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BALLISTIC MISSILE PROLIFERATION: SEEKING GLOBAL SOLUTIONS TO REGIONAL PROBLEM

As the war in the Persian Gulf has demonstrated, the spread of ballistic missiles holds potentially tragic consequences for regional stability. As the record of the Iran-Iraq war, the war in Afghanistan, and the war in the Persian Gulf shows, ballistic missiles have become a weapon of choice for States in the developing world. Striking quickly and without warning, they are the ideal terror weapon; the vulnerability of opponents to the weapon magnifies its impact. The former Director of the Central Intelligence Agency, William Webster, has testified that by the end of the decade, 15 States in the developing world will possess ballistic missiles, and 6 of them will have intermediate-range ballistic missiles (IRBMs). These weapons will be of increasing range and sophistication.

To date, efforts to control ballistic missiles have centred upon restricting the supply of missiles and missile components. Chief among these efforts has been the Missile Technology Control Regime (MTCR) which was announced by Canada, the Federal Republic of Germany, France, Italy, Japan, the United Kingdom and the United States in 1987, and which has subsequently been joined by eight additional States. But, an anti-proliferation policy that focuses upon the supply side will have limited efficacy. To be truly effective, anti-proliferation policy should be expanded to encompass measures to reduce the demand for ballistic missiles, including continued diplomatic efforts to encourage regional reconciliation and the deployment of anti-missile defences to limit the utility of the ballistic missile and discourage the proliferation of missile technology.

Emerging Ballistic Missile Problem

Saddam Hussein's use of ballistic missiles against United States forces, Israel and Saudi Arabia, his possession of chemical and biological weapons, and his pursuit of a nuclear weapon capability serve as a microcosm of the problems posed by the spread of weapons of mass destruction and their means of delivery. During the war in the Persian Gulf, Iraq launched 81 modified Scud missiles against United States forces, Israel and Saudi Arabia. While most were ineffective, a single strike on a United States barracks near Dhahran, Saudi Arabia, caused 28 deaths and 100 injuries, fully one third of all United States deaths in the Gulf war. Many other Scuds were aimed at civilian targets. The missile attacks had a political impact far beyond their military effectiveness, threatening both to broaden the war by bringing Israel into the conflict and to sap local support for the anti-Iraq coalition.

The pattern of terror attacks upon civilians was foreshadowed by Iraq's use of missiles during its war with Iran. The Soviet Union is responsible for supplying Saddam Hussein's regime with hundreds or even thousands of 300-km Scud B missiles. During the Iran-Iraq war, Iraq modified many of these Scuds to produce the 650-km Al-Hus-sein and 900-km Al-Abbas missiles. Some 190 Al-Hussein missiles were fired at Iranian cities from February to April 1988, causing approximately 2,000 Iranian casualties, evacuation of half the population of Tehran and a severe disruption in the Iranian war economy. For one Iraqi analyst, the lesson of the conflict was clear:

> "[T]he Iran-Iraq War... conclusively proved and operationally demonstrated that land-to-land missiles could be effective weapons in armed combat or total war specifically, even if they are armed with conventional warheads."

More likely, it was the effect such weapons had on an Iranian population already tired of the war and suffering from waning morale, rather than the limited destructive-ness of the missiles themselves, which caused them to have an impact in the conflict.

The Soviet-sponsored Afghan Government has also used ballistic missiles extensively. According to William Webster, over 1,000 Scud B missiles provided by Moscow have been used by the Afghan Government to punish and demoralise the mujahidin resistance. They were used extensively during the 1989 siege of Jalalabad, though their military value here too is suspect. The missiles are both easier for the poorly trained Afghan army to operate than aircraft, and, unlike aircraft, are invulnerable to anti-aircraft missiles such as the Stinger, which caused heavy losses among Soviet and Afghan aircraft after their introduction into the war.

The United States has also been the target of Third-World ballistic missiles. In April 1986, following the United States air strike on the Libyan Arab Jamahiriya in response to terrorist attacks on United States citizens, Libya launched two Scud B missiles at the United States Coast Guard facility on Lampedusa, off the coast of Italy.

Soviet-supplied Scuds and Frog rockets, aimed at both civilian and military targets, were also employed by Egypt and the Syrian Arab Republic against Israel during the Yom Kippur War.

While the United States and the Soviet Union are in the process of eliminating their intermediate-range missiles and are continuing to negotiate on significant reductions in their arsenals of intercontinental-range weapons, a growing number of States in the developing world are busy acquiring equivalent systems. Such States are acquiring ballistic missiles through three processes: purchase, modification and indigenous development.

To date, the most prominent phenomenon has been the purchase of complete missiles by States in the developing world from suppliers in the industrialised world. None the less, the purchase of complete missile systems is becoming more difficult with the advent and expansion of the MTGR. Particularly significant was the announcement in May 1990 that the Soviet Union would "observe the spirit and the guidelines of [the MTCR]" and that Moscow was "taking measures to restrict missile proliferation on a worldwide basis, including export controls." In fact, the Soviet Union has historically been the greatest source of ballistic missiles in the developing world: the USSR sold thousands of Frog, SS-21 and Scud B missiles to clients in the Middle East and Asia. American sales of ballistic missiles, by contrast, have been limited to the sale of a handful of short-range Lance and Honest John rockets to South Korea, Taiwan province of China, and Israel in the 1970s.

While the United States, Europe, Japan and the Soviet Union have withdrawn from the missile market, new suppliers are stepping in to take their place. Of primary concern are China and North Korea. Missile sales by China, which is outside the MTCR framework, remain a continuing concern. In 1988 China sold a number of its DF-3 IRBMs to Saudi Arabia. The longest-range missiles sold to the developing world, the Chinese missiles were a clear signal of Beijing's entrance into the ranks of major arms suppliers.'More disturbing still are reports that China is developing the M-series of ballistic missiles with foreign funding for the purpose of export. The M-9, for instance, is a 600-km solid-fuel system first displayed in 1986. There are indications that China may sell the M-series missiles to the Islamic Republic of Iran, the Syrian Arab Republic and possibly other States.

North Korea is another emerging missile supplier. According to two experts in the field, North Korea managed to reverse-engineer Scuds obtained from Egypt with the aid of Chinese technical assistance and Iranian funding. P'yongyang has reportedly delivered indigenously-produced Scuds to Iran and Egypt, and may sell them to other customers as well.

In addition, Brazil has shown an interest in producing missiles for export. Brazilian rocket and missile systems are derived from their Sonda series of sounding rockets. Brazil has already produced the Astros series of unguided rockets based on the Sonda I-III, and it is likely that the Sonda IV will be produced in a military version. Avibras and Orbita, a consortium of Engesa, Embraer and three smaller firms, each have plans for a series of ballistic missiles with ranges of up to a thousand kilometres. Brazil has negotiated with the Libyan Arab Jamahiriya over the sale of ballistic missiles, and more recently proposed developing two such missiles for the Islamic Republic of Iran, with ranges of 600 and 1,000 km.

Another tier of States have modified missiles supplied by the industrial States. Iraq modified its arsenal of Soviet-supplied Scuds by decreasing the weight of their warhead and increasing the size of their fuel and oxidizer tanks, producing the 650-km Al-Hussein and 900-km Al-Abbas missiles used during the War of the Cities with Iran and the war in the Persian Gulf against the United States-led Coalition. North Korea has also reportedly produced its own modification of the Scud, dubbed the Scud C, with a range of 500 km. It has been reported that P'yongyang intends to sell these missiles to the Libyan Arab Jamahiriya, the Syrian Arab Republic, the Islamic Republic of Iran, and Iraq. There have also been reports of a further North Korean Scud derivative, the Scud D, with a range of 1,000 km and improved accuracy. South Korea has also reportedly modified some of its United States-supplied Nike Hercules surface-to-air missiles (SAMs) to produce surface-to-surface missiles (SSMs).

A number of technologically sophisticated States in the developing world are pursuing programmes to manufacture long-range ballistic missiles incorporating Western (and, increasingly, indigenous) technology. Many indigenous missile programmes build from previous programmes, including SAMs, sounding rockets, and space-launch vehicles (SLVs). There is a clear link between civilian space-launch vehicles and ballistic missile programmes. In fact, any SLV can be used in a surface-to-surface mode with the addition of a guidance-and-control package. A number of States, including China, Israel, the Soviet Union and the United States, have converted dedicated military missiles for use as civilian launch vehicles. Others, such as Brazil and India, have produced ballistic missiles which were developed as an outgrowth of civilian sounding rocket and SLV programmes.

