as human rights and fundamental liberties.[98] The Parliamentary Assembly of the Council of Europe, consisting of national parliament delegates, advises and coordinates member views on European technology policies, including civilian space policy.[99] Thus, despite its strong support for the concept, it appears that the Council of Europe could not establish an RSMA.[100]

(iii) The WEU

Basically defence and security oriented, the WEU has become the one body in Europe where all-encompassing space policies could be developed.[101] It regularly issues recommendations - often somewhat overlapping ESA programs -with the understanding that European security largely depends on civilian spin-offs or a strong civilian space technology.[102] Michel Guionnet, adviser to the Director General of CNES, concluded that "the WEU could be a forum in which reconnaissance satellite programmes could be conducted".[103] He took note of the reports by the Deputy Secretary General of the WEU to the Council (on May 22, 1984) that considered it possible that a "military observation satellite could come within the framework of the Standing Armament Committee as suggested by a Belgian and a German parliamentarian."[104]

(iv) The Independent European Programmes Group (IEPG)[105]

The purpose of the IEPG is to harmonize and coordinate national military programs in Europe. It is said that the IEPG is very much suited to the identification of technical problems and to the establishment of technical cooperation regarding reconnaissance programs.[106] However, it has been pointed out that the IEPG's program totally ignores space issues,[107] which should make this organization unsuitable as the center for satellite monitoring of arms control agreements.

(v) Conclusion

If a decision is taken to establish a regional agency to build and operate reconnaissance satellites, that agency could be established most effectively by the WEU, together with the possibility of allowing ESA and the IEPG to cooperate on technical aspects. Moreover, clearly the institutional question is not very critical in this case; success is more dependent on political will and consensus than on institutional or legal problems.

However, government representatives of the WEU have preferred to take gradual, low-cost, low-risk approaches that would evolve from data processing and interpretation, using commercially available data including those acquired by SPOT and Landsat, into a WEU agency with its own satellite systems.[108] Industrial concerns such as Italy's Selenia Spazia, Germany's Dornier and France's Alcatel Espace have strongly challenged the WEU's willingness to develop Europe's own satellite system.[109] Another difference is seen among government officials: some insist on sharing data of Helios (the French-Spanish-Italian joint project)[110] for the monitoring purposes in Europe once it is in operation (in 1993-94) while France is adamantly against this.[111]

(e) The NNA Proposals

Within the framework of an RSMA, neutral and non-aligned countries (NNAs) have also articulated unique proposals, separate from the above-mentioned concepts. In early 1985, Swiss Secretary of State at the Federal Department of Foreign Affairs, Mr. E. Brunner, proposed that neutral states in Europe build their own satellite verification of arms control agreements.[112] The Swedish Energy Minister proposed at the SIPRI conference on space weapons and international security on July 5, 1985, that NNAs, together with other countries possessing sufficient space technology, take the initiative to launch an independent satellite for monitoring uses. Such uses would include not only verification of arms control agreements but also the monitoring of crisis situations.[113] Although very general and far from being an elaborate proposal, the so-called Arms Control and Conflict Observation Satellite (ACCOS) appears to be intended for verification of bilateral of superpower arms control agreements as well.[114] No significant developments have resulted from these initial verbal proposals.

Sweden announced another initiative in September 1988, after the technical study was completed - the Tellus project.[115] Tellus would comprise several satellites including photo-reconnaissance (with one meter resolution) and radar satellites.[116]

3. <u>Open Skies (Aerial Surveillance) Agreement</u>

During the Eisenhower era, mutual arms inspection by any means including aircraft, was regarded by the USSR as nothing more than an attempt at espionage. After the U-2 incident, interest in aerial surveillance was rapidly fading with satellites becoming the principal reconnaissance tool of the superpowers.[117] It was only in 1986, within a Conference on Confidence and Security-Building Measures and Disarmament in Europe (CCSBMDE), that the Stockholm Declaration provided for a limited degree of aerial inspection in central Europe.[118] Significant progress in making aerial inspection acceptable to the Soviet-bloc countries was due to drastic political changes in the USSR and Eastern Europe. On March 9, 1989, at the opening of the Vienna follow-up meeting of CCSBDE, Soviet Foreign Minister Eduard Shevardnadze announced that there was no verification method that the USSR would not accept as long as it was conducted on a reciprocal basis.[119] As previously mentioned, thirty-four years since the Eisenhower plan, President Bush introduced a new Open Skies proposal in May 1989, conceived on a "broader, more intensive and radical basis".[120] The essence of the Bush proposal was that all NATO and Warsaw Pact nations should open their airspace to regular unarmed, non-combat type aerial surveillance.[121] On September 21, 1989, Soviet Foreign Minister Shevardnadze and United States Secretary of State James Baker agreed on convening an Open Skies conference during their meeting in Wyoming.[122] Subsequently, Canada, offered to host such a conference.[123] By December 1989, representatives of the sixteen NATO members states reached a consensus on the common policy enunciated in a document entitled the "Basic Elements with regard to an Open Skies regime".[124] Unlike the original Eisenhower proposal, which involved the two Superpowers, Bush's proposal covered sixteen NATO countries and seven former Warsaw Treaty Organization countries. The new Open Skies accord was conceived as an instrument to promote "openness" and "transparency" rather than to provide for verification of a specific arms control agreement.[125] Hence, although useful for verifying certain arms control treaties, the Open Skies proposal was intended primarily to complement aerial surveillance provided for in the Stockholm Declaration of 1986.

The Open Skies conference opened in Ottawa on February 12, 1990, and after two additional sessions, agreement was reached in 1992.[126] This important agreement permits each contracting state to overfly the territory of others on short notice, using unarmed civilian or military non-combat aircraft. The purpose is to reduce suspicion and enhance confidence among the parties. The Treaty requires each party to accept a specific number of overflights and entitles each party to carry out a specified number of such flights itself. Participating states must open all of their territory to overflight. Countries being overflown may demand that their own aircraft be used, equipped with an authorized package of sensors consisting of commercially available technologies. The sensors allowed under the Treaty may have the capability of acquiring information about military equipment twenty-four hours a day in all weather. An Open Skies Consultative Commission, located in Vienna, will coordinate Treaty implementation. Canada will be chairing the Commission's first session, which will have to settle some still unresolved issues, such as the allocation of costs for overflights when the host country provides the aircraft.[127]

The Open Skies Treaty is the first agreement to subject to aerial surveillance the territory of North America, Europe and the Asian part of Russia. It is also the first arms control agreement which was signed by Russia, Belarus, Ukraine, Georgia and the three Baltic Republics - all acting as fully independent states. It is important to stress that this Treaty will be helpful in the verification of various arms control agreements, such as the Treaty on Conventional Forces in Europe.

C. PRIVATE INITIATIVES

1. Mediasat

The term "news media" or "media" in this section refers to both the electronic and the printed media. As was mentioned in Chapter III, Section E, at present, the imagery from Landsat, SPOT and Soyuzkarta of Russia is available to private firms and government institutions at an affordable price.[128] Media's use of satellite imagery has not, however, been very commonplace so far. Although some highly-specialized magazines such as Aviation Week and Space Technology often show satellite images, overall, the media's experience with remotely-sensed imagery has been limited.[129] However, it is also true that the media's use of satellite imagery has substantially increased since SPOT entered this market.[130] Recent (1985-87) uses of remotely-sensed images obtained via satellites by the media include:

Television News

April 1985	Iran/Iraq area (ABC)
January 1986	Libyan military airfield and SA-5 sites (ABC)
February 1986	Soviet naval facility at Murmansk (ABC)
April 1986	Chernobyl nuclear plant (all networks)
July 1986	Soviet nuclear testing facility at Semipalatinsk some 1800 miles southeast of Moscow (ABC, CBS, CNN) (SPOT imagery)
August 1986	Soviet shuttle facility at Tyuratam in central USSR (ABC)
October 1986	Soviet submarine base at Gremikha (Swedish TV)
April 1987	Soviet radar facility near Krasnoyarsk in central USSR (ABC) (twenty meter SPOT imagery)
August 1987	Iraqi poison gas factory

Newspapers/ Magazines

March 1986	Libyan SA-5 sites and military bases (New York Post)
April/May 1986	Chernobyl nuclear plant (many newspapers and magazines)
September 1986	Soviet Kola Peninsula (Jane's Defence Weekly)
October 1986	Soviet cosmodromes at Plesetsk and Baikonur (National Geographic Magazine)
March 1987	Soviet Navy base at Murmansk and Soviet Air Force base at Severomorsk (AW&ST. Since 1974, this magazine has published more than twenty-two news items using satellite images)
March 1987	Pakistan nuclear processing facility (London Sunday Observer)
July 1987	Soviet nuclear submarine base on Barents Sea (AW&ST)
October 1987	Suspected USSR laser weapons facilities at Nurelsk and at the Sary Shagan site (AW&ST) (SPOT imagery, Space media network)
January 1989	Armenia earthquake (AW&ST)[131]

During the Gulf War in 1990-91, satellite-obtained images of Iraq and Kuwait appeared in the press and on television on several occasions.

It is said that the images provided by satellite of the Chernobyl nuclear plant in April 1986 were crucial in stimulating the interest of the media in satellite imagery.[132] Images of the Krasnoyarsk radar obtained by the French SPOT satellite constituted a violation of the 1972 ABM Treaty, leading an arms control expert to note that

> [f]or the first time, commercial satellites will be able to monitor what the Soviets decide to do about [the radar facility] -something in the past only governments, with their highly classified spy satellites, were able to do.[133]

It bears repeating that it was the "civilian" remote sensing SPOT that obtained clear photos of the Soviet submarine base in the Arctic.

Since at this time no commercial remote sensing system is designed to meet the specific needs of the media, the media are contemplating the possibility of setting up a "Mediasat", "a satellite system and business organization which would routinely collect news and information for media use from space."[134] The Mediasat would differ from standard commercial remote sensing enterprises in three respects: (i) it would provide images with spatial resolution of five meters or less; (ii) it would afford speedy global coverage; and (iii) it would be under media control in regard to systems and products.[135]

As far as the resolution is concerned, the higher the resolution, the more detailed the picture and more information it contains,[136] which is essential for news reporting, since the users are ordinary citizens, rather than expert analysts. Customers of Landsat, SPOT and Soyuzkarta receive data several weeks to several months after their orders.[137] This is wholly unsatisfactory to media which must deliver news within twenty-four hours after an incident.

To ensure independence from government control and to satisfy the above mentioned imperatives of spatial resolution and speed, a separate organization - Mediasat - is contemplated, in the United States.[138] The setting up and the operation of such a satellite system would, of course, have to be done in accord with United States and international law.

The Land Remote Sensing Commercialization Act of 1984,[139] applies to a specific licensing system with a view to ensuring private sector compliance with existing international law, United States national concerns and the public welfare. Among current international agreements to which the United States is a party, Article VI of the Outer Space Treaty explicitly provides for states' international responsibility and the obligation to exercise supervision (the interpretation of both terms remains open) over space ventures of their nationals and national private enterprises:

> [s]tates Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including

> the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization. [emphasis added]

Article IX of the Outer Space Treaty is also relevant in this context because it provides, *inter alia*, that a State party to the Treaty that has reason to believe that an activity or experiment planned by it or its nationals or by another state in space would cause potentially harmful interference with activities of other States parties in the peaceful exploration and use of outer space, **shall undertake appropriate international consultations before proceeding with any such activity or experiment.** [emphasis added.]