A number of States in the developing world have also co-operated on missile projects. The most significant example has been co-operation between Argentina, Egypt and Iraq to construct the Condor II—a mobile, solid-fuel missile, which reportedly was to incorporate advanced technology from the Pershing II. While the leaders of both Argentina and Egypt have announced the termination of the programme, they may continue to benefit from technology derived from it.

India has tested both the 150-km Prithvi and the 2,500-km Agni, the latter a derivative of its SLV-3 space-launch vehicle. If deployed, the Agni would give India the capability to strike targets throughout South Asia as well as much of China. Further, a number of Indian observers have noted that the Agni will possess the range to strike the United States base at Diego Garcia. In addition, the technology for the Indian SLV programme could provide it with the capability to field an intercontinental ballistic missile within twenty years.

Israel, for its part, has tested the Jericho II missile with a 1,500 km range, and used a Jericho II with an added stage to launch its two experimental satellites into orbit. If deployed in a surface-to-surface mode, such a missile could have a range of 7,500 km, allowing Israel to target not only the Arab States and the Islamic Republic of Iran, but also much of the Western USSR. It is also believed that Israel has transferred technology from the Jericho II to South Africa.

Future Trends in Third-Party Ballistic Missile Forces

So far, the use of ballistic missiles has been confined to the use of inaccurate, short-range, conventional missiles purchased from the Soviet Union and China. In coming years, the threat posed by ballistic missiles is likely to grow in a number of areas as a result of the modernisation of indigenous industrial infrastructures and an increase in the scientific and technical skill of their workforces.

Longer-range systems. Most missiles which have in the past been sold to the developing world have a relatively limited range. A number of States, however, have programmes to develop missiles with a much longer range. India, Israel and Brazil, for example, are in the process of developing powerful space-launch vehicles which could be adapted for military missions. Other States will be able to follow the example of Iraq and significantly extend the range of present missile systems. These systems may allow States to broaden the scope of regional conflicts significantly. As regional powers acquire longer-range systems, they will have an increasing capability both to project their influence beyond the region and to exclude outside powers from local conflicts in particular and from regional affairs in general.

More accurate guidance. Current ballistic missiles in the developing world have limited accuracy owing to their relatively austere guidance systems. For example, the circular error probable (CEP)—the radius within which half of the missiles launched are likely to fall—of the Scud B is generally assessed to be one kilometre. That of Iraq's Al-Hussein and Al-Abbas missiles was probably significantly less owing to their increased range and to structural modifications to their airframes. In the future, Third-World ballistic-missile systems are likely to increase in accuracy because of technical improvements in their guidance systems. With access to advanced inertial navigation systems (INS), it is not unreasonable to assume that within the next twenty years a number of developing States will be able to field highly accurate missile systems. Within the next twenty years, highly accurate ring laser gyroscopes may also become available for use in missiles, leading to a significant increase in accuracy. Others will be able to manufacture less accurate systems indigenously. Should MTCR controls be expanded, States seeking ballistic missiles may be forced to produce their own guidance packages. Israel, Brazil and India have manufactured their own systems. China may also enter the INS market. While its systems are less accurate than their American, European or Soviet counterparts, they may be attractive to those States that do not have the capacity to construct their own systems and that are locked out of access to more advanced systems by MTCR restrictions.

The use of more accurate guidance and control systems on Third World ballistic missiles has the potential to multiply their lethality. This increase in accuracy will, therefore, also have a great impact on employment strategies, making counter-military strikes a feasible alternative to the destruction of civilian targets. This trend will be facilitated by the growing availability of commercial satellite imagery from systems such as LANDSAT and SPOT and, for the more advanced countries, of indigenous satellite reconnaissance capabilities.

More lethal warheads. While the use of ballistic missiles has, to date, been restricted to conventional high-explosive warheads, many States acquiring such weapons are also developing more lethal payloads. In addition to standard high-explosive warheads, missiles can be fitted with advanced conventional warheads containing such pay-loads as submunitions or fuel-air explosives, which could significantly enhance destructive effects, especially against targets such as airfields, supply depots, roads or railway-yards. Highly accurate Soviet theatre missiles armed with advanced conventional warheads were seen as a major threat to the North Atlantic Treaty Organisation and provided an original impetus for the development of theatre missile defences in the mid-1980s. Israel, for its part, has been concerned about the use of highly accurate Soviet-supplied SS-21s by the Syrian Arab Republic against Israeli airfields and mobilisation centres. India is reportedly investigating a range of such warheads, including pre-fragmented munitions, bomblets, minelets, and incendiary warheads for its Prithvi and Agni missiles, though there are significant technological hurdles to be overcome. Dr. V. S. Arunachalam, Scientific Adviser to the Indian Minister of Defence, has gone so far as to state:

> "India is convinced that missiles provide an optimum option as weapons and their improved accuracy over long ranges make even nuclear warheads unnecessary."

Chemical and biological warheads may provide another attractive option to nations developing a ballistic delivery capability. Aimed against soft targets such as cities, airfields or unprotected troop concentrations, such weapons delivered without warning by missile could have a devastating effect, though they are highly sensitive to temperature, humidity, and wind speed and direction. The technology needed to construct chemical weapons is widespread, and that needed to deploy biological weapons is increasing. Of the States developing a ballistic missile capability, the Islamic Republic of Iran, Iraq, China, North Korea, India, Pakistan, the Syrian Arab Republic, Egypt, Israel, and the Libyan Arab Jamahiriya possess or are developing chemical warfare capabilities. Indeed, the Syrian Arab Republic and North Korea are believed to possess chemical warheads for their ballistic missiles, and there is evidence that the Islamic Republic of Iran, Iraq, and the Libyan Arab Jamahiriya have development programmes for similar warheads.

Nuclear-armed ballistic missiles could devastate both civilian and military targets. Needless to say, high accuracy would not be required to destroy most targets. Not surprisingly, those States that are most eagerly attempting to develop a missile capability are also those with the most active nuclear programmes. William Webster has testified that four of the countries developing missile capabilities already have nuclear weapons or advanced nuclear weapons programmes. By the end of the decade, an additional four could develop similar capabilities.

Current Anti-Proliferation Policy

The growth of ballistic-missile capabilities demands a response. The MTCR announced in 1987, a set of co-ordinated export policies designed to limit the spread of missiles capable of delivering a 500-kg payload to a distance of 300 km. The MTCR export restrictions include a ban on the sale of missile-production facilities and a strong presumption to deny exports of complete delivery systems, including complete rocket systems, such as ballistic-missile systems, space-launch vehicles and sounding rockets unmanned air-vehicle systems, including cruise-missile systems, drones and remotely-piloted vehicles; and the following major subsystems: individual rocket stages; re-entry vehicles; rocket engines; guidance sets; thrust vector controls; and warhead safing, arming,, fusing and firing mechanisms (category I systems). In addition, the export of dual-use missile components (category II systems) is to be judged on a case-by-case basis.

The assumption underlying such traditional supply-side anti-proliferation policy has been that while the denial of all technology that could be used to construct ballistic missiles, for instance, may not be possible, the denial of a handful of key components would be enough to halt a programme. Put another way, it has been hoped that export restrictions would be able to raise the cost of acquisition— political and economic—to a sufficiently high level to make it an unattractive option. However, the MTCR faces a number of limits on its ability to control exports. First, the existence of a cartel limiting supply raises the economic incentive for cheating among members. The Condor II programme is testimony to the willingness of European companies to violate their nations' export policies. Similarly, experts from a wide range of countries have been implicated in the programme to upgrade Iraq's Scuds. Secondly, the incentive to cheat also fosters the establishment of new sources of supply outside the cartel. For instance, the removal of the Soviet Union from the missile export business because of both its signature of the Treaty between the United States and the

USSR on the Elimination of their Intermediate-Range and Shorter-Range Missiles and its acceptance of the MTCR restrictions has been a boon to such second-tier suppliers as North Korea. Thirdly, there remain significant differences in enforcement standards both within and between MTCR members. This is accentuated by the fact that the MTCR is an informal, voluntary association without an institutionalised arrangement to govern the interpretation of restrictions. While United States export policy for missile technology has been strict, its control of dual-use equipment has been less stringent. For other MTCR members, the control of both category I and category II transfers has been weaker. Such behaviour has significantly hindered efforts to halt the spread of ballistic-missile technology. For instance, United States and European firms are known to have supplied equipment that helped Iraq construct its Sa'ad-16 missile development complex.

Membership in the MTCR has expanded significantly in the four years since it was first announced. Australia, Belgium, Denmark, Luxembourg, the Netherlands, New Zealand, Norway and Spain have become formal members of the regime. As noted earlier, the Soviet Union has announced that it will observe the MTCR guidelines. Other European States have reportedly been consulted about MTCR membership. Still, a number of key missile producers, such as China and North Korea, remain unlikely to join the regime, regardless of what incentives they may be given.

The MTCR is an important step towards slowing the spread of ballistic missile technology. The regime can be credited with slowing a number of ballistic missile programmes. In addition, there is significant evidence that pressure by the United States and its allies may have led Argentina and Egypt to withdraw from the Condor II programme. In the end, however, supply-side policies will fail as a single solution to missile proliferation because they fail to address the root cause of the acquisition of such capabilities, namely the fact that rising regional powers view the possession of such weapons as advantageous for the advancement of their individual national security interests. A number of developing States have shown considerable determination and tenacity in their attempt to acquire ballistic missiles, devoting a significant amount of scarce economic resources to the endeavour. Even if enforcement of the MTCR were perfect, the fact that regional powers view ballistic missiles as important, both as symbols of their national will and as instruments of national policy, and the fact that they are acquiring increasing capabilities to manufacture advanced technology domestically, indicates that it will be difficult to halt the spread over the long term.

In order to meet the continuing challenge of stemming the spread of ballistic missile technology and of mitigating the consequences when it does proliferate, anti-proliferation policy needs to take on an added dimension, namely that of lowering the demand for such systems. Policies relating to demand can work in two ways: by lowering the perceived need for ballistic missiles, and by reducing the military utility of the ballistic missile.

Bilateral or regional initiatives to diffuse regional crises and make the outbreak of war less likely will raise the cost of possession and at the same time lessen the demand for ballistic missile technology. Three broad categories of diplomatic approaches are possible.

The hardest to achieve, though in the long run the most desirable, would be the comprehensive settlement of outstanding political issues. Regional political rivalries and enduring religious and ethnic animosities provide a strong incentive to acquire advanced military technology. Reducing tensions in these volatile areas will in turn decrease the perceived desirability of, and need for, such systems.

Less comprehensive, though still quite challenging, would be the negotiation of formal bilateral or multilateral agreements covering the possession, stockpiling and deployment of weapons of mass destruction and their means of delivery. Such measures could include agreements or treaties limiting the number, types and ranges of ballistic missile and aircraft systems; controlling mass-destruction warheads; and limiting or banning ballistic-missile tests. The war in the Persian Gulf has given an impetus to efforts to control weapons of mass destruction and their means of delivery in the Middle East. For example, a recent United Nations report on establishing a nuclear weapon free zone in the Middle East recommended a mutual missile freeze in the region. However, the report also illustrates the difficulty involved in such an enterprise. Arms control measures are likely to be most feasible in cases where conflicts are bilateral and lack a recent history of animosity or violence; where parties to the conflict share common cultural values; and where proliferation is not far advanced. By contrast, arms control is liable to be exceedingly difficult in a multilateral context, especially one charged with tension or conflict. In general, arms control is easiest to achieve where it is least needed.

A third possibility involves the adoption of formal or informal confidence- and security-building measures (CSBMs). The United Nations can play a key role in such a process, acting as facilitator and mediator in such potentially explosive situations. A number of significant precedents already exist. India and Pakistan have negotiated an agreement not to attack each other's nuclear facilities, and Argentina and Brazil have initiated on-site visits to each other's nuclear facilities. Further CSBMs could include information and intelligence exchanges, on-site inspection of defence production and space-launch facilities, and prior notification of missile tests.

A complementary approach to lowering the demand for ballistic missiles involves reducing the military utility of such weapons. Ballistic missile defence (BMD) could assume an important role in anti-proliferation policy. Extended nuclear deterrence has served as a key concept underpinning alliance relationships over the past four decades. With the deployment of ballistic missile defences, extended defence may become a key operative concept in collective security. The success of the United States Patriot anti-tactical ballistic missile (ATBM) in protecting both Saudi Arabia and Israel during the war in the Persian Gulf is vivid testimony to the potential effectiveness of anti-missile defences. The Patriot served a dual role: militarily, it protected Coalition forces and their host countries from attack by Iraqi missiles; politically, it provided reassurance in the face of Iraqi attempts at coercion. In the future, the transfer of defensive technology could become an important factor in providing both direct defence and political reassurance to States threatened by neighbours with ballistic missiles.

Ballistic missile defence offers an attractive option to States under threat of attack by ballistic missiles. Ground-based area theatre missile defence systems are likely to be costly. However, it is doubtful that they will be orders of magnitude more expensive than advanced air defence systems, which are being purchased in large numbers throughout the world. Indeed, BMD may be thought of as a form of extended air defence. Further, the deployment of BMD is likely to be both less costly and more stabilising than the alternative: the acquisition of countervailing offensive capabilities, which could fan a sense of insecurity in an opponent and fuel a spiralling regional arms race.

The effectiveness of ground-based theatre missile defences would be greatly enhanced by the deployment of space-based early-warning sensors. The short flight times of most missiles which are spreading throughout the developing world make early detection crucial. Space-based platforms could play a key role in supporting defences. None the less, early warning satellites are clearly beyond the economic and technological means of all but the most advanced States. A co-operative regime holds the possibility of redressing this problem. A number of States have advanced proposals in the United Nations for the creation of international and regional satellite monitoring agencies, which would utilise multinational surveillance platforms to monitor arms control agreements. Similarly, the deployment of ground-based defences could be accompanied by the use of space-based sensors provided by the United States and the Soviet Union, alone or in concert, or by other Powers.

The deployment of missile defences may also play a key role in dissuading States in the developing world from acquiring ballistic missiles. Ballistic missiles have enjoyed a privileged position as the only weapon against which there is no deployed defence. The fielding of active defences will substantially reduce the effectiveness of the ballistic missile as both a weapon and an instrument of coercion. Ballistic missile programmes are inherently uncertain enterprises, consuming significant economic and human resources. BMD may therefore reduce the desirability of the ballistic missile as a weapon of choice for States in the developing world. BMD alone cannot solve the problems posed by the proliferation of weapons of mass destruction and their means of delivery. However, the deployment of defences will foreclose what is currently an easy option for States seeking a coercive capability and may channel third-world arms purchases down less destabliliz-ing paths.

The war in the Persian Gulf represents a turning-point in international relations, a triumph of collective security and a warning to potential regional hegemons worldwide. However, the spread of weapons of mass destruction and their means of delivery will continue to jeopardise regional stability. Such threats are likely to increase in the future, owing to both the expanding list of producers of missile technology and the growing lethality of such weapons. While the trend cannot be halted altogether, the adoption of a balanced non-proliferation agenda, one based on restricting the supply of, and reducing demand for, such weapons, holds the promise of both limiting the spread of advanced military technology and of channelling such proliferation as does occur along less destabilising paths.

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PROLIFERATION OF MISSILE CAPABILITY

The proliferation of missiles in the Third World has become a major source of concern. Australia, Canada, Denmark, France, Germany, Italy, Japan, New Zealand, Norway, Spain, the United Kingdom, the United States and the Benelux countries have joined efforts to counter this trend under the Missile Technology Control Regime (MTCR) established in 1987.

Most of those concerns, however, are focused on the proliferation of ballistic missiles. They tend to have a long range and a very high penetrability. They can be used as delivery vehicles of weapons of mass destruction such as nuclear or chemical weapons. They were used during the Iran-Iraq war and more recently in the war in the Persian Gulf.

It should be emphasised that ballistic missiles are only one class of high-technology weapons the proliferation of which in the Third World is bound to affect international security. Cruise missiles and guided missiles such as the man-carried air defence interceptor Stingers are other classes of weapons with the same potentiality. The significance of guided missiles such as the Stingers may be judged by the fact that they had apparently a more decisive impact on the outcome of the Afghan conflict than the Iraqi Scud missiles in the conflicts where they were used.

The proliferation of cruise missiles should also be a legitimate source of concern. Using the commercially available global positioning system (GPS) technology, it is easier today for a Third World country to design a cruise missile with an accuracy of 100 metres, than a ballistic missile of the same accuracy.

Missiles are weapons with a high capacity to penetrate enemy territory. Before the war in the Persian Gulf, there was no credible defence against them. The war has been the first occasion on which an anti-tactical ballistic missile (ATBM) system—the Patriot—demonstrated some real although limited ATBM capability. The defence footprint (area defended) of the Patriot was very limited. The primary significance of a successful interception of an incoming missile was its political—not its military—effect. However, the Patriot did demonstrate its ability to defend its defence footprint reasonably well. The era of ATBM capability is upon us.