The obligation to hold consultations before a space activity with a potential for interference with other users of outer space is undertaken by a private entity such as Mediasat reinforces the state of registry's obligation with respect to the authorization and continuing supervision of private activities of its nationals.[140]

As far as U.S. national security is concerned, U.S. federal espionage laws prohibit gathering, transmitting, photographing, publishing or selling defence information as well as disclosing classified information.[141] On the other hand, the Commercial Space Transportation Act of 1984 provides that "mission approval will be granted absent clear evidence that some aspect of the proposed launch poses a threat to distinct U.S. national security interests."[142] Further, Section 4241(b) of the Land Remote Sensing Act stipulates:

> No license shall be granted by the Secretary [of Commerce] unless the Secretary determines in writing that the applicant will comply with the requirements of this Act, any regulations issued pursuant to this Act, and any applicable international obligations".[143]

Those who seek a license must act and operate that system "in such manner as to preserve and promote the national security of the United States".[144] The Secretary of Commerce also has the authority to grant, terminate, modify, condition, transfer or suspend licenses should the licensee fail to comply with the Act.[145]

As can be seen, the licensing and the operation of Mediasat would be subject to a number of restrictions. Some attorneys are of the opinion that such a licensing system is not in accord with the First Amendment of the United States Constitution, which ensures no law may be enacted to abridge the freedom of the press.[146] Licence restrictions with respect to resolution, the areas where imagery may be taken and dissemination of data could constitute a prior restraint of freedom of speech, a restriction allowed under U.S. law only to prevent direct, immediate and irreparable damage to the United States and its nationals.[147] Thus, it is probably high cost and government restrictions rather than technological obstacles that would likely prevent the media industry from placing into orbit their own satellite system in the immediate future. However, once the media decide to proceed with their own information-gathering satellite system, such a system could and probably would have a role, though an informal one, in the global monitoring process. That is, at least, the hope of some commentators.[148]

2. **The International Agency for Space Surveillance (IASS)**

At this time, comprehensive monitoring of outer space activities is carried out only by the United States and Russia, the only two countries possessing well developed ground-based and space-based means of surveillance. Three Italian scientists, including Professor Bruno Bertotti, an adviser to the Italian government, find this situation unsatisfactory, believing that an "international regime seems by far superior to the proliferation of national means of verification, which are inefficient and unfair."[149] They have recommended an international system for the surveillance of what they call "dangerous space activities". Among such activities they include "anti-satellite weapons, spacecraft carrying radioactive material on board, uncontrolled re-entry of space objects, and explosions or collisions generating swarms of orbiting debris".[150] Even assuming that the current absence of confrontation between the great powers in space will continue, the authors note that "military applications in space can be expected to develop qualitatively, and quantitatively, increasing the fuzziness of the demarcation between stabilizing and potentially dangerous activities. ... Eventually, these developments could undermine the regime of non-interference."[151] Monitoring "potentially dangerous" space activities, in the opinion of these authors, could be best ensured on a multilateral basis, by an "International Agency for Space Surveillance". Such an agency, they suggest, should concentrate on monitoring particular spacecraft in selected Earth orbits,[152] rather than attempt to monitor systematically every space object. What is interesting about their proposed agency is that it would, at least in its initial configuration, conduct the monitoring exclusively from land-based facilities.

The minimum requirements for setting up the agency would include: (a) tracking stations equipped with radar, telescopic cameras, radio receivers and phase-sensitive radars; (b) an operations control center (OCC) to collect and process the data and provide the stations with an observation schedule; and (c) a reliable communication and data link network connecting the OCC with the stations.[153]

As the authors readily admit, the key to the implementation of their proposal would be the cost of the enterprise. If the initial structure of the agency were of limited size, based on current-technology, they reckon the cost would not exceed "several tens of millions of dollars for the initial investment and a fraction of this sum for the annual expenditure."[154] This pales in comparison with the cost of a verification system for conventional arms control in Europe, estimated to be about 500 million ECU initially and 175 million ECU per year.[155]

While an organization such as the proposed IASS could not monitor land-based objects and activities, it could, at a relatively modest cost, provide a significant instrument of surveillance of events occurring in the lower orbits around the Earth. What is particularly noteworthy about this private initiative is the strong belief of the authors that international monitoring is preferable to national monitoring.

CHAPTER VI - ENDNOTES

1. UN GAOR, 40th Sess., UN Doc. A/40/192 (1985). CD/639 21 August 1985 is almost the same document, with minor differences in wording from A/40/192; see also, CD/PV.-322, in which the Soviet delegation addressed the importance of "Star Peace" and proposed that an international conference be convened not later than 1987 to set up an international space organization.

2. Ibid. at 5-6.

3. Ibid. at 6.

4. Ibid. at 7. The draft resolution was re-issued for technical reasons in UN GAOR, 40th Sess., UN Doc. A/C.1/40/L.1 (1985).

5. UN GAOR, 40th Sess., 6th Mtg., UN Doc. A/40/PV.6 (1985) [provisional] at 78.

6. Ibid. The catchphrase "star peace" is also found in, e.g., CD/PV.341 (20 February 1986), CD/PV.364 (24 June 1986), CD/PV.377 (7 August 1986), and CD/729 (25 August 1986).

7. UN GAOR, 40th Sess., 48th Mtg., UN Doc. A/40/PV.48 (1985) [provisional] at 62.

8. Ibid. at 57-68.

9. Prevention of Arms Race in Outer Space, GA Res. 40/87, UN GAOR 40th Sess., UN Doc. A/40/87 (1986).

10. Nikolai Ryzkov's message is reproduced in Union of Soviet Socialist Republics Mission to the United Nations Press-Release No. 96 (June 13,1986).

11. V. Vereshchetin & Dr. E. Kamenetskaya, "On the Way to a World Space Organization" (1987) 12 Annals of Air & Space L. 337; see also A.S. Piradov, "Creating a World Space Organization: A Global Approach to Mastering Space" (1988) 4 Space Policy 112.

12. Vereshchetin & Kamenetskaya, ibid. at 338-39. Ryzhkov's message at 3-5.

13. Vereshchetin & Kamenetskaya, ibid. at 344.

14. C. Covault, "Soviet Endorses French Proposal for Space Reconnaissance Agency" (24 Oct. 1988) AWST at 23.

15. P. Lewis, "Soviets Press Offer on Disputed Radar", New York Times, (28 Sept. 1988) A3. A radar at Abalakuo, near the city of Krasnoyarsk, was first spotted on American Satellite photos in 1983, and the US had long charged that the radar violated the ABM Treaty, as it was not situated on the periphery of Soviet territory and oriented outward as the Treaty required in order not to permit the development of a nationwide anti-missile defence. While the Soviet Union denied the violation of ABM Treaty, it nevertheless imposed a one year moratorium on further work on the radar alleging that it had not been in operation since October 1987. Later, the Soviet Union stated that the radar would be dismantled if the US agreed to adhere to the ABM Treaty, the traditional interpretation of which limits the scope of anti-missile tests in space. The Reagan administration, on the other hand, had advanced a "broad" interpretation of the Treaty, which would allow an expanded pattern of tests on an anti-missile defence system. After the USSR agreed to dismantle the radars in September 1989, by letter from Secretary-General Gorbachev to President Bush in October, Mr. Shevardnadze told the Soviet legislature in Moscow that the Krasnoyarsk radar was in open violation of the ABM Treaty and added that the Kremlin had known that for some time. M.R. Gordon, "US Aides Are Split on Soviet Treaty Compliance", New York Times (28 June 1988) A15; M.R. Gordon, "Split is Reported over ABM Accord", New York Times (15 July 1988) A5; P. Taubman, "Moscow proposes to Remove Radar at a Siberian Site", New York Times, (20 July 1988) A1 & 7; M.R. Gordon, "US Welcomes Soviet Radar Proposal", New York Times (21 July 1988) A3; M.R. Gordon, "Radar Removal: Two Tracks?" New York Times (22 July 1988) A7; M.R. Gordon, "US Delays Move on Soviet Radar", New York Times (9 August 1988) A9; M.R. Gordon, "Moscow Links Disputed Radar to '72 ABM Treaty", New York Times (14 May 1989) 8; R.N. Perle, "Soviet Nuclear Blackmail", New York Times (17 May 1989) A27K; B. Keller, "Moscow Says Afgan Role was Illegal and Immoral: Admits Breaking Arms Pact" New York Times (24 Oct. 1989) A1 & 14; M.R. Gordon, "US Officials Hail New Soviet Stance" New York Times (24 Oct. 1989) A14.

16. UN GAOR, 43d Sess., 4th Mtg., UN Doc. A/C.1/43/PV.4 (1988) at 61.

17. T.E. Cremins, "Security in the Space Age" (1990) 6 Space Policy 33 at 39.

18. UN GAOR, Committee on Peaceful Uses of Outer Space, International Cooperation in the Peaceful Uses of Outer Space, UN Doc. A/AC.105/407 (1988).

19. Only para. 8(e) mentioned disarmament: "Carry out, through inter-state machinery, the functions of supra-national monitoring of compliance with long-term multi-lateral agreements on preventing an arms race in outer space and halting it on Earth."

20. UN GAOR, COPUOS 31st Sess., UN Doc. A/AC.105/L.171 (1988).

21. Ibid. para. IV.

22. Ibid. para. VIII.

23. CD/817-CD/OS/WP.19 (1988)

24. Ibid. at 2-3.

25. Ibid. at 4-5.

26. Ibid. at 5-6.

27. Ibid. at 6.

28. Ibid. at 7.

29. See e.g., CD/PV.449 (17 March 1988) at 13.

30. CD/OS/WP.18 (1987).

31. Both the Soviet International Space Inspectorate proposal and the GDR structured discussion proposal are mentioned in CD/833 (25 August 1988), special report of the ad hoc committee on the prevention of arms race in outer space, para. 25.

32. M.L. Stojak, "The Role of the United Nations in Verification: An Outer Space Case Study", in N.M. Matte, ed., Arms Control and Disarmament in Outer Space: Towards Open Skies, vol. 3 (Montreal: CRASL, 1989) 185 at 192.

33. With regard to Paxsat, infra, Section B.1 of this Chapter.

34. Covault, supra, note 14 at 23.

35. CD/OS/WP.39 (2 August 1989).

36. Ibid. at 5.

37. Ibid. at 6.

38. Emphasis added. Ibid. at 4.

39. CD/954 (24 August 1989) paras. 65 & 66.

40. UN GAOR UN Doc. A/S-15/34 (1988); see also CD/937-CD/OS/WP.39 (21 July 1989) at 4.

41. CD/954-CD/OS/WP.40 (1 August 1989) at 2-4.

42. Ibid. at 5.

43. Ibid. at 6. CD/937-CD/OS/WP.35 at 5.

44. CD/954 (24 August 1989) para. 67.

45. CD/937-CD/OS/WP.35 at 5.

46. See e.g., D.R. Goyal, ed., Nuclear Disarmament : The Six-Nation Initiative and the Big Power Response (New Delhi: Sterling, 1987) appendix 1 at 59-62. The six signatories also issued a joint message in CD/676 (10 March 1986) to the leaders of the USA and the USSR.

47. CD/807 (19 Feb. 1988).

48. UN GAOR, UN Doc. A/S-15/AC.1/1 (1988).

49. Cremins, supra, note 17, at 38-39.

50. Ibid. at 39.

51. Dept. of External Affairs of Canada, Paxsat Concept: The Application of Space-Based Remote Sensing for Arms Control Verification, Verification Brochure No. 2 (Ottawa, 1986) [hereinafter the Paxsat Concept]; see also, F.R. Cleminson, "Paxsat and Progress in Arms Control: Canadian Research Focuses on Remote Sensing Applications" (1988) 4 Space Policy 97.

52. R. Cleminson, "Multilateralism in the Arms Control and Verification Process--A Canadian Perspective" in N.M. Matte, ed., Arms Control and Disarmament in Outer Space, vol. 2 (Montreal: CRASL, 1987) 39 at 48.