Because of their lack of accuracy the Scuds were militarily insignificant in the Persian Gulf war. To have a significant military value, missiles should have an accuracy matching the lethal radius of their warhead. The CEP (the standard measurement of a missile's accuracy) of the Iraqi Scuds (at best hundreds of metres) was very large relative to the damage that could be inflicted by the 250 kilograms of explosive it was delivering. This forced Iraq to aim at soft targets, such as cities. In a sense, the less accurate missiles are more of a concern because they can be effective only if they carry weapons with a large lethal radius such as nuclear weapons, or if they are targeted against cities and civilians, whereas accurate long-range weapons arguably fall into the more legitimate category of strategic weapons, which can be used for deep strike against military targets. The MTCR cannot make this distinction.

The purpose of the MTCR is to contain the spread of missile capability by denying Third World countries access to missile technology. The MTCR countries cannot do more than co-operatively control their export of the relevant technology. Some important missile producers have not joined that effort, among them the Soviet Union. The USSR has provided countries in the Middle East—notably Iraq and the Syrian Arab Republic—with a large number of tactical ballistic missiles. China is another country which does not seem to share the concerns of the MTCR countries and has exported missiles, some with a range in excess of 1,000 kilometres. It is conceivable that these countries will be persuaded to join the MTCR. That would strengthen the MTCR significantly, but this will not solve the problem raised by the proliferation of missiles permanently, and for reasons we shall discuss in this paper this will not create a satisfactory situation. The MTCR will also suffer from trying to deny to Third World countries weapon systems that some members such as the United States have in their arsenal, and are still actively developing. Some Third World countries (India, Pakistan, Argentina, Brazil, to name a few) are currently developing that kind of technology. This demonstrates the fact that the spread of technological capabilities is inevitable. Virtually all the countries of the world will, ultimately, have the capability of doing what is today the privilege of a few. The MTCR can only buy time by delaying the process of proliferation. It has to be supplemented by policy initiatives associating the countries that do not belong to the MTCR, whose purpose would be to establish a world order in which long-range weapons of mass destruction are not a threat.

What is "Missile Capability"?

A ballistic missile uses a rocket engine for the first phase of its flight, and then it follows a "ballistic trajectory". That is, it has the trajectory of a dead object falling back. The accuracy of the missile is determined by its "guidance system". The guidance system is a device which analyses the movement of the missiles by detecting the forces applied on the missiles. It is supposed to detect with high sensitivity and precision the deviations from an ideal trajectory and provide adequate corrections. The corrections are applied through fins or thrust vector control.

Both phases of guidance are quite delicate: detection of deviation from the ideal path and implementation of the corrections. A missile undergoes high acceleration, and travels through the atmosphere at very high velocity. It is subjected to very large forces. Small errors in the value or angle of its velocities translate into large errors at the end of its trajectory. The guidance system must be able to detect very small signals, in the midst of great noise. Modern systems use laser gyroscopes and require high processing capabilities. Implementing corrections is also a delicate operation. Compared to the guidance system, the rocket engine technology is probably easier to develop. A lot of information is publicly available on rocket engines and on missile kinematics and stability.

Countries such as Brazil or India could not be totally denied the ability to build a missile through export control, although it might slow their progress. The development of guidance systems is the main area in which they might find it difficult to make progress on their own. This is an area in which export control could make a difference. It seems that the possibility that missiles could be used in a nuclear mode is the major source of concern with missile proliferation. The consequence of MTCR policies on Brazilian or Indian missiles will not be to prevent Brazil from building missiles, but to make sure that their first missiles will not be very accurate, that is, that they could be used efficiently only against civilian targets or as delivery vehicles for weapons of mass destruction such as nuclear weapons. The MTCR might not be very effective at preventing a country from acquiring the delivery vehicles for nuclear weapons, because these do hot need to be very accurate in order to be effective.

If a Third World country wanted to acquire a conventional long-range strike capability, it would be able to do that more easily with cruise missiles than with ballistic missiles. What cruise missile capability entails is of a totally different nature. A cruise missile is basically an unmanned aeroplane. United States cruise missiles are very accurate, very penetrable and offer a large variety of launching techniques as compared to ballistic missiles. They can be launched from the ground, surface ships, submarines, or aeroplanes. As delivery vehicles for weapons, they are more flexible than ballistic missiles. Like ballistic missiles, they can be used for delivery of unitary payloads, but they can also, more easily than ballistic missiles, deliver submunitions and disperse chemical weapons. The guidance system of United States cruise missiles uses the terrain contour recognition technique called TERCOM. TERCOM compares the profile of the terrain it flies over with a profile stored in its memory. To be operational it requires a wealth of intelligence data on the target country and high processing capability. This kind of technology is out of reach for most countries. The United States is the only country using such a technique.

The appearance of the global positioning system has changed that situation. It is now theoretically possible to equip those missiles with a GPS receiver, commercially available, far cheaper than TERCOM, which tells the missile its position within one hundred metres. Countries able to build aeroplanes could even more easily build a cruise missile. The control of the flight requires a radar altimetre, coupled with a servo-mechanism that controls the flight, which seems less stressful technologically than is the guidance system required for a ballistic missile. Also, cruise missiles do not require re-entry vehicles that must withstand very severe temperature conditions. In common with ballistic missiles, cruise missiles require warheads. The warhead is one component of cruise and ballistic missiles which cannot be deployed by means of dual-use technology, but is very specific to military applications.

Another incentive for Third World countries to be interested in cruise missiles instead of ballistic missiles is the advent of the anti-tactical ballistic missile capability. Now that the Patriot has demonstrated a limited, but significant, ATBM capability in the Persian Gulf war, the United States and perhaps other countries will certainly feel encouraged to work on ATBMs.

On the other hand, the emergence of ATBMs does not yet signal the end of the era of ballistic missiles. The Patriot has demonstrated only a very limited ATBM capability. It will take a long time to upgrade Patriot capability, and for a long time only a very few countries will be able to afford that kind of capability. Furthermore, long-range ballistic missiles will remain difficult to intercept for a very long time and it is possible to conceive counter measures to ATBMs, and penetration aids, which might defeat the next generation of ATBMs. The use of tactical ballistic missiles might, however, involve measures to counter ATBM defence. There is no efficient defence against cruise missiles.

The interception of cruise missiles requires a completely different architecture from ballistic missiles. Unlike that of ballistic missiles, the launching of a cruise does not send a very large signal easily detectable from space. The detection of cruise missiles cannot be made from air-defence ground-based radars. The cruise missiles fly too low. The detection requires airborne radars such as airborne warning and control systems (AWACS), able to distinguish a cruise missile from above, that is, from the background noise. This is very difficult and requires high processing capabilities. There are reasons to believe that cruise missiles will remain very penetrable for some time to come.

Discussion of policies of export control tend to use the concept of dual-use technology in a simplistic way. Any technology or technological concept which finds a military and civilian application belongs to the elusive family of "dual-use" technologies. Some aspects of ballistic missile technology may be said to be "dual-use": the technology for space launchers and re-entry vehicles is of direct use for ballistic missiles. In fact, ballistic missiles were originally developed together with the space programme in the Soviet Union, and some Soviet launchers today use stages derived directly from ballistic missiles. Containing the spread of ballistic missile technology will constrain the space programmes of Third World countries: if the MTCR were successful, the space programmes of Third World countries would not deal with launchers at all, only with payloads and non-MTCR countries would be obliged to use the services of one of the MTCR countries offering launches.

In the same way, cruise-missile technology has a lot in common with aeroplanes. A policy of technology export control denying Third

World countries access to cruise missile technology will almost inevitably deny them access to aeroplane manufacturing technology. If the control is pushed to its limit, it might even complicate the purchase of commercial airplanes, since these will be equipped with GPS receivers. On the other hand, the control could focus on specific components of cruise missiles which do not have any civilian application, instead of dealing with all the components included in a cruise missile.