53. Ibid.

54. Reportedly, the third system was later dismissed and a treaty to dismantle space weapons, negotiated primarily by the superpowers but extended to multilateral participation was thought to be politically more appropriate. It should be noted, accordingly that the recession of the third system does not stem from technological deficiencies. See F.J.F. Osborne, "The Paxsat Concept: A Study of Space to Space Remote Sensing", in J. O'Manique, ed., A Proxy for Trust: Views on the Verification Issue in Arms Control and Disarmament Negotiations, (Ottawa: The Norman Paterson School of International Affairs, Carlton Univ., 1985) 89 at 91-92.

55. Paxsat Concept, supra, note 51 at 41.

56. F.R.S. Cleminson, "The Feasibility of Space-Based Remote Sensing in the Verification of a Treaty to Prevent an Arms Race in Outer Space", in N.M. Matte, ed., An Arms Race in Outer Space: Could Treaties Prevent It? (Montreal: CRASL, 1985) 13 at 16-19; F.J.F. Osborne, "Comments for Panel on State of the Art in Remote Sensing Technology" in N.M. Matte, ed., Space Surveillance for Arms Control and Verification: Options, (Montreal: CRASL, 1987)49 at 50.

57. Osborne, supra, note 54 at 91.

58. Paxsat Concept, supra, note 51 at 44.

59. Dept. of External Affairs of Canada, Confidence (and Security) Building Measures in the Arms Control Process: A Canadian Perspective (Arms Control and Disarmament Studies No. 1) (August 1985) at 28-29.

60. Paxsat Concept, supra, note 51 at 44.

61. 'Detection' level requires location of a class of units, object or activity interest. 'General identification' requires determination of general target type. 'Precise identification' requires discrimination within target types of known types. 'Description' requires size/dimension, configuration/layout, components construction, count of equipment. Highest level required for monitoring is 'Analysis, which requires up to 10 cm resolution. See Appendix 3.

62. Dept. of External Affairs of Canada, 10 The Disarmament Bulletin (1989) at 12-13.

63. Ibid., at 36.

64. CD/786 (24 August 1987) para. 42; CD/870 (12 Sept. 1988) para. 41; CD/954 (24 August 1989) para. 65.

65. Paxsat Concept, supra, note 51 at 44.

66. UN GAOR 12th Spec. Sess., UN Doc. A/S-12/AC.1/55 (1982) at 2.

67. UN GAOR 37th Sess., Plen. Mtg., at 1638, UN Doc. A/37/-PV.98 (1982). It became UN Res.37/78K.

68. UN GAOR 38th Sess., at 2-3, UN Doc. A/38/404 (1982).

69. See supra, Chapter V.

70. B. d'Aboville & M. Guionnet, "The ISMA Proposal--Time for Reappraisal?" (1986) 2 Space Policy 153 at 153-54.

71. See B. Jasani, "Use of Space Technology for Preventing Wars" (1984) unpublished paper, at Tokyo Seminar on Peace, Science and Technology sponsored by the United Nations University, at 5.

72. ESA's members are Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, Switzerland and the UK. Austria and Norway are associate members, and Canada is an observer.

73. Bulgaria, Cuba, Czechoslovakia, GRD, Hungary, Mongolia, Poland, Romania, and the USSR are members of the Interkosmos Council. The future of this organization is very much in doubt as the time of this writing (June 1992).

74. The Address by the President at the Inter-parliamentary Conference of the Assembly of the Western European Union (WEU) held in London on 5 Sept. 1989. Reprinted in "Documentation" (1989) 5 Space Policy 345.

75. Council of Europe Doc. AS/Science (34) 7 July 1982, see also, C. Voute, "ISMA Proposals" (1985) 1 Space Policy 106 at 107. Concerning UNISPACE 82, see Report of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, UN Doc. A/Conf.101/10 (1982).

76. Council of Europe, Parliamentary Assembly debate on 24 Jan. 1983, Report of the Committee on Science and Technology, Council of Europe Document No. 4998, reprinted in " Documentation" (1985) 1 Space Policy 111 at 113; also reprinted in C. Voute, "The ISMA Proposal and European Political Climate" (1987) in B. Jasani & T.

Sakata, eds., Satellites for Arms Control and Crisis Monitoring (Oxford: Oxford Univ. Press, 1987) at 144 (Annex 3).

77. Ibid.

78. Voute, supra, note 76 at 136.

79. Parliamentary Assembly of the Council of Europe, North-South Conference: Europe's Role, Council of Europe Document AS/CEC (84) 4, 1984, para. 11, see also, Voute, supra, note 76, at 131-32 and 136.

80. C. Voute, "A European Military Space Community" (1986) 2 Space Policy 206 at 209, from official text of the address by Mitterand, 7 Feb. 1984. See also, "Extract from President Mitterand's Speech, the Hague, 7 February 1984", reprinted in "Documentation " (1985) 1 Space Policy 111 at 114.

81. Ibid., see also Voute, supra, note 76 at 131.

82. Voute, supra, note 80 at 217.

83. Belgium, France, Germany, Italy, Luxembourg, the Netherlands, and the UK (the European NATO partners and France). Two another countries are in the process of joining the WEU.

84. Assembly of Western European Union, Proceedings of the Thirtieth Ordinary Session (Second Part) III: Assembly Documents, Documents 996 (WEU: Paris, Dec. 1984). Reprinted in Voute, supra, note 88, at 142-43.

85. Ibid. at (ix).

86. Ibid. at 4 [emphasis added].

87. Ibid. at 7.

88. Supra, note 74, at 345.

89. Ibid.

90. Ibid.

91. Ibid.

92. M. Guionnet, "A Framework for a Regional Satellite Monitoring Agency" (1987), in Jasani & Sakata, eds., supra, note 76, 124 at 126.

93. Convention for the Establishment of a European Space Agency, 30 May 1975, 1 Basic Texts of the European Space Agency A6 (entered into force 30 October 1980) (this convention is reprinted in N. Jasentuliyana, and R.S.K. Lee, eds., Manual on Space Law (New York: Oceana, 1979).

94. Article II Purpose "The purpose of the Agency shall be to provide for and to promote, for exclusively peaceful purposes, co-operation among European states in space research and technology and their space applications, with a view to their being used for scientific purposes and for operational space applications systems: (a) by elaborating and implementing a long-term European space policy, by recommending space objectives to the member states, and by concerting the policies of the member states with respect to other national and international organizations and institutions; (b) by elaborating and implementing activities and programmes in the space field; (c) by co-ordinating the European space programme and national programmes, and by integrating the latter progressively and as completely as possible into the European space programme, in particular as regards the development of application satellites; (d) by elaborating and implementing the industrial policy appropriate to its programme and by recommending a coherent industrial policy to the member states."

95. Voute, supra, note 80, at 217.

96. Guionnet, supra, note 92, at 126. B. Jasani evaluates that a satellite monitoring agency in ESA is "fully compatible with cooperation for peaceful purposes in the field of application of peace technology" while some questions are also put towards the interests of neutral and non-aligned states. See B. Jasani, "Arms Control and Conflict Observation Satellites" (1985) 1 Space Policy 363 at 367.

97. Voute, supra, note 76, 134. Voute, supra, note 80, at 217, Guionnet, ibid., at 127.

98. Guionnet, ibid., at 126

99. Voute, supra, note 80, at 215.

100. Guionnet, supra, note 92, at 126.

101. Voute, supra, note 80, at 216.

102. Ibid., at 214-45.

103. Guionnet, <u>supra</u>, note 92, at 128.

104. <u>Ibid.</u> at 127.

105. Belgium, Denmark, France, Germany, Greece, Luxemburg, the Netherlands, Norway, Turkey and the UK are the members of the IEPG which was established in 1976.

106. Guionnet, <u>supra</u>, note 92, at 128.

107. Voute, <u>supra</u>, note 80, at 214.

108. G. de Biganti, "Europeans Split on Verification Satellite Need", Space News (2-9 April 1990).

109. <u>Ibid.</u>

110. Military photographic reconnaissance satellite, Helios is being developed by France, Italy and Spain. See Chapter III-E-3.

111. de Briganti, <u>supra</u>, note 108; see also, "Western European Union - Basis for a European Verification Agency?", (1990) 6 Space Policy 248.

112. B. Jasani, <u>supra</u>, note 96, at 367.

113. <u>Ibid.</u>, at 367-68.

114. <u>Ibid.</u>

115. See The Swedish Board for Space Activities, Verification Study of a Verification Satellite "Project Tellus" Final Report (1988).

116. <u>Ibid.</u>

117. See <u>e.g.</u>, J. Boulden, "1990 Open Skies Conference in Canada" (1989) 4:4 Peace & Security 13.

118. The text of the Stockholm Declaration is found in ACDA, <u>Arms Control and Disarmament Agreements: Texts and Histories of Negotiations</u> (Washington: GPO, 1990) 319ff. Stockholm Declaration of 1986 para. 89 provides:

"(89) The inspecting State will specify whether aerial inspection will be conducted using an airplane, a helicopter or both. Aircraft for inspection will be chosen by mutual agreement between the inspection and receiving States. Aircraft will be chosen which provide the inspection team continuous view of the ground during the inspection.

(90) After the flight plan, specifying , inter alia, the inspection team's choice of flight path, speed and altitude in the specified area, has been filed with the competent air traffic control authority the inspection aircraft will be permitted to enter the specified area without delay. Within the specified area, the inspection team will, at its request, be permitted to deviate from the approved flight plan to make specific observations provided such deviation is consistent with paragraph (74) as well as flight safety and air traffic requirements. Directions to the crew will be given through a representative of the receiving State on board the aircraft involved in the inspection.

(91) One member of the inspection team will be permitted, if such a request is made, at any time to observe data on navigational equipment of the aircraft and to have access to maps and charts used by the flight crew for the purpose of determining the exact location of the aircraft during the inspection flight.

(92) Aerial and ground inspectors may return to the specified area as often as desired within the 48-hour inspection period."

119. F.R. Cleminson, "Open Skies: Challenge for the 1990s" in N.M. Matte, supra note 32, 41 at 44.

120. Transcript of Bush's Remarks on Transforming Soviet-America Relations" The New York Times (13 May 1986) A6.

121. External Affairs and International Trade Canada, The Disarmament Bulletin No.12 (1989/90) at 4 [hereinafter EAITC].

122. R. Purver,"Arms Control Digest" (1989) 4:4 Peace & Security 12.

123. EAITC, supra, note 121 at 4.

124. The Basic Elements Paper on Open Skies is reprinted in EAITC, ibid., at 10-12.

125. First two days were allotted for the ministerial portion of the conference, and the rest of the conference was

headed by the officials of representatives from all the NATO and the Warsaw Pact States.

126. The Treaty was signed on March 24, 1992.

127. The details of the Open Skies Agreement is not available to the public as of June 1992. For a reference, see e.g., U.S. Dep't of State, Fact Sheet Open Skies Conference (9 February 1990) 5; D. Hughes, "Open Skies Treaty will Give 23 Nations Surveillance Rights"(19 February 1990) AWST 20.

128. More than thirty U.S. government institutions and private firms requested Soviet satellite images immediately after the Soviet announcement of its participation in the remote sensing market in 1987. Soyuzkarta was, at that time, expected to offer five meter resolution images using KFA-100 camera. See M.L. Stojak, "Observation on Arms Control in Outer Space and Verification Issues at the Conference on Disarmament" in N.M. Matte, ed., Space Surveillance for Arms Control and Verification: Options (Montreal: CRASL, 1987) 147 at 154.

129. When Landsat data began to be available, many experts believed that remote sensing could soon become a thriving industry with a little experience and a little government support, which turned out to be overly optimistic. Today, the overall market is still weak. This holds also for applications such as mineral exploitation, forestry and agriculture which are cost-effective in comparison with other means of gathering information. See Office of Technology Assessment, Commercial Newsgathering from Space: A Technical Memorandum, (Washington: GPO, 1987) at 17 [hereinafter referred to as "OTA Memorandum"].

130. Ibid., at 11. Other non-governmental organizations such as academic and research institutions and consulting firms began to use remotely-sensed data as well. They usually rely on outside contractors to have satellite data interpreted rather than hiring their own photo-interpreters. For example, the Ocean Earth Construction and Development Corporation, founded in 1980, surveys and analyzes civilian satellite data on national security matters (their service included the Falklands war and Iran/Iraq war) and disseminates them through media organizations. A Swedish firm, Space Media Network, has been also providing the media with analyzed data since 1986. See G.P. Sloup, "Arms Control Verification: The Poor Person's Approach" (1986) 29 Colloquium of IISL 77 at 81.

131. Ibid., at 15; R. DalBello & R.A. Williamson, "Gathering News from Space" (1987) 3 Space Policy 298.

132. G.P. Sloup, "Mediasat, Gray Reconnaissance and the New United Nations Principles on Remote Sensing" (1987) 30 Colloquium of IISL 385 at 392.

133. M.E. Brender, "Remote Sensing Satellite and the First Amendment" (1987) 3 Space Policy 293 at 295.

134. OTA Memorandum, supra, note 129 at 1.

135. R. DalBello, "The Legal and Political Implications of Media Newsgathering from Space" (1987) 30 Colloquium of IISL 279 at 270-80; see also, OTA Memorandum, ibid. at 8-11.

136. OTA Memorandum, ibid., at 23. For instance, if the spatial resolution improves from ten meters to five meters, the amount of data to be obtained, transmitted and processed would increase four times. Thus, while EOSAT's thirty meter resolution sensors obtain a data of 85 million bites per second, Radarsat's five meters resolution sensors of the same swath width would obtain 3,060 million bites per second.

137. DalBello & Williamson, supra, note 131 at 302.

138. R.J. Aamoth, "From Landsat to Mediasat: The Development of Remote-Sensing Technology and the First Amendment Right of the Press", P.A. Bruck, ed., A Proxy for Knowledge: The News Media as Agents in Arms Control Verification (Ottawa: The Norman Paterson School of International Affairs, Carleton University Proceedings, 1988) 125 at 129 and 141.

139. P.L. 98-365 (HR 5155) (July 17, 1984). 15 U.S.C.S. sections 4201-92.

140. R. DalBello, "The Land Remote Sensing Commercialization Act of 1984" (1985) 1 Space Policy 289 at 290-91.

141. 18 U.S.C. 792. See also, DalBello, supra, note 135 at 282.

142. 15 U.S.C. sec. 4242(b)(1). DalBello, ibid., at 287.

143. 15 U.S.C.S. sec. 4041 (Title IV, sec. 401). Department of Commerce issued the final rules and regulations to implement the Land Remote Sensing Act of 1987. The Secretary of Commerce, before licensing, must consult

with the Secretary of State and Secretary of Defense in order to ensure that national security and foreign policy would be intact.

144. Ibid. sec. 4242(b)(1) (Title IV, sec. 402(b)(1)). The Department of Commerce rejected media's request to stipulate more specific guidelines on licensing. See DalBello, supra, note 135 at 283.

145. Ibid. sec. 4043(1).

146. In regard to the freedom of speech and press and first amendment, see U.S.C.S. Constitution Articles IV-VII Amendment 1-4 (New York: Bancroft-Whitney, 1986) at 238-46; Aamoth, supra, note 138 at 133-40.

147. OTA Memorandum, supra, note 129 at 6 and 35; see also, C. Voute, "Some Consequences of the Commercialization of Satellite Remote Sensing" (1987) 3 Space Policy 307 at 309-11. Washington attorney Aamoth claims that the regulations have to meet two requirements: (1) susceptible of objective measurement, and (2) narrow specificity. The Land Remote Sensing Act fails these requirements since neither "national security" nor "international obligations" delineated in section 4241(b) is defined or places meaningful limits on the discretionary power of the Secretary of Commerce under Title IV of the Act. Aamoth concluded that the government could not meet the heavy burden of proof to deny the full First Amendment protection towards newsgathering from space. See Aamoth, supra, note 138 at 129-44.

148. See e.g., J.A. Schear, "Verification: A Role for the Media?" in P.A. Bruck, ed., supra, note 138 101.

149. H. Anselmo, B. Bertotti & P. Farinella, "International Surveillance of Outer Space for Security Purposes" (1991) 7 Space Policy 184.

150. Ibid.

151. Ibid., at 185.

152. Ibid., at 187.

153. Ibid., at 192.

154. Ibid., at 195.

155. Ibid.

CONCLUSION

Since its inception in 1978, first as the Committee on Disarmament and later as the Conference on Disarmament (CD), this major multilateral body of the world community has yet to produce a single disarmament treaty. The current agenda of the CD was agreed upon by consensus and reflects the priorities identified at SSOD I.[1] Thus, nuclear disarmament is accorded a much higher priority than other types of disarmament or disarmament-related issues (e.g., monitoring and verification of arms control and disarmament agreements), as if nothing had changed in the arena of world politics since 1978. After fourteen years of debate and negotiations, most of the Conference's agenda remains unfinished, the only tangible accomplishment being the still incomplete draft of the Chemical Weapons Convention. One of the reasons for this lack of achievement can be traced, apart from the CD's agenda, to the tendency on the part of many participants to engage in overly generalized and sweeping approaches to a problem (e.g., the "Comprehensive Program of Disarmament"), or in endless and largely fruitless definitional debates (e.g., several years spent on the definition of a "space weapon").

Despite such meagre results in terms of formal agreements, if the CD did not exist, it would have to be invented. For fourteen years now, this world-wide negotiating body of relatively limited size (thirty-nine member states) but geopolitically representative, has provided a platform for open deliberation and negotiation to states with greatly different interests and concerns. The high level of professional competence characteristic of many of the state representatives on the CD, makes this body potentially of great value in all phases of the disarmament process. The Conference on Disarmament, in permanent session for a good deal of the year, is and will remain in the foreseeable future the sole multilateral negotiating forum in the field of disarmament and arms control. What is needed is a strong request by the U.N. General Assembly addressed to the CD asking this body to concentrate on certain specific, clearly defined issues.

It is widely recognized that issues of confidence-building measures, transparency in armaments and monitoring compliance with arms control and disarmament agreements are currently issues that merit the special attention of the Conference. At its 1991 session, the U.N. General Assembly requested the CD, *inter alia*, to address the question of and "to elaborate universal and non-discriminatory practical means to increase openness and transparency in the field [of disarmament]".[2]

Most nations and especially the U.N. Security Council need a whole range of reliable information about global crisis spots, other threats to peace and whether parties to disarmament agreements comply with their treaty obligations. Before making a judgment in accordance with Article 39 of the Charter (breach of peace; threats to the peace; acts of aggression), it is of crucial importance that the Council be fully aware of a state's conduct with regard to its disarmament obligations.

As has been demonstrated earlier, most existing multilateral arms control and disarmament agreements, while containing more or less vague provisions on verification, do not entrust any international organization with the task of monitoring compliance. The one exception to this situation is the Non-Proliferation Treaty which entrusts the International Atomic Energy Agency with the administration of a safeguard system. The future Convention on Chemical Weapons will create an entirely new organization for purposes of verification. Efforts to monitor compliance both with multilateral and bilateral arms control agreements have resulted in the development in the United States and the former Soviet Union of an impressive array of observation techniques or "national technical means of verification". These systems range from sophisticated optical and infrared satellite photography, radar and other remote electronic sensors, to traditional espionage and overt diplomatic contacts with officials and citizens of the target country.

Verification is today largely unilateral and non-cooperative. Each state makes its own evaluations; it reacts to any breach of an agreement to which it is a party on the basis of its own interests. As a result, in the absence of a collective process, verification appears to be not a guarantee that the agreement will be implemented but a guarantee of the individual security of the parties. Each state, on the basis of its unilaterally acquired information, may consider itself justified in taking countermeasures which are harmful to the agreement itself, or may even withdraw from it. Yet, as has been amply documented in this study, few countries today possess the technical and financial means which would allow them to monitor compliance with a multitude of arms control treaties to which they are parties, involving many countries and environments (e.g., the seabed, the oceans, the land, the airspace and outer space).

Continuous and reliable monitoring, one that provides a steady flow of up-to-date data and one that enjoys the confidence of states, can easily be recognized as an important factor for the enhancement of mutual confidence among parties to various arms control and disarmament treaties. The obvious solution to the problem outlined above lies in the establishment of a multilateral agency for verification and monitoring. The Conference on Disarmament would be an ideal forum for discussing and negotiating the creation of such an agency. Given the non-intrusive nature of space-based means of surveillance, it would seem that the setting up of an agency using satellites for purposes of monitoring compliance with disarmament agreements would encounter the least opposition.

It will be recalled that already the 1986 Stockholm Document refers to satellites when it states that "the participating States recognize the National Technical Means can play a role in monitoring compliance with agreed Confidence-and-Security-Building measures". Article XV of the CFE Treaty provides that every party shall have the right to use national or multinational technical means of verification at its disposal in a manner consistent with generally recognized principles of international law and that no party shall interfere with these systems or use concealment measures that impede verification of compliance by NTMs. Possibly, as a first step toward the establishment of a regional, European, organization, the Western European Union reportedly at the end of 1992 will start to operate a satellite data analysis center using images from commercial satellites like SPOT and Landsat; later on, it will use images produced by the French-Spanish-Italian HELIOS satellite, to be launched in 1993-94. Other data producers, like Russian Soyuzkarta, may also be used.[3] Information thus obtained will be used for monitoring arms control treaties, crises and environmental disasters. It is virtually certain, in view of recent events in central and eastern Europe, that participation in this WEU initiative will be open to all interested European countries.

While this European plan inaugurating a multilateral monitoring satellite system merits support, it nevertheless leaves out over one hundred member states of the United

Nations. It includes a majority of the world's most technologically advanced nations, even if Russia is not counted as a participant. Many of the countries left out enthusiastically endorsed the concept of the International Satellite Monitoring Agency (ISMA) following the submission to the U.N. General Assembly of the ISMA Report prepared by a Group of Experts appointed by the U.N. Secretary-General. What prevented this concept from receiving more attention subsequently was the fact that it was submitted to the U.N. during the height of the Cold War, when neither of the superpowers was willing to share information collected by satellites with an organization which it could not control. In addition, the cost of the implementation of an ISMA was being exaggerated by the opponents of this French initiative. The present political conditions in Europe and in the North Atlantic area are totally different from those existing in the early 1980s. The former Soviet Union and the United States have become friends, Russia has become a more open country, and a leading supporter of collective measures in the maintenance of international peace and security. Most importantly in this context, as already mentioned, Russia is now a firm supporter of an ISMA. The time is therefore ripe to make meaningful progress on the road towards the establishment of a truly international satellite monitoring agency for the purpose of verifying compliance with disarmament agreements and for monitoring international crisis spots.[4] The excellent study prepared by the ISMA Group of Experts, unrivalled to this day in its comprehensiveness and moderation, could provide the Conference on Disarmament with a solid basis from which to proceed.

CONCLUSION - ENDNOTES

1. For a comparison of the CD's 1979 and 1992 agendas, see UNIDIR Newsletter (April 1992) at 22-23.

2. A. Kamal, "The Perspective of the Conference on Disarmament" (April 1992) UNIDIR Newsletter 18 at 19.

3. S. Sur. ed., Verification of Disarmament or Limitation of Armament: Instruments, Negotiations, Proposals, (New York: UNIDIR Publication, 1992) at 132.