Countries Developing Those Capabilities

Of fundamental importance for the discussion of the proliferation of missile technology is the extent of its spread and the dynamics of its diffusion. We follow the tradition of discussing it by country, because we do not know of a better approach. It provides a unique insight into the variety of situations and the political framework in which the non-proliferation regime will be applied. The most notable countries that tend to be associated in one way or the other with missile proliferation are: Afghanistan (which possesses considerable amount of Soviet missiles and used them in unprecedented numbers against the mujahidins); Algeria (which has a few Soviet Frog missiles); Argentina (which is potentially a producer); Brazil (which also has a missile programme); China; Cuba (which also has short-range Soviet missiles); Egypt (which has an ongoing programme of development of ballistic missiles); India (which also has a space programme); Indonesia (which has a small rocket programme); the Islamic Republic of Iran (which is actively trying to acquire missiles); Iraq (whose capabilities were seriously set back during the war in the Persian Gulf); Israel (which has an advanced programme); North Korea (which has Soviet missiles); South Korea (which is sometimes suspected of trying to develop missiles); the Libyan Arab Jamahiriya (which tries to purchase and sell, and is suspected of developing them); Pakistan (which is supposed to have tested some missiles); Saudi Arabia (which has purchased some Chinese long-range missiles); the Soviet Union (which has been a major source of missiles), and the Syrian Arab Republic (which possesses Soviet missiles and seems to be interested in acquiring others).

Of greater interest for our discussion are the countries which are either developing themselves a missile capability or directly supporting it. They are: Argentina, Brazil, China, Egypt, India, Israel, the Libyan Arab Jamahiriya, Pakistan and the Syrian Arab Republic.

A programme for the development of a missile capability is a serious endeavour, and one which takes several years. It requires resources and a lasting commitment. The amount of resources required is such that some countries have combined their efforts in some programmes. They do not produce any tangible results for several years. The motivation behind this effort has a direct bearing on its content. The United States, through the National Aeronautics and Space Administration engaged in co-operative programmes of rocket development with some of those countries, namely: Argentina, Brazil, India and Pakistan.

As regards Israel, this activity is vital for its security. Because of its precarious relations with its neighbours, Israel needs to maintain a technological edge over its neighbours, at least in areas as vital as long-range strike weapons. Israel has a very active programme of missile development, ATBMs (Arrow), and even space launchers. The state of advancement of Israeli missile technology is comparable to that of the most advanced countries. There is little that the MTCR countries could do (if they were so inclined), that could affect the pace of the Israeli missile modernisation programmes.

The Syrian Arab Republic does not have the capability to develop missiles. It depends on the rest of the world for its supply. Furthermore, it seems that Syria does not have the resources to initiate a significant missile development programme. On the other hand, it has shown a very active interest in ballistic missiles, and there is little that Syria could do to circumvent an efficient regime of missile non-proliferation. The possibility that such an export control regime could be effectively implemented must be a major preoccupation for a neighbour of Israel such as Syria, which does not have its own capabilities.

The Libyan Arab Jamahiriya has a lot in common with Syria, but there are a few differences: it is not a direct neighbour of Israel and it has more resources. In fact, Libya has in the past tried to develop some autonomous capabilities by using some German know-how. On the other hand, Libya suffered from an international isolation, bordering on a boycott, for its alleged support of some terrorist movements. Libyan internal activities have been submitted to a level of scrutiny that is probably higher than that of any other country. This programme is still going on, despite international interference: the German company Otrag, which is helping Libya, has been under pressure from the German Government to leave Libya, but this programme, although not negligible, does not have the potential to lead to the establishment of a significant infrastructure, and to provide Libya with a significant missile capability in the foreseeable future.

For Libya, the final severance of its ties with the German company does not depend on MTCR agreements. It depends on the enforcement of German laws. Without German technological support, the prospects of the Libyan missile programme do not look good. The Egyptian activities in this area seem more promising. The Egyptian missile programme dates back to the Nasser years (the early 1960s). At that time, its political connotation was far more threatening to the security of the region than is the case today. The Egyptian programme today does not seem to proceed from a strategic decision to develop missile capabilities systematically in order to provide Egypt with new weapons that will change its military posture. It seems to proceed rather from the logic of military modernisation. Given the size of the Egyptian military forces and their composition, and given the security environment of Egypt, it is natural that the Egyptian military should be interested in missiles. They are not trying to purchase missiles quickly, but rather to develop autonomous capabilities.

The programme seems to express a prophylactic, long-term policy. The Egyptians cannot expect the support of any MTCR country in that endeavour. They are engaged in some form of collaboration with Argentina in missile technology. The exact content of this association is difficult to identify precisely. These two countries are not perceived as “problem countries”, so it is interesting to see that they insist on conducting a policy which could be perceived as undermining world stability, and which inspires serious opposition among the MTCR countries. From the perspective of Egypt there is a completely different rationality. What is good for the MTCR is not necessarily good for Egypt. And a prudent policy for the Egyptians might be to avoid involvement with the MTCR. The problem with the MTCR is that this is probably true for many other countries.

Argentina and Brazil represent countries with high potentialities justifying great ambitions for the long term. The level of education of their elite is as high as in any advanced country. One would expect the Governments of those countries to have strong incentives to have budding programmes in areas such as nuclear, space or missile technology. On the other hand, the state of their economy does not allow them to have large-scale programmes. Argentina’s Condor missile programme seems to have been developed largely on the basis of the importing of solid fuel technologies from Germany and financial help from Iraq, among other factors. The state of technological advancement of Argentina is such that it will not always depend on the ability of

German companies for the development of its programme. Argentina is able to learn and develop those capabilities by itself. The precedent of what happened with Iraq, and of the collaboration that is probably going on with Egypt proves that Argentina will have the opportunity (if and when it has acquired the capability) to defeat the purpose of the MTCR.

The same is true of Brazil. Brazil has ongoing space and missile programmes. One should expect the technology programmes in Brazil to grow at a varied pace (influenced somewhat perhaps by the economic and financial oscillations of the country). Technology is vital for the development and future of Brazil. It would be less than rational for a Brazilian Government to constrain technology programmes for political reasons.

Brazil might also be an objective hindrance to the success of the MTCR. Brazil developed ties for the export of its missile technology with Iraq, Saudi Arabia and the Libyan Arab Jamahiriya. The fact that countries such as Brazil and Argentina are prepared to collaborate on a technology as sensitive as missile technology with countries of the Middle East quite rightly gives rise to questions. The Persian Gulf war coincided with or triggered a reappraisal by many countries of the problems that the instability in the Middle East raises for international security. One could hope that countries that do not belong to that region will consider their responsibility not to contribute to aggravation of the situation. Otherwise they could expect to be submitted to strong pressure to do so.

India and Pakistan tend to be discussed together because they are the two major components of a problematic region: South Asia. But, the activities of these two countries in missile technology are quite different, in size and content. India is a large country. Despite the fact that its per capita gross national product is small, India can afford a space programme, and can have aspirations of being a local Super-Power. It has an operational launch vehicle, the SLV-3, which is, however, modest by comparison with most other existing launchers—it can put a payload of only 80 pounds in orbit, but it uses a four-stage series of solid propellant rockets. India does not officially have operational missiles, but clearly it does not need the help of foreign countries to be able to provide itself with ballistic missiles.

Pakistan has developed close relations with an improbable mix of countries: China and the United States. Their activities in missile technology, programmes and testing are strongly influenced by the nature of their relation with those allies each of which pursues a different goal in its alliance with Pakistan. For the United States, the proximity of the Soviet Union and Afghanistan is the main source of interest in Pakistan, whereas for China the competition for local influence with India is the main motivation. The relevance of the military programmes of Pakistan is measured by their consequences on their military posture *vis-a-vis* India. The United States has far less interest in armed conflicts between India and Pakistan than does China. And the contribution of the United States to Pakistan's rocket programme is small and for civilian purposes. The United States is not interested in seeing Pakistan acquire a huge ballistic missile arsenal. The Chinese attitude on that subject is quite different. China is suspected of all sorts of dubious contributions to the Pakistani programmes in missile and even nuclear weapon technology. China could become an important factor in the proliferation of missile technology. Not only does China have launchers and missiles of many different ranges, it seems to be very inclined to export them. China has purportedly created companies dedicated to arms export. In the words of a senior officer in charge of arms export:

> "We are determined to devote ourselves to raising funds for promoting the four modernisations of China. This is a glorious mission that should claim credence above all others...."

China has raised serious concerns by selling CSS-2's to Saudi Arabia, and more recently by giving the impression that it is close to selling M-9s to the Syrian Arab Republic. China's need for hard currency seems to be the major source of concern as regards its attitude to trying to meet the potential demand of various countries for missiles and missile technology.

The countries discussed follow different kinds of logic in their attitude towards missile technology. For some countries, the pursuit of missile capability expresses their immediate security needs. This is the case for Israel for example. Others, like Argentina or Brazil, seem to pursue objectives more loosely related to their security. The goals of the MTCR will hardly coincide with what the countries we discussed consider their interests. Other countries not interested in missile technology will suddenly find the purchase of some technologies more difficult. It might not always be easy to convince them that their security is better served in that way, because it slows down the spread of missile technology. In other words, some of the countries acquiring or developing missile capabilities might legitimately resent the MTCR, and the countries not even interested in missile technology might resent the MTCR even more. That means that the MTCR could easily become a source of contention between the North and the South. This would be the most self-defeating outcome of the MTCR.

Critique of the MTCR

The proliferation of missile capability is generally discussed in the context of the proliferation of nuclear or chemical weapons. The degree of missile capability is often assessed in parallel with the nuclear or chemical capability of the country concerned, mostly the nuclear capability. The policy of Iraq under the regime of Saddam Hussein played a very important role in generating worldwide concerns on that subject.

Clearly, there is a scary synergism between missile capability and nuclear or to a lesser extent chemical proliferation. It is important to acknowledge the fact that if one could decouple the problems raised by nuclear proliferation from the debate on the proliferation of missiles, the debate would have a totally different character.

One lesson of the Persian Gulf war was that, equipped with conventional warheads, Scuds were basically irrelevant militarily. And despite their visibility, they did not achieve much politically. The fact that the United States used some of its tactical missile ATACMS during that conflict went completely unnoticed. But, the United States cruise missiles are credited with having made a major contribution to the outcome of the conflict. This suggests that maybe the lesson of the Persian Gulf conflict is that the military value of conventional tactical ballistic missiles is questionable whereas conventional cruise missiles can clearly be very efficient weapons. Countries for which the possession of conventional cruise missiles could make a difference will react negatively to a regime denying them access to a weapon system which has demonstrated its worth. One can expect that such countries will not co-operate in ensuring the success of that regime.

In the spirit of trying to make the MTCR less obnoxious to the Third World, no effort should be spared to make it as sophisticated and acceptable as possible. One area in which there is room for improvement is in the use of the concept of "dual-use" technology. Part of missile technology belongs to what is referred to as "dual-use technologies". The concept of dual-use technologies can be very misleading in discussions on technology transfer. A "dual-use technology" has a civilian and a military application. But both applications can (and in general do) imply a large effort of development, of a very different nature. The difference between a car and a tank illustrates the kind of difference. A tank is not a cost-effective civilian object, and a car is of little military value. Both are the result of a serious effort to optimize their specific applications. Military requirements tend to be quite different from civilian requirements. So the military and civilian exploitation of "dual- use" technologies refer in most cases to very different activities. There are a few technologies which are dual-use in the superficial sense in which the word tends to be used. As we have noticed, the rocket engines of launchers and ballistic missiles are a case in point. But, the demands put on the guidance systems of ballistic missiles have no civilian equivalent, the airframe, or body of cruise missiles has hardly any legitimate civilian use, warheads can hardly be construed as dual-use, and so on.

One drawback to resisting any attempt to refine the concept of "dual use" is that it can aggravate the negative impact of a policy of restriction of technology transfer and it will contribute to antagonising the countries to which the export control will apply. Furthermore, restraining the transfer of technology can only have a negative impact on the economies of all the countries involved. It is theoretically possible to improve this situation by accepting the intellectual challenge of refining its application on dual-use technology. That would mean opening further the black box of technology, accepting a case-to-case approach. Little or no effort has been made so far to gain this additional insight into the anatomy of dual-use technologies. By refining the application of that kind of policy on dual-use technologies, one could make the corresponding policy more intellectually respectable and most probably soften its negative impact significantly. This refinement should take place at two levels: conceptual and translation into policy. At the conceptual level, what is needed and possible is to get a more "dynamic" approach to technology proliferation and dual uses.

The interface between technologies and economic development should be scrutinised. The same technology does not make the same economic sense in different countries. There is room for a lot of refinement at the theoretical level. There is no excuse for limiting the degree of sophistication at the conceptual level. At the policy level however, a completely different logic pertains. At that level too much sophistication could result in impeding the implementability of a policy or in making it lose its coherence. I would contend, however, that keeping to simplistic concepts in the name of pragmatism is not a good approach.

The major flaw in the MTCR approach, which will no doubt guarantee that it could never be a long-term solution, is the fact that the United States and the other countries constituting the MTCR club possess the weaponry they want to deny to the rest of the world. And they do not intend to get rid of their weapons, quite the contrary: one can expect that not only will the United States keep its arsenal of missiles, but it will actively improve them, work on ATBMs, and work at maintaining a technological advantage as large as possible. Seen from the perspective of United States defence policy, this is at least as legitimate as it is for Brazil or Argentina to maintain an active missile programme with international ramifications.

Any regime of technological control is transient in nature. The progress of technology is an irresistible process which will not be stopped by any form of legislation, national or international. The spread and advances of technology constitute a dynamic system. What regimes like the MTCR can achieve at best is to slow down some trends, such as the speed of the spread of missile technology. As we mentioned before, another effect will be to encourage some countries of the Third World to develop autonomous capabilities, thereby limiting further the ability of the MTCR countries to have any impact on the proliferation of technology.

The political environment that the MTCR will create is uncertain. At best the MTCR countries will be successful at convincing Third World countries that the MTCR serves their interests. That means that special provisions will be found to alleviate the potential negative impact of the MTCR. In that rosy scenario the MTCR could be part of a "new world order", based on the co-operation of most countries for its success. More realistically, the MTCR will cause most Third World countries to have serious reservations. It will take some convincing to gain their co-operation and their support will be at best mercenary and provisional. Depending on the way the MTCR is implemented and enforced it might encourage joint ventures between Third World nations targeted against the intentions of the MTCR countries. In other words, legitimate concerns regarding the threat that weapons of mass destruction could be used in the Third World could create the conditions for a polarisation between the North and the South. Clearly, the MTCR will have to be supplemented by other initiatives. A theoretical possibility—one which is not a realistic option—is an international ban on missile technology. This would be the equivalent for missile technology of the draft comprehensive convention on chemical weapons.

The notion that it would be impossible to enforce such a treaty is only true superficially. If no country had the right to develop and procure long-range missiles, it would not be easy to circumvent such a treaty. The development of such missiles is not easy. It requires a serious programme. Nations which are denied by treaty the right to possess such missiles will be very anxious to see the other nations complying. This would make circumvention difficult. As compared to the chemical weapons convention, there is no indication that a missile convention would be particularly difficult to implement. On the other hand, many countries already have hundreds of such weapons, and they will not agree to destroy them. This is the real problem. Since the members of the MTCR are among those countries, the moral bases of their desire to prevent proliferation are low.

The MTCR is objectionable morally; it does not solve efficiently the problem it addresses and it could contribute to dividing the world. It has to be improved in terms of its basic precepts if it is to become more intellectually respectable: but it is necessary. A world without a MTCR would be even worse.

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) was designed to pave the way to a worldwide regime of nuclear disarmament. Concretely it has sanctified a very imperfect world a bit better than it would have been otherwise. The MTCR, like the NPT, belongs to a class of fixes that, at best, prevent the world from becoming even more dangerous. This is achieved by trying to prevent natural evolution and by trying to contain it through arrangements that are inherently unstable. The active co-operation of several nations is needed to maintain the fragile regime thus defined. They will have to be prepared to react to a variety of situations, and will have to hope that time will create the conditions for more international co-operation and trust.

The belief that the proliferation of missile technology can be solved intellectually in a satisfactory way is as yet unjustified. Technology can both benefit and harm mankind. Making sure that it does only the former is impossible. It will take far more than the MTCR to achieve that. The MTCR cannot be better than a suboptimal fix in a situation full of real dangers.

Conclusion

The proliferation of missile capability is a very worrisome development. It is a serious problem still in search of a solution. Non-proliferation regimes such as the MTCR do not have the potential to provide a long-term solution because they cannot stop Third World countries from developing an autonomous capability. A policy of technology transfer based on the present simplistic interpretation of what "dual-use technology" entails could come with a very large cost. Luckily for the supporters of the policy, the cost is difficult to assess and can be denied, because its assessment requires a comparison with a hypothetical situation.

The benefit, on the other hand, is easier to appreciate. What the MTCR could achieve is to buy precious time. As bad as a MTCR can be, there does not seem to be any alternative to it. The proliferation of missile capability presents the world with a real problem. The absence of a satisfactory solution creates a real pressure. We are presented with an uncomfortable dilemma, which should be dealt with as a dilemma. One cannot be comfortable with the proposed solution of a MTCR, but it is an inevitable component of tomorrow's policy. The challenge is to give the best possible face to a MTCR, and to make it work as well as possible.