4. See e.g., B. Jasani, "ISMA-Will it Ever Happen?" (1992) 8 Space Policy 13.

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- Convention on International Civil Aviation, 7 December 1944, 15 U.N.T.S. 295.

- Antarctic Treaty, 1 December 1959, 402 U.N.T.S. 702, 12 U.S.T. 794, T.I.A.S. No. 4780.

- Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water, 5 August 1963, 14 U.S.T. 1313, T.I.A.S. No. 5433, 460 U.N.T.S. 43.

- Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205.

- Treaty for Prohibition of Nuclear Weapons in Latin America, 14 February 1767, 33 U.S.T. 1792, T.I.A.S. No. 10147, U.N.T.S. 281.

- Agreement of the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 22 April 1968, 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119.

- Treaty on Non-Proliferation of Nuclear Weapons, 1 July 1968, 21 U.S.T. 483, T.I.A.S. No. 6839, 729 U.N.T.S. 161.

- Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof, 11 February 1971, 23 U.S.T. 161, T.I.A.S. No. 7337, 955 U.N.T.S. 115.

- Convention on International Liability for Damages Caused by Space Object, 29 March 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762, 961 U.N.T.S. 187.

- Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 10 April 1972, 1015 U.N.T.S. 163, 26 U.S.T. 583, T.I.A.S. No. 8062.

- Convention on Registration of Objects Launched into Outer Space, 14 January 1971, 28 U.S.T. 695, T.I.A.S. No. 8480, 1023 U.N.T.S. 15.

- Convention on the Prohibition of Military or any Other Hostile Use of Environmental Modification Techniques, 18 May 1977, 31 U.S.T. 333, T.I.A.S. No. 9614, 610 U.N.T.S. 151.

- Agreement Covering the Activities of States on the Moon and Other Celestial Bodies, 5 December 1979, UN GAOR, A/Res/32/68.

- Convention on the Prohibition or Restrictions on the Use of Certain Conventional Weapons Which may be Deemed to be Excessively Injurious or to Have Indiscriminate Effects, 10 October 1980, UN Doc. A/CONF.95/15.

- The South Pacific Nuclear Free Zone Treaty, 6 August 1985, 24 I.L.M. 1440.

- Treaty on Conventional Armed Forces in Europe, 19 November 1990, SIPRI Yearbook 1991 461.

- Treaty Between the United States of America and the USSR on the Limitation of Anti-Ballistic Missile Systems, 26 May 1972, 23 U.S.T. 3435, T.I.A.S. No. 7503, 864 U.N.T.S. 39.

- Interim Agreement Between the United States of America and the USSR on Certain Measures With Respect to the Limitation of Strategic Offensive Weapons, 26 May 1972, 23 U.S.T. 3461, T.I.A.S. No. 7504.

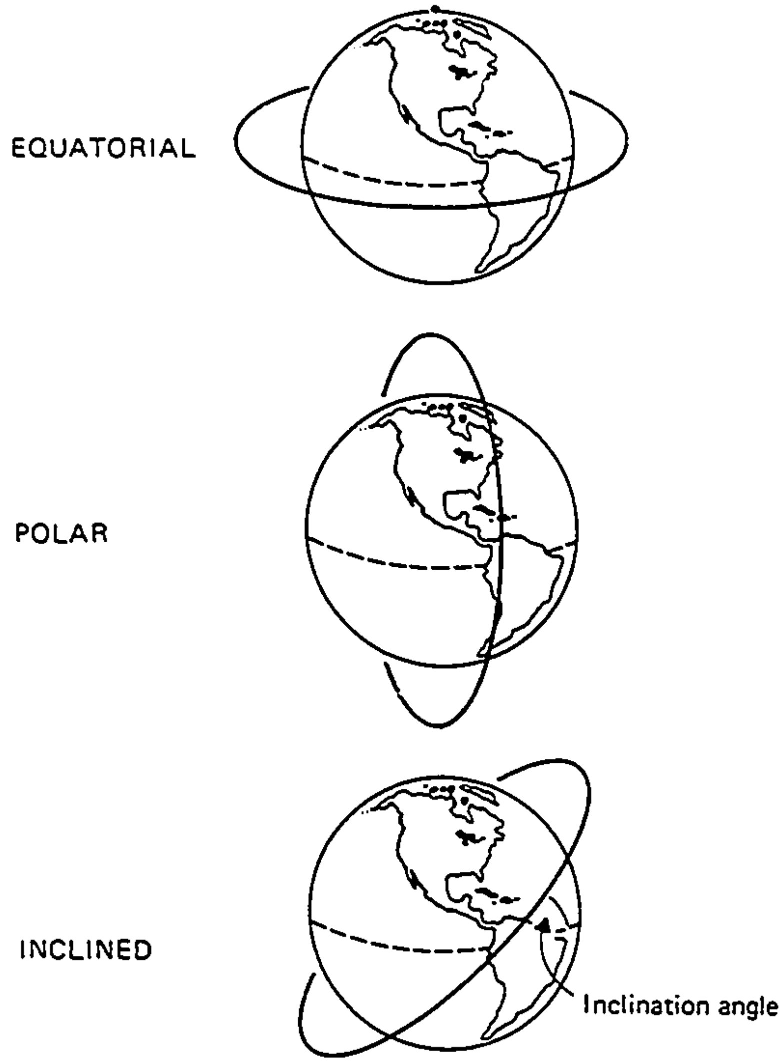
- Treaty Between the United States of America and the USSR on the Limitation of Underground Nuclear Weapons Tests, 3 July 1974.

- Treaty Between the United States of America and the USSR on Underground Nuclear Explosions for Peaceful Purposes, 28 May 1976.

- Treaty Between the United States of America and the USSR on the Limitation of Strategic Offensive Arms, 18 June 1979.

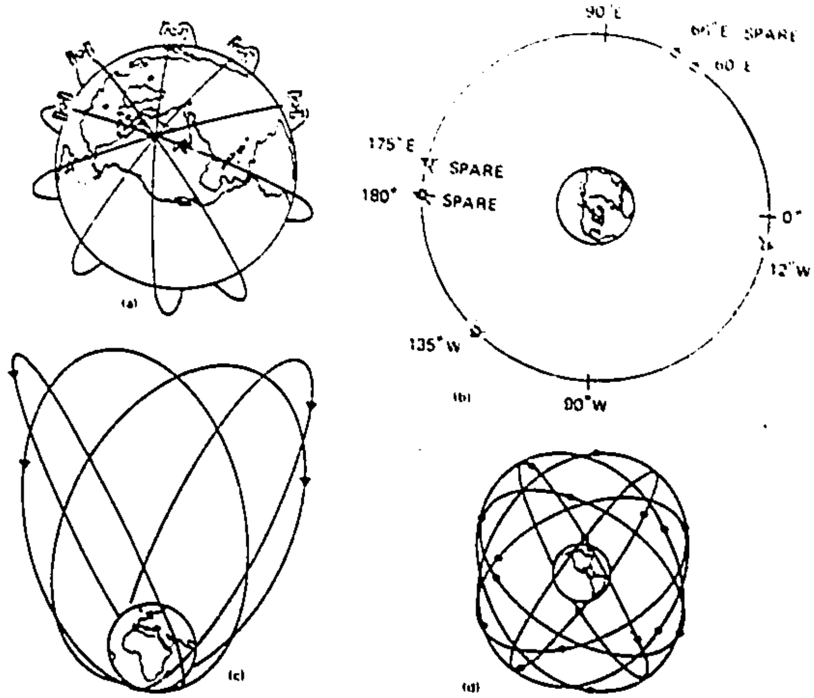
- Treaty Between the United States of America and the USSR on the Elimination of Their Intermediate-Range and Shorter-Range Missiles, 8 December 1987, 27 I.L.M. 84.

APPENDIX - 1



SPECIFICATIONS OF ORBIT TYPE include inclination angle as well as altitude. The inclination angle is the angle made by the orbital plane and the plane of the earth's equator. The orbits of most LEO military satellites are polar, Molniya orbits are always inclined, currently populated semi-synchronous orbits are inclined, and the GEO belt is equatorial.

Source: J.S. Nye & J.A. Schear, eds., Seeking Stability in Space: Anti-Satellite Weapons and the Evolving Space Regime (1985) at 32.



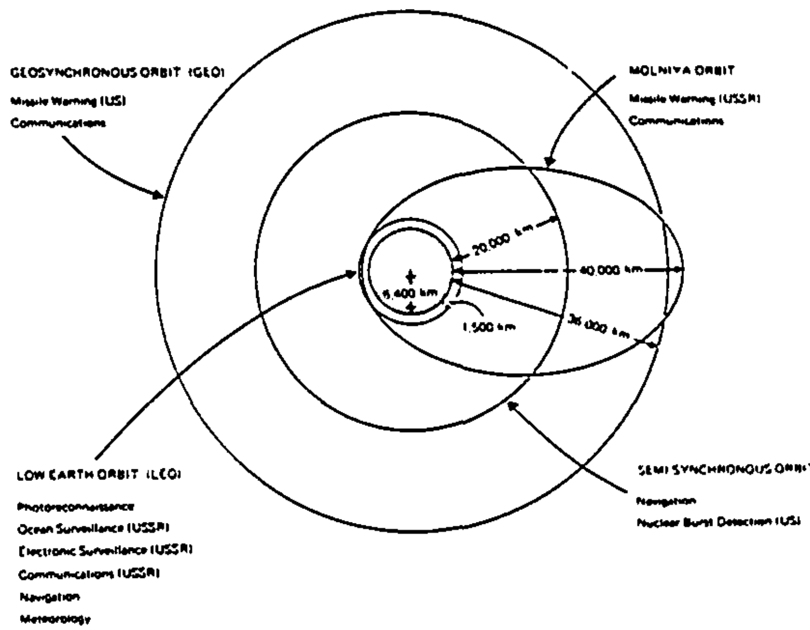
MILITARY SATELLITE CONSTELLATIONS illustrate the four orbit categories.

(a) Five U.S. TRANSIT navigation satellites in polar LEO, arranged in five separate orbital planes.

(b) Four U.S. DSCS communications satellites in GEO equatorial orbit.

(c) Four Soviet Molniya communications satellites in inclined Molniya (hence the orbit name) orbits, arranged in four planes.

(d) Eighteen U.S. Navstar GPS navigation and nuclear burst detection satellites in inclined semi-synchronous orbits, arranged in six planes.



. THE FOUR MAJOR ORBIT TYPES, drawn here to scale, contain almost all military satellites. The LEO region, represented here by a 1500 km (930 mi.) circular orbit, is subject to attack by both the U.S. and Soviet ASATs. The U.S. ASAT also has the propulsive capability to attack Molniya orbit, although it will not in fact have that capability in its proposed operational deployment; the Soviet ASAT cannot attack Molniya orbit. Neither ASAT can climb to semi-synchronous orbit or GEO. The nature and orbits of U.S. reconnaissance satellites are classified. The super-synchronous region above GEO is little populated today, but its vast reaches offer opportunities for satellite survivability that are likely to be exploited in the future.

Source: J.S. Nye & J.A. Schear, eds., Seeking Stability in Space: Anti-satellite Weapons and the Evolving Space Regime (1985) at 31 and 32.