The MTCR does not include all the countries with advanced missile capability. Among the countries not belonging to the MTCR one finds countries such as Sweden and countries with a record such as that of the USSR and China. The efficiency of what a MTCR could achieve depends on the co-operation of those countries. For some of them, such as China, this support might come at a cost.

Even if these countries co-operate fully, that would still not make a MTCR a flawless approach. It would be offensive in that it would deny some Third World countries the ability to pursue some technological avenues they consider favourable for their development. Ideally, a MTCR should define a "flexible" regime, that is, a regime that would take into account the facts that a component does not *per se* make a whole missile, that most dual-use technologies require separate developments for their military and civilian exploitation, and that in some cases it would be impossible to conceal completely an attempt to exploit them militarily.

A flexible MTCR regime would certainly reduce significantly the indirect cost of the implementation of the regime of control of technology transfer. Whatever those savings (it is impossible to assess them), the notion of a flexible regime is unacceptable because it opens the door to abuses and it is a bureaucratic impossibility: it supposes a "clever regulation" and a bureaucracy able to enforce it: two propositions, we are told, that put us in the realm of utopia. If we accept that logic, the choice today is between an inept and costly MTCR or letting the world become a very dangerous place fast.

As it is designed, the MTCR will contribute to emphasising the divide between North and South, and advanced societies and the Third World. It could apparently only aggravate a division of the world which is much more arbitrary than meets the eyes, and which can only breed trouble for the future. It is critical that the MTCR be designed in such a way that Third World countries can find in it protection for their interests. Although this is clearly essential it goes against the grain of what the MTCR is designed to be.

Proposing a World where some countries protect their privilege of possessing specific weapons systems (and use them when needed, as was the case in the war in the Persian Gulf), while other countries are denied the possession of the same weapons is in the long run an untenable proposition. Outlawing those weapons altogether would be more satisfactory. The idea of outlawing ballistic missiles, or at least a class of them, is a heresy today. One day, denying the rest of the world access to those missiles will cease to be an option. Outlawing them might then be seen as the best solution. In that perspective, it might be prudent not to wait too long before assessing the pros and cons of such a regime.

PROLIFERATION OF BALLISTIC MISSILES AND REGIONAL SECURITY

The aggression against Kuwait and its annexation by Iraq last August led to the unusually fierce Persian Gulf war which broke out at the beginning of this year. During the war, as a result of the large-scale air attack by the multinational forces and the interception by the United States Patriot anti-tactical ballistic missile (ATBM) system, Iraq's Soviet-made Scud B missiles were rendered of little effect. Nevertheless, their repeated attacks on Israel and Saudi Arabia caused great fear among the local peoples. As ballistic missiles have been used several times in some regional conflicts since the 1970s, the international community has shown increasingly grave anxiety concerning the impact which the proliferation of ballistic missiles could have on regional security and therefore the demand to put a stop to their proliferation is becoming stronger day by day.

Historical Background and Status Quo

The proliferation of ballistic missiles is the product of the East-West Cold War following the Second World War. On the basis of the

V-2 used by Germany in the later stage of the Second World War, the United States and the Soviet Union respectively developed their first groups of ballistic missiles not long after the end of the war. Later on, owing to the changes in the situation in Europe, both sides caused a proliferation of the missiles first by making them available to their respective allies either by deploying missiles in the territory of their allies or by helping them to develop their own missiles.

The proliferation of ballistic missiles to the Third World was also caused by the keen competition between the United States and the USSR for spheres of influence. As early as the late 1950s and early 1960s, the United States and the Soviet Union began to provide their respective friends with tactical ballistic missiles. Besides Turkey, a member of the North Atlantic Treaty Organisation, the United States provided South Korea and Taiwan province of China with Honest John missiles, and some United States munitions corporations assisted Israel in developing ballistic missiles by itself. The Soviet Union, on its part, provided Algeria and Egypt with Frog-4 or Frog-5 missiles. Along with the continued intensification of the Arab-Israeli conflicts and the outbreak of the third and fourth Middle East wars, the Soviet Union provided Egypt, the Syrian Arab Republic, the Libyan Arab Jamahiriya, Iraq and South Yemen with Frog-7 and Scud B missiles in the early 1970s while the United States agreed in 1975 to the emergency supply of 200 Lance missiles to Israel (to be delivered in the following year).

The precedents set by the United States and the USSR were followed by some Western countries. Quite a few Western European countries, while energetically developing their own missile technology, transferred missiles or missile technology to some Third World countries or dispatched missile experts to help them design and develop ballistic missiles. All these practices have contributed significantly to missile proliferation since the 1970s. Up to now, more than 20 countries and regions in the Third World have possessed or are developing ballistic missiles and there are nearly 30 types of ballistic missiles which have already been deployed or are under development.

Today, there has been a proliferation of missiles to all parts of the world. The region most affected is beyond doubt the Middle East, where the most acute and complex contradictions and the most protracted and intense conflicts have existed. Judging from the trend of development of proliferation, although it is difficult for Iraq to continue to acquire and develop new ballistic missiles in a brief space of time under the restraint imposed by resolution 687 (1991) of the United

Nations Security Council, the lessons drawn from the war in the Gulf may possibly enhance the desire of other small and medium-sized countries to develop and possess these missiles. What is more, not only would it be difficult to check the momentum of missile proliferation in the near future, but more new generations of missiles may appear and more and more countries may possess ballistic missiles.

Causes of Proliferation

As mentioned above, the proliferation of ballistic missiles has a history of more than three decades. It is not difficult for people to see that the proliferation of missiles came about primarily as a result of the East-West Cold War and the intense competition between the two Super-Powers. It was the United States and the Soviet Union that first allowed missiles and missile technology to proliferate in large quantities and to wide areas. To strengthen and expand their respective spheres of influence, they have competed with each other in providing weapons to foreign countries (horizontal proliferation) while steadily improving the quality of their own weapons (vertical proliferation). They have proliferated missiles not only to their respective allies but also to the Third World countries by means of military aid or the sale of arms. Their basic intention in so doing is to exercise influence over their allies, to influence the outcome of regional conflicts in a way beneficial to themselves through their support of the governments of friendly nations and to gain access to military installations and bases or to exert pressure on the rulers of importing countries.

The United States found out later that, like nuclear proliferation, the proliferation of missiles and missile technology to the Third World brought more disadvantages than advantages to itself and that it would in the end jeopardize its interests in protecting its technologies and its security. Therefore, the United States began to tighten its control over the export of missiles from the latter half of the 1970s. The Soviet Union, too, has not exported the new-generation ballistic missiles to the Third World since the 1980s. However, as the missiles and missile technology possessed by the Third World have come mainly from these two Super-Powers, the military industries and armament development programmes of many countries are still heavily dependent on the United States and the Soviet Union in terms of funds, technology, trained personnel and other matters. Consequently, the acts of direct and indirect, active and passive proliferation of missiles and missile technology on the part of these two countries have never stopped. The self-contradictory "dual policy" pursued by them on the question of non-proliferation—opposing proliferation unfavourable to themselves but encouraging or acquiescing in proliferation favourable to themselves—has proved that the traces of competition between the two Super-Powers can still be found in the matter of missile proliferation in the world today.

The proliferation of missiles is also the result of the constant intensification of the regional arms race. The occurrence and development of regional conflicts have provided the Super-Powers and other outside forces with opportunities for meddling and for regional hegemonism and expansionism. In the meantime, it is precisely due to the interference by the big Powers and to the rampancy of regional hegemonism that regional contradictions have become more acute and complex and that regional conflicts have become more intense and protracted, thus, steadily intensifying the regional arms race. The protracted arms race among the countries concerned, whether in the Middle East or in South and North-East Asia, has led to the race in production of ballistic missiles. With the support and assistance given by the United States and other Western countries, Israel has developed rapidly its military strength and military science and technology, thus, impelling such countries as Egypt and the Syrian Arab Republic to try their best to increase their defence capability and to strive to seek sources of weapons. This has provided the Soviet Union with a huge market for arms. The development of ballistic missiles by Israel, which began in the first half of the 1960s, has incited Egypt to develop missiles by itself. With Israel's deployment of Jericho I missiles and its purchase of Lance missiles from the United States, more Arab countries have imported large numbers of Frog and Scud missiles from the Soviet Union. The race in ballistic missiles between Iraq and Iran and between India and Pakistan has been caused by the constant escalation of the arms race.

The pursuit of high profits by the munitions corporations of the developed countries is another important cause of the proliferation of missiles throughout the world. Despite the great efforts made by the international community to stop the proliferation of missiles over the years, most of the technology and spare parts and components of the various types of missiles that have been developed successfully or that are under development in some Third World countries have now been provided by the munitions enterprises of developed countries such as the United States and Western European countries.