APPENDIX - 3

Resolution (in metres) required for interpretation tasks

Target	Detection[a]	General identification[b]	Precise identification[c]	Description[d]	Analysis
Bridge	6	4.6	1.5	0.9	0.3
Communications					
Radar	3	0.9	0.3	0.15	0.04
Radio	3	1.5	0.3	0.15	0.15
Supply dump	1.5	0.6	0.3	0.03	0.03
Troop units	6	2	1.2	0.3	0.08
Airfield facilities	6	4.6	3	0.3	0.15
Rockets and artillery	0.9	0.6	0.15	0.05	0.01
Aircraft	4.6	1.5	0.9	0.15	0.03
Command and control headquarters	3	1.5	0.9	0.15	0.03
Missile sites (SSM/SAM)	3	1.5	0.6	0.3	0.08
Surface ships	7.6	4.6	0.6	0.3	0.08
Nuclear weapon components	2.4	1.5	0.3	0.03	0.01
Vehicles	1.5	0.6	0.3	0.05	0.03
Land minefields	9	6	0.9	0.03	-
Ports and harbours	30.5	15	6	3	0.3
Coasts and landing beaches	30.5	4.6	3	1.5	0.08
Railway yards and shops	30.5	15	6	1.5	0.6
Roads	9	6	1.8	0.6	0.15
Urban areas	61	30.5	3	3	0.3
Terrain	-	91	4.6	1.5	0.15
Surfaced submarines	30.5	6	1.5	0.9	0.03

Source: "Reconnaissance Handy Book", p.125, published by McDonnell Douglas Corporation, USA.

[a] Requires location of a class of units, object or activity of military interest.
[b] Requires determination of general target type.
[c] Requires discrimination within target types of known types.
[d] Requires size/dimension, configuration/layout, components construction, count of equipment, etc.

Source: B. Jasani, ed., Outer Space - A New Dimension of the Arms Race (1982) at 47.

APPENDIX - 4

Operational military satellites in orbit on 31 December 1989

Country/ Mission	Spacecraft name/ Secondary payload	Alternative name/ (Host spacecraft)	Launch date
China			
Communications	STW-1	China 15	8 Apr. 1984
	STW-2	Tungfanghung 2	1 Feb. 1986
	STW-3	China 22	7 Mar. 1988
	STW-4	China 25	22 Dec. 1988
France			
Military communications	Syracuse I-A	(On Telecom 1A)	4 Aug. 1984
	Syracuse 1-C	(On Telecom 1C)	11 Mar. 1988
Japan			
Military communications	Superbird-X 1A	(On SCS 1A)	5 June 1989
UK			
Military communications	SKYNET 2B	9354	23 Nov. 1974
	SKYNET 4-B	..	10 Dec. 1988
USSR			
Photoreconnaissance	Cosmos 2052	SU PHOTO 4-97	30 Nov. 1989
	Cosmos 2049	SU PHOTO 5-11	17 Nov. 1989
Electronic intelligence	Cosmos 1805	SU ELINT 3-23	10 Dec. 1986
	Cosmos 1812	SU ELINT 3-24	14 Jan. 1987
	Cosmos 1842	SU ELINT 3-26	27 Apr. 1987
	Cosmos 1908	SU ELINT 3-29	6 Jan. 1988
	Cosmos 1933	SU ELINT 3-30	15 Mar. 1988
	Cosmos 1953	SU ELINT 3-31	14 June 1988
	Cosmos 1975	SU ELINT 3-32	11 Oct. 1988
	Cosmos 1943	SU ELINT 4-7	15 May 1988
	Cosmos 1980	SU ELINT 4-8	23 Nov. 1988
	Cosmos 1888	SU ELINT 5-1	1 Oct. 1987
	Cosmos 1894	SU ELINT 5-2	28 Oct. 1987
Electronic ocean reconnaissance	Cosmos 1949	SU EORSAT 1-27	28 May 1988
	Cosmos 2033	SU EORSAT 1-29	24 July 1989
	Cosmos 2046	SU EORSAT 1-30	27 Sep. 1989
Radar ocean reconnaissance	*None since Cosmos 1932*		
Military communications	Cosmos 1852	SU COM 1-313	16 June 1987
	Cosmos 1853	SU COM 1-314	16 June 1987
	Cosmos 1854	SU COM 1-315	16 June 1987
	Cosmos 1855	SU COM 1-316	16 June 1987

Source: World Armaments and Disarmament: SIPRI Yearbook 1990 (1990) a6 101-106.

Country/ Mission	Spacecraft name/ Secondary payload	Alternative name/ (Host spacecraft)	Launch date
.	Cosmos 1856	SU COM 1-317	16 June 1987
	Cosmos 1857	SU COM 1-318	16 June 1987
	Cosmos 1858	SU COM 1-319	16 June 1987
	Cosmos 1859	SU COM 1-320	16 June 1987
	Cosmos 1924	SU COM 1-321	11 Mar. 1988
	Cosmos 1925	SU COM 1-322	11 Mar. 1988
	Cosmos 1926	SU COM 1-323	11 Mar. 1988
	Cosmos 1927	SU COM 1-324	11 Mar. 1988
	Cosmos 1928	SU COM 1-325	11 Mar. 1988
	Cosmos 1929	SU COM 1-326	11 Mar. 1988
	Cosmos 1930	SU COM 1-327	11 Mar. 1988
	Cosmos 1931	SU COM 1-328	11 Mar. 1988
	Cosmos 2008	SU COM 1-329	24 Mar. 1989
	Cosmos 2009	SU COM 1-330	24 Mar. 1989
	Cosmos 2010	SU COM 1-331	24 Mar. 1989
	Cosmos 2011	SU COM 1-332	24 Mar. 1989
	Cosmos 2012	SU COM 1-333	24 Mar. 1989
	Cosmos 2013	SU COM 1-334	24 Mar. 1989
	Cosmos 2014	SU COM 1-335	24 Mar. 1989
	Cosmos 2015	SU COM 1-336	24 Mar. 1989
	Cosmos 1937	SU COM 2-42	5 Apr. 1988
	Cosmos 1954	SU COM 2-43	21 June 1988
	Cosmos 1992	SU COM 2-44	26 Jan. 1989
	Cosmos 1994	SU COM 3-31	10 Feb. 1989
	Cosmos 1995	SU COM 3-32	10 Feb. 1989
	Cosmos 1996	SU COM 3-33	10 Feb. 1989
	Cosmos 1997	SU COM 3-34	10 Feb. 1989
	Cosmos 1998	SU COM 3-35	10 Feb. 1989
	Cosmos 1999	SU COM 3-36	10 Feb. 1989
	Cosmos 2038	SU COM 3-37	15 Sep. 1989
	Cosmos 2039	SU COM 3-38	15 Sep. 1989
	Cosmos 2040	SU COM 3-39	15 Sep. 1989
	Cosmos 2041	SU COM 3-41	15 Sep. 1989
	Cosmos 2042	SU COM 3-42	15 Sep. 1989
	Cosmos 2043	SU COM 3-43	15 Sep. 1989
Communications	Molniya 1-68	..	5 Sep. 1989
	Molniya 1-71	..	11 Mar. 1988
	Molniya 1-72	..	17 Mar. 1988
	Molniya 1-70	..	26 Dec. 1986
	Molniya 1-73	..	16 Aug. 1988
	Molniya 1-74	..	28 Dec. 1988
	Molniya 1-75	..	15 Feb. 1989
	Molniya 1-76	..	27 Sep. 1989
	Cosmos 1961	Potok 5	1 Aug. 1988
	Cosmos 2054	Potok 6	27 Dec. 1989
Early warning	Cosmos 1793	SU BMEWS 1-51	20 Nov. 1986
	Cosmos 1849	SU BMEWS 1-53	4 June 1987
	Cosmos 1903	SU BMEWS 1-55	21 Dec. 1987
	Cosmos 1922	SU BMEWS 1-56	26 Feb. 1988

Country/ Mission	Spacecraft name/ Secondary payload	Alternative name/ (Host spacecraft)	Launch date
	Cosmos 1966	SU BMEWS 1-57	30 Aug. 1988
	Cosmos 1974	SU BMEWS 1-58	4 Oct. 1988
	Cosmos 1977	SU BMEWS 1-59	25 Oct. 1988
	Cosmos 2001	SU BMEWS 1-60	14 Feb. 1989
	Cosmos 2050	SU BMEWS 1-61	24 Nov. 1989
Navigation	Cosmos 1904	SU NAV 3-61	23 Dec. 1987
	Cosmos 1959	SU NAV 3-63	18 July 1988
	Cosmos 2004	SU NAV 3-64	22 Feb. 1989
	Cosmos 2016	SU NAV 3-65	4 Apr. 1989
	Cosmos 2026	SU NAV 3-66	7 June 1989
	Cosmos 2034	SU NAV 3-67	25 July 1989
	Cosmos 1946	GLONASS 34	21 May 1988
	Cosmos 1947	GLONASS 35	21 May 1988
	Cosmos 1948	GLONASS 36	21 May 1988
	Cosmos 1970	GLONASS 37	16 Sep. 1988
	Cosmos 1971	GLONASS 38	16 Sep. 1988
	Cosmos 1972	GLONASS 39	16 Sep. 1988
	Cosmos 1987	GLONASS 40	10 Jan. 1989
	Cosmos 1988	GLONASS 41	10 Jan. 1989
	Cosmos 2022	GLONASS 42	31 May 1989
	Cosmos 2023	GLONASS 43	31 May 1989
Geodetic	Cosmos 1950	SU GEOD 2-10	30 May 1988
	Cosmos 2037	SU GEOD 2-12	28 Aug. 1989
	Cosmos 1989	Etalon 1	10 Jan. 1989
	Cosmos 2024	Etalon 2	31 May 1989
Minor military	Cosmos 1578	SU MINMIL 6-1	28 June 1984
	Cosmos 2027	SU MINMIL X-1	11 June 1989
Radar calibration	Cosmos 1960	SU RADCAL 2-18	28 July 1988
	Cosmos 1508	SU RADCAL 3A-6	11 Nov. 1983
	Cosmos 1985	SU RADCAL 4-1	23 Dec. 1988
	Cosmos 2053	SU RADCAL 2-20	27 Dec. 1989
Military mapping	*None active at the end of 1989*		
USA			
Photoreconnaisance	KH-11/6	..	4 Dec. 1984
	KH-11/8	..	26 Oct. 1987
	KH-11/9	..	6 Nov. 1988
	KH-12A/1	USA-40	8 Aug. 1989
Electronic intelligence	Chalet 3	Vortex 3	31 Oct. 1981
	Chalet 6	Vortex 6 USA-37	10 May 1989
	Jumpseat 4	..	8 Feb. 1985
	Jumpseat 5	..	14 Feb. 1987
	Magnum 1	..	24 Jan 1985
	Magnum 2	..	23 Nov. 1989

Country/ Mission	Spacecraft name/ Secondary payload	Alternative name/ (Host spacecraft)	Launch date
Electronic ocean reconnaissance	NOSS 7	White Cloud	9 Feb. 1986
	NOSS-SSU 7-1	..	9 Feb. 1986
	NOSS-SSU 7-2	..	9 Feb. 1986
	NOSS-SSU 7-3	..	9 Feb. 1986
	NOSS 8	White Cloud	15 May 1987
	NOSS-SSU 8-1	..	15 May 1987
	NOSS-SSU 8-2	..	15 May 1987
	NOSS-SSU 8-3	..	15 May 1987
	NOSS 9	White Cloud	5 Sep. 1988
	NOSS-SSU 9-1	..	5 Sep. 1988
	NOSS-SSU 9-2	..	5 Sep. 1988
	NOSS-SSU 9-3	..	5 Sep. 1988
	NOSS 10	USA-45	6 Sep. 1989
	NOSS-SSU 10-1	White Cloud	6 Sep. 1989
	NOSS-SSU 10-2	..	6 Sep. 1989
	NOSS-SSU 10-3	..	6 Sep. 1989
Imaging radar	Lacrosse 1	..	2 Dec. 1988
Military communications	AFSATCOM D-8	(On DMSP 5D-2/3)	19 June 1987
	AFSATCOM D-9	(On DMSP 5D-2/4)	3 Feb. 1988
	AFSATCOM F-2	(On FLTSATCOM 2)	4 May 1979
	AFSATCOM F-3	(On FLTSATCOM 3)	18 Jan. 1980
	AFSATCOM F-4	(On FLTSATCOM 4)	31 Oct. 1980
	AFSATCOM F-6	(On FLTSATCOM 6)	4 Dec. 1986
	AFSATCOM F-8	(On FLTSATCOM 8)	25 Sep. 1989
	AFSATCOM S-5	(On SDS F-5)	31 July 1983
	AFSATCOM S-5A	(On SDS F-5A)	28 Aug. 1984
	AFSATCOM SCT-1	(On DSCS III-A1)	30 Oct. 1982
	AFSATCOM SCT-4	(On DSCS III-B4)	3 Oct. 1985
	AFSATCOM SCT-5	(On DSCS III-B5)	3 Oct. 1985
	AFSATCOM SCT-2	(On DSCS III-A2)	4 Sep. 1989
	SDS F-5	..	31 July 1983
	SDS F-5A	..	28 Aug. 1984
	LES 8	AFSATCOM	15 Mar. 1976
	LES 9	AFSATCOM	15 Mar. 1976
	NATO 3-A	..	22 Apr. 1976
	NATO 3-C	..	19 Nov. 1978
	NATO 3-D	..	14 Nov. 1984
	DSCS II-13	DSCS 9443	21 Nov. 1979
	DSCS II-14	DSCS 9444	21 Nov. 1979
	DSCS II-15	DSCS 9445	30 Oct. 1982
	DSCS II-16	DSCS A-16 USA-43	4 Sep. 1989
	DSCS III-A 1	DSCS A-1	30 Oct. 1982
	DSCS III-B 4	DSCS B-4	3 Oct. 1985
	DSCS III-B 5	DSCS B-5	3 Oct. 1985
	DSCS III-A 2	DFS-2 USA-44	4 Sep. 1989
	FLTSATCOM 2	..	4 May 1979
	FLTSATCOM 3	..	18 Jan. 1980
	FLTSATCOM 4	..	31 Oct. 1980
	FLTSATCOM 6	F-7	4 Dec. 1986

Country/ Mission	Spacecraft name/ Secondary payload	Alternative name/ (Host spacecraft)	Launch date
	FLTSATCOM 8	F-8	25 Sep. 1989
	Leasat 1	Syncom IV F-2	30 Aug. 1984
	Leasat 2	Syncom IV F-1	8 Nov. 1984
	Leasat 3	Syncom IV F-3	12 Apr. 1985
	Gapfiller 1	(On Marisat 1)	19 Feb. 1976
	Gapfiller 2	(On Marisat 2)	10 June 1976
	Gapfiller 3	(On Marisat 3)	14 Oct. 1976
Early warning	DSP 10	F-13	6 Mar. 1982
	DSP 11	F-12	14 Apr. 1984
	DSP SED 12	F-6R	22 Dec. 1984
	DSP SED 13	F-5R	29 Nov. 1987
	DSP-I 14 F-14	USA-39	14 June 1989
Navigation	Transit 19	Oscar 24 SOOS 1	3 Aug. 1985
	Transit 20	Oscar 30 SOOS 1	3 Aug. 1985
	Transit 21	Oscar 27 SOOS 2	16 Sep. 1987
	Transit 22	Oscar 29 SOOS 2	16 Sep. 1987
	Transit 23	SOOS 3	26 Apr. 1988
	Transit 24	SOOS 3	26 Apr. 1988
	Transit 25	Oscar 23 SOOS 4	25 Aug. 1988
	Transit 26	Oscar 32 SOOS 4	25 Aug. 1988
	Transit NOVA 1	..	15 May 1981
	Transit NOVA 2	..	16 June 1988
	Transit NOVA 3	..	12 Oct. 1984
	Transit TIP-4	Oscar 11 TRANSAT	28 Oct. 1977
	Navstar 1A-5	..	9 Feb. 1980
	Navstar 1A-6	..	26 Apr. 1980
	Navstar 1R-9	..	13 June 1984
	Navstar 1A-8	..	14 July 1983
	Navstar 1R-10	..	8 Sep. 1984
	Navstar 1R-11	..	9 Oct. 1985
	Navstar 2A-12	NDS 13 USA-35	14 Feb. 1989
	Navstar 2A-13	NDS 14 USA-38	9 June 1989
	Navstar 2A-14	NDS 16 USA-42	18 Aug. 1989
	Navstar 2A-15	NDS 17	21 Oct. 1989
	Navstar 2A-16	NDS 18	11 Dec. 1989
Weather	DMSP 5D-2/4	S-9	3 Feb. 1988
	DMSP 5D-2/3	S-8	19 June 1987
Nuclear detection	NUDETS DSP-9	(On DSP-9)	16 Mar. 1981
	NUDETS DSP-10	(On DSP-10)	6 Mar. 1982
	NUDETS DSP-11	(On DSP-11)	14 Apr. 1984
	ARD-1/2 14	(On DSP-I F-14)	14 June 1989
	NUDETS DMSP-8	(On DMSP 5D-2/3)	19 June 1987
	NUDETS DMSP-9	(On DMSP 5D-2/4)	3 Feb. 1988
	IONDS 1	(On Navstar 1A-8)	14 July 1983
	IONDS 2	(On Navstar 1R-9)	13 June 1984
	IONDS 3	(On Navstar 1R-10)	8 Sep. 1984
	IONDS 4	(On Navstar 1R-11)	9 Oct. 1985

Country/ Mission	Spacecraft name/ Secondary payload	Alternative name/ (Host spacecraft)	Launch date
	IONDS 5	(On Navstar 12)	14 Feb. 1989
	IONDS 6	(On Navstar 13)	9 June 1989
	IONDS 7	(On Navstar 14)	18 Aug. 1989
	IONDS 8	(On Navstar 15)	21 Oct. 1989
	IONDS 9	(On Navstar 16)	11 Dec. 1989
Geodetic	Geosat	..	13 Mar. 1985
Military science	STP P83-1 Hilat	Oscar 16	27 June 1983
	STP P87-1	Polar Bear	14 Nov. 1986
	SDI-S (?)	USA-41	8 Aug. 1989
Ballistic missile defence	SDI STM-3	Delta Star	24 Mar. 1989
	SDI VUE	(On DSP-I F-14)	14 June 1989

Military satellites launched in 1991

Type/Country/ Spacecraft name	Alternative name (Host spacecraft)	Designation	Launch date	Booster	Facil-ity	Mass (kg)	Apogee (km)	Perigee (km)	Inclin. (deg)	Period (min)	Comments
Imaging intelligence											
USSR											
THIRD GENERATION—MEDIUM RESOLUTION											
SU PHOTO 3M-103	Cosmos 2121	1991-004A	17 Jan.	SL-4	PL	6 300	306	325	82.6	90.0	Replaced C-2120
SU PHOTO 3M-104	Cosmos 2136	1991-016A	6 Mar.	SL-4	PL	6 300	256	336	62.8	90.2	. .
SU PHOTO 3M-105	Cosmos 2152	1991-048A	9 Jul	SL-4	PL	6 300	237	349	82.3	90.4	Upper stage malfunctioned
FOURTH GENERATION											
SU PHOTO 4-92	Cosmos 2124	1991-008A	7 Feb.	SL-4	PL	6 500	189	317	62.8	89.6	Observed Desert Storm
SU PHOTO 4-93	Cosmos 2134	1991-011A	15 Feb.	SL-4	TT	6 500	235	311	64.9	89.5	Observed Desert Storm
SU PHOTO 4-94	Cosmos 2138	1991-023A	26 Mar.	SL-4	PL	6 500	164	345	67.1	89.6	First at this inclination since C-2052
SU PHOTO 4-95	Cosmos 2156	1991-066A	17 Sep.	SL-4	PL	6 500	185	350	67.1	89.9	. .
SU PHOTO 4-96	Cosmos 2163	1991-071A	9 Oct.	SL-4	TT	6 500	214	360	64.8	89.8	Deliberately exploded on 6 Dec.
SU PHOTO 4-97	Cosmos 2171	1991-078A	20 Nov.	SL-4	PL	6 500	186	306	62.8	89.1	. .
SU PHOTO 4-98	Cosmos 2174	1991-085A	17 Dec.	SL-4	TT	6 500	204	331	64.9	89.6	. .
FIFTH GENERATION											
SU PHOTO 5-13	Cosmos 2153	1991-049A	10 Jul	SL-4	TT	6 800	214	272	64.9	89.0	. .
MILITARY MAPPING AND REMOTE SENSING											
Resurs-F1 53	Resurs-F 10	1991-035A	21 May	SL-4	PL	5 500	166	231	82.3	89.1	. .
Resurs-F1 54	Resurs-F 11	1991-044A	28 June	SL-4	PL	5 500	257	272	82.3	89.8	. .
Resurs-F1 55	Resurs-F 12	1991-052A	23 July	SL-4	PL	5 500	263	285	82.3	89.8	. .
Resurs-F1 56	Resurs-F 13	1991-058A	21 Aug.	SL-4	PL	5 500	226	230	82.3	89.1	. .
SU PHOTO 4T-14	Cosmos 2149	1991-036A	24 May	SL-4	TT	6 800	193	383	67.1	90.0	Topographic survey/mapping

Source: World Armaments and Disarmament : SIPRI Yearbook 1992 (1992) at 142-146.

USA

Lacrosse P 1	USA-69	1991-017A	8 Mar.	Titan 404A	WTR	14 550	672	679	68.0	98.3	Elements for initial orbit
Lacrosse P 2	USA-72	1991-076A	8 Nov.	Titan 404A	WTR	14 550	1 053	1 165	63.4	107.5	Certainly not White Cloud NOSS

Electronic intelligence

USSR

SU ELINT 3-34	Cosmos 2151	1991-042A	13 June	SL-14	PL	4 375	636	663	82.5	97.8	..
SU ELINT 4-11	..	Failure	30 Aug.	SL-16	TT	12 500	..	..	..	..	Second consecutive failure
SU EORSAT 1-36	Cosmos 2122	1991-005A	18 Jan.	SL-11	TT	4 250	412	427	65.0	92.7	Upper stage mistaken for Iraqi Scud

USA

Lacrosse P2 ESS-1	USA-74	1991-076C	8 Nov.	Titan 404A	WTR	45	1 053	1 165	63.4	107.5	Elint subsatellite
Lacrosse P2 ESS-2	USA-76	1991-076D	8 Nov.	Titan 404A	WTR	45	1 053	1 165	63.4	107.5	Elint subsatellite
Lacrosse P2 ESS-3	USA-77	1991-076E	8 Nov.	Titan 404A	WTR	45	1 053	1 165	63.4	107.5	Elint subsatellite

Military communications

USSR

SU COM 1-345	Cosmos 2125	1991-009A	12 Feb.	SL-8	PL	45	1 458	1 473	74.0	115.3	..
SU COM 1-346	Cosmos 2126	1991-009B	12 Feb.	SL-8	PL	45	1 467	1 497	74.0	115.6	..
SU COM 1-347	Cosmos 2127	1991-009C	12 Feb.	SL-8	PL	45	1 467	1 479	74.0	115.4	..
SU COM 1-348	Cosmos 2128	1991-009D	12 Feb.	SL-8	PL	45	1 446	1 469	74.0	115.1	..
SU COM 1-349	Cosmos 2129	1991-009E	12 Feb.	SL-8	PL	45	1 431	1 469	74.0	114.9	..
SU COM 1-350	Cosmos 2130	1991-009F	12 Feb.	SL-8	PL	45	1 402	1 469	74.0	114.6	..
SU COM 1-351	Cosmos 2131	1991-009G	12 Feb.	SL-8	PL	45	1 388	1 468	74.0	114.4	..
SU COM 1-352	Cosmos 2132	1991-009H	12 Feb.	SL-8	PL	45	1 416	1 469	74.0	114.8	..
SU COM 2-47	Cosmos 2150	1991-041A	11 Jun	SL-8	PL	750	780	806	74.0	97.7	..
SU COM 3-56	Cosmos 2143	1991-033A	16 May	SL-14	PL	400	1 400	1 416	82.6	114.0	Replaced C-2090–C-2095
SU COM 3-57	Cosmos 2144	1991-033B	16 May	SL-14	PL	400	1 413	1 416	82.6	114.2	Replaced C-2090–C-2095
SU COM 3-58	Cosmos 2145	1991-033C	16 May	SL-14	PL	400	1 406	1 416	82.6	114.1	Replaced C-2090–C-2095
SU COM 3-59	Cosmos 2146	1991-033D	16 May	SL-14	PL	400	1 395	1 416	82.6	114.0	Replaced C-2090–C-2095
SU COM 3-60	Cosmos 2147	1991-033E	16 May	SL-14	PL	400	1 390	1 416	82.6	113.9	Replaced C-2090–C-2095
SU COM 3-61	Cosmos 2148	1991-033F	16 May	SL-14	PL	400	1 384	1 416	82.6	113.8	Replaced C-2090–C-2095

Type/Country/ Spacecraft name	Alternative name (Host spacecraft)	Designation	Launch date	Booster	Facil-ity	Mass (kg)	Apogee (km)	Perigee (km)	Inclin. (deg)	Period (min)	Comments
SU COM 3-62	Cosmos 2157	1991-068A	28 Sep.	SL-14	PL	400	1 407	1 415	82.6	114.1	..
SU COM 3-63	Cosmos 2158	1991-068B	28 Sep.	SL-14	PL	400	1 404	1 411	82.6	114.0	..
SU COM 3-64	Cosmos 2159	1991-068C	28 Sep.	SL-14	PL	400	1 389	1 410	82.6	113.8	..
SU COM 3-65	Cosmos 2160	1991-068D	28 Sep.	SL-14	PL	400	1 400	1 410	82.6	114.0	..
SU COM 3-66	Cosmos 2161	1991-068E	28 Sep.	SL-14	PL	400	1 395	1 410	82.6	113.9	..
SU COM 3-67	Cosmos 2162	1991-068F	28 Sep.	SL-14	PL	400	1 408	1 420	82.6	114.2	..
SU COM 3-68	Cosmos 2165	1991-077A	12 Nov.	SL-14	PL	400	1 395	1 413	82.6	113.9	..
SU COM 3-69	Cosmos 2166	1991-077B	12 Nov.	SL-14	PL	400	1 407	1 413	82.6	114.1	..
SU COM 3-70	Cosmos 2167	1991-077C	12 Nov.	SL-14	PL	400	1 400	1 413	82.6	114.0	..
SU COM 3-71	Cosmos 2168	1991-077D	12 Nov.	SL-14	PL	400	1 390	1 413	82.6	113.9	..
SU COM 3-72	Cosmos 2169	1991-077E	12 Nov.	SL-14	PL	400	1 393	1 413	82.6	113.8	..
SU COM 3-73	Cosmos 2170	1991-077F	12 Nov.	SL-14	PL	400	1 412	1 413	82.6	114.1	..
Molniya 1-80	..	1991-012A	15 Feb.	SL-6	PL	1 250	424	39 934	62.8	717.9	..
Molniya 1-81	..	1991-043A	18 June	SL-6	PL	1 250	446	39 903	62.8	735.0	Constellation of 8 satellites
Molniya 1-82	..	1991-053A	2 Aug.	SL-6	PL	1 250	624	40 627	62.8	737.0	..
Potok 8	Cosmos 2133	1991-010A	14 Feb.	SL-12	TT	2 120	35 800	35 800	2.3	1438.0	Not announced; moved twice in 1991
Potok 9	Cosmos 2172	1991-079A	22 Nov.	SL-12	TT	2 120	35 800	35 800	0.0	1436.0	Announced as data relay, 346 East
GALS	Cosmos 2155	1991-064A	13 Sep.	SL-12	TT	2 120	35 762	35 810	1.3	1436.0	Data relay, at 337 East
NATO											
NATO 4A	..	1991-001A	8 Jan.	Delta 7925	ETR	1 433	34 915	35 614	4.2	1409.4	
USA											
Microsat 1	MACSAT/Multisat	1991-051A	17 July	Pegasus	EAFB	22	358	455	82.0	92.7	Multiple Access Communications Sat
Microsat 2	MACSAT/Multisat	1991-051B	17 July	Pegasus	EAFB	22	358	453	82.0	92.7	1990 launch delayed by spacecraft flaw
Microsat 3	MACSAT/Multisat	1991-051C	17 July	Pegasus	EAFB	22	357	453	82.0	92.7	Bent-Pipe UHF com. satellite
Microsat 4	MACSAT/Multisat	1991-051D	17 July	Pegasus	EAFB	22	356	453	82.0	92.7	In lower orbit due upper stage flaw
Microsat 5	MACSAT/Multisat	1991-051E	17 July	Pegasus	EAFB	22	358	455	82.0	92.7	All re-entered Jan. 1992
Microsat 6	MACSAT/Multisat	1991-051F	17 July	Pegasus	EAFB	22	360	455	82.0	92.7	..
Microsat 7	MACSAT/Multisat	1991-051G	17 July	Pegasus	EAFB	22	359	456	82.0	92.7	..
AFSATCOM D-11	(on DMSP 5D-2 /6)	1991-082A	28 Nov.	Atlas E	WTR	0	840	857	98.9	102.0	..

Ballistic missile early warning											
USA											
DSP-I 16 F-16	USA-75	1991-080B	24 Nov.	STS	ETR	2 370	35 780	35 780	1.0	1 436.0	Replaced DSP-12 over Indian Ocean
Military navigation											
USSR											
Nadezhda 3	COSPAS 6	1991-019A	12 Mar.	SL-8	PL	750	938	1 017	82.9	104.7	Replaced C-1727; civil nav.
SU NAV 3-70	Cosmos 2123	1991-007A	5 Feb.	SL-8	PL	750	982	1 019	82.9	104.8	..
SU NAV 3-71	Cosmos 2135	1991-013A	26 Feb.	SL-8	PL	750	922	1 017	82.8	104.5	..
SU NAV 3-72	Cosmos 2142	1991-029A	16 Apr.	SL-8	PL	750	961	1 015	83.0	104.9	..
SU NAV 3-73	Cosmos 2154	1991-059A	22 Aug.	SL-8	PL	750	969	1 004	82.9	104.8	..
SU NAV 3-74	Cosmos 2173	1991-081A	26 Nov.	SL-8	PL	750	971	1 031	82.9	104.8	..
GLONASS 50	Cosmos 2139	1991-025A	4 Apr.	SL-12	TT	900	19 111	19 149	64.8	675.7	..
GLONASS 51	Cosmos 2140	1991-025B	4 Apr.	SL-12	TT	900	19 105	19 154	64.8	675.7	..
GLONASS 52	Cosmos 2141	1991-025C	4 Apr.	SL-12	TT	900	19 108	19 151	64.8	675.7	..
USA											
Navstar 2B-22	USA-71	1991-047A	4 July	Delta 7925	ETR	930	20 083	20 278	55.3	717.9	..
Weather											
USSR											
Meteor 3-4	..	1991-030A	24 Apr.	SL-14	PL	2 750	1 184	1 210	82.5	109.4	..
Meteor 3-5	..	1991-056A	15 Aug.	SL-14	PL	2 750	1 197	1 219	82.5	109.4	Carried US ozone mapping instrument
USA											
DMSP 5D-2I/6	USA-73 S-11-I	1991-082A	28 Nov.	Atlas E	WTR	755	840	857	98.9	102.0	Replaced DMSP 5D-2/5
Nuclear explosion detection											
USSR	*Soviet nuclear explosion detection sensors are probably mounted on early warning or navigation satellites.*										
USA	*US nuclear explosion detection sensors are mounted on satellites launched for other primary missions.*										
NDS 15	(On Navstar 2B-22)	1991-047A	4 July	Delta 7925	ETR	135	20 083	20 278	55.3	717.9	Nuclear Detection System

Type/Country/ Spacecraft name	Alternative name (Host spacecraft)	Designation	Launch date	Booster	Facil-ity	Mass (kg)	Apogee (km)	Perigee (km)	Inclin. (deg)	Period (min)	Comments
NUDETS DMSP-11	(On DMSP 5D-2/6)	1991-082A	28 Nov.	Atlas E	WTR	0	840	857	98.9	102.0	..
ARD-1/2 16	(On DSP-I 16)	1991-080B	24 Nov.	STS	ETR	2 370	35 780	35 780	1.0	1436.0	Replaced DSP-12 over Indian Ocean
Other military missions											
USSR											
RADAR CALIBRATION											
SU RADCAL 2-22	Cosmos 2137	1991-021A	19 Mar.	SL-8	PL	950	449	495	65.9	94.0	..
SU RADCAL 2-23	Cosmos 2164	1991-072A	10 Oct.	SL-8	PL	950	295	726	73.9	94.5	..
LAUNCH VEHICLE DEVELOPMENT											
SL-17 test	..	Failure	20 Nov.	SL-17	Omsk	..	..	..	..	..	Core stage exploded 20 Nov. 1991
USA											
BALLISTIC MISSILE DEFENSE											
SDI-S CIRRIS	(On STS-39)	1991-031A	28 Apr.	STS	ETR		253	268	57.0	89.7	Cryogenic IR Radiance Instrum. Shuttle
SDI-S MPEC	..	1991-031F	28 Apr.	STS	ETR		253	268	57.0	89.7	Multi-Purpose Experiment Canister
SDI-S CRO-A	..	1991-031E	28 Apr.	STS	ETR	80	250	270	57.0	89.7	Chemical Release Observation
SDI-S CRO-B	..	1991-031D	28 Apr.	STS	ETR	80	244	256	57.0	89.5	Chemical Release Observation
SDI-S CRO-C	..	1991-031C	28 Apr.	STS	ETR	80	243	261	57.0	89.5	Chemical Release Observation
SDI-S IBSS	SPAS 2-01	1991-031B	28 Apr.	STS	ETR	1 904	242	257	57.0	89.5	IR Background Signature Survey
SDI-E LOSAT-X	..	1991-047B	4 July	Delta 7925	ETR	75	400	414	40.0	92.6	Plume data; re-entered 30 Oct. 1991
TECHNOLOGY DEVELOPMENT											
STP-F REX	USA-70 ? STEP 5	1991-045A	29 June	Scout G-1	WTR	85	773	875	89.6	101.4	Radiation Experiment
LAUNCH VEHICLE DEVELOPMENT											
Titan 4 SRMU 1	SRM Upgrade	Failure	28 Mar.	Titan 4 B	EAFB	..	..	..	..	0.1	Rocket motor upgrade test; exploded

Launch facility abbreviations: EAFB = Edwards Air Force Base, California, USA; ETR = Eastern Test Range, Cape Canaveral, Florida, USA; PL = Plesetsk, Russia, USSR; TT = Tyuratam (Baikonur), Kazakhstan, USSR; WTR = Western Test Range, Vandenberg Air Force Base, California, USA