To restrict the proliferation of missile technology, seven Western countries, headed by the United States, after four years of secret negotiations, signed the document concerning the Missile Technology Control Regime (MTCR), in Rome in April 1987, in an attempt to exercise strict control over the export of missile technology. However, it is the munitions firms of these countries themselves that have sold missile technology and spare parts and components of missiles to some Third World countries directly or indirectly and openly or secretly for the purpose of seeking high profits. According to the American Broadcasting Company, Iraq has the capability to produce medium-range missiles and almost all its technology and equipment have come from the corporations of the Western countries, including the United States. Another typical example was the involvement of firms from many Western countries in the Argentine Condor I and Condor II programmes. Such instances involving Western corporations are, in fact, numerous. As pointed out by the *Financial Times* of London, the MTCR has not won clear support from the higher levels of the Governments of most of the signatories, and instances of violations of its restrictive provisions by the firms, particularly those of European countries, can be found everywhere. Apparently, the proliferation of missiles in the world would not have developed to the point where it is today without the direct or indirect technological assistance offered by the munitions enterprises of the developed countries.

Impact and Latent Danger

Ballistic missiles have so far been used five times in regional conflicts. Apart from the launching of a few Scud B missiles by Iraq in the recent Gulf war, they were used four times earlier. In the fourth Middle East war, in October 1973, the Syrian Arab Republic launched approximately 20 Frog-3 and Frog-7 missiles to attack some military bases in the northern part of Israel, with no great damage resulting therefrom. In the early period of the Iran-Iraq war, Iraq launched a few short-range missiles against border towns of the Islamic Republic of Iran and then launched more than 100 Scud B missiles against Iran's targets deep inside its territory between 1983 and 1986; Iran launched a counter-attack on Iraq after acquiring the same type of missiles from the Libyan Arab Jamahiriya in 1985; both sides waged a large-scale "War of the Cities" against each other in the spring of 1988, resulting in the loss of the lives of thousands of civilians. On 15 April 1986, the Libyan Arab Jamahiriya launched two Scud B missiles against a United States coast guard station in the coastal area of Italy in retaliation for the United States air attack, but they missed the target. Another instance is that of the missile attack on the guerrilla positions by the Afghan

Government troops at the end of 1988, with a total of over 50 Scud B missiles fired.

The use of ballistic missiles in regional conflict has to a certain extent increased the intensity and complexity of war. The impact of the proliferation of missiles on regional security should be neither underestimated nor exaggerated. The above-mentioned facts have proved that the destruction and casualties caused by ballistic missiles with conventional warheads, which are used to attack military targets, industrial facilities and residential areas, are limited, and they can exercise no decisive influence over the process of war. One of the reasons why the Third World countries wish to possess ballistic missiles is their desire to exert some sort of military deterrence on the opposing countries in their own region. However, these missiles account for only a very small part of the military strength of the countries concerned because of their limited economic strength and it is difficult for these missiles to constitute the main deterrent force against other countries. Although all of Israel's neighbours except Jordan and Lebanon have possessed ballistic missiles, the military circles of Israel hold that "the demon has not yet come out of the bottle" and so the threat posed to Israel by the proliferation of missiles is "potential" rather than "actual." For some of the Third World countries, such as Brazil and Argentina, the purpose of developing and possessing ballistic missiles is not just for mutual deterrence but for the establishment of their own political status as a regional power by developing technology and enhancing defence capability. However, the increase in the number of Third World countries possessing ballistic missiles and the growth in the number of missiles obviously involve the following latent dangers as far as regional stability and world security are concerned.

Escalation of Regional Arms Race and Regional Instability

As the proliferation of missiles takes place mainly in those "hot spot" areas where turbulence and confrontation have long existed and where military conflicts occur occasionally, the increase in the number of missiles deployed or the possession by one country of a certain new type of missile tends to make its hostile neighbour or neighbours increase the number of their missiles in the same way or acquire a similar new type of missile. The opposing sides in the Middle East have been stepping up their development of new-generation missiles. For instance, Israel has been developing the Jericho II; Egypt, the Badr 2000 (Egyptian designation for the Condor II); and Iraq, the Al-Hussein and the Al-Abbas. Israel signed an agreement with the United States on the joint development of the Arrow ATBM at the end of June 1986, according to which the United States is to share 80 per cent of the cost and Israel 20 per cent. In addition, the United States decided at the end of last year to sell the Patriot ATBM systems to Israel (it was planned to enable Israel to deploy them by the end of this year).

As a result of the outbreak of the war in the Persian Gulf, the United States has taken the measure of emergency delivery and thus Israel has acquired the ATBM capability ahead of schedule. Undoubtedly, this will enhance the determination of other countries in the region to try to improve the penetration capability of their ballistic missiles in the future. In South Asia, India's successful test-launching of its Agni medium-range missile, with a maximum range of 2,500 kilometres on 22 May 1989, has naturally caused anxiety among its neighbours. All these facts have shown that the unlimited proliferation of missiles can only bring about a spiralling escalation of the regional arms race, further intensify the tension in the regions concerned, and even cause the outbreak of an even newer and bigger regional conflict.

Proliferation of Chemical and Nuclear Weapons and World Security

As chemical weapons can be produced in a far simpler way than nuclear weapons, and as it is relatively easy to acquire most of the raw materials needed for producing them on the international market, some Third World countries are reluctant to abandon their right to produce chemical weapons, in an apparent attempt to use this kind of "atom bomb of the poor" to deter their neighbouring opponents. As an ideal means of delivery of chemical weapons, ballistic missiles are what those countries that intend to possess chemical weapons seek to acquire.

Likewise, ballistic missiles are also the best means of delivery of nuclear weapons, and the countries which are developing their new-generation medium-range missiles are precisely those to be considered as "nuclear-threshold countries", that is, countries which have the potential of producing nuclear weapons. The successful development of medium-range missiles may possibly incite to some extent the desire of these countries to possess more chemical and nuclear weapons. Therefore, the proliferation of ballistic missiles has increasingly been considered in recent years to be interwoven with the proliferation of chemical and nuclear weapons. Once chemical and nuclear weapons are really possessed by some countries in "hot spot" regions and are used in regional conflicts, this will inevitably not only bring about disastrous consequences to other countries in the same region but also engender an extremely great danger to world security and peace.

Intervention by the Super Powers and Regional Contention

The proliferation of ballistic missiles to the Third World and the "hot spot" regions in particular has not only aggravated the contradictions and struggles among the countries concerned there but has also provided a pretext for new intervention by the Super-Powers. The United States holds that the possession and updating of ballistic missiles by the Third World countries have increased the threat to the security of its regional allies and, furthermore, have constituted a threat to the security of its forces and bases overseas.

Accordingly, former United States President Ronald Reagan called for struggling resolutely against this "dangerous trend" in National Security Decision Directive No. 70, which he signed in November 1982. The tough stand and firm action taken by the United States against Iraq in the recent Gulf crisis were caused by the unanimous opposition on the part of countries all over the world to Iraq's policy of aggression and expansion. But in the meantime they have fully shown that the United States has, for its own strategic interests, taken advantage of this opportunity to get rid of this "malignant tumour", which had long been regarded as a threat to its security. Although unable to contend with the United States in the handling of the Gulf crisis as a result of being busy with resolving difficulties that had arisen in the domestic political situation, the Soviet Union did its utmost to play its role as a Super-Power and constantly created difficulties for the United States in seeking ways to bring about a political settlement. It did so also in the post-war security arrangements to prevent United States monopoly of power in the Middle East after the war.

Ways of Preventing Missile Proliferation

For a long time the international community has made great efforts to control the proliferation of missiles, but only minimal results have been achieved so far. The MTCR divides into two categories the items the export of which is restricted. The first category covers the "most sensitive" items, including complete sets of rocket systems with a payload of over 500 kilogrammes and a range of over 300 kilometres as well as subsystems and their production equipment, stages of individual rockets, re-entry vehicles, solid or liquid fuel for rocket engines, rocket guidance systems and launching devices and so on. The second category refers to the production technology which may be useful to the large-scale production of missiles but presents little risk in the near future, including 15 items such as production facilities for propellants, structural materials, aviation electronics, ground support equipment, testing equipment and computer software. The agreement stipulates that the items listed in the first category are to be under severe restriction and are generally not permitted to be exported and those in the second category are permitted to be transferred, except in special circumstances, so long as there are guarantees between Governments. This agreement is the first written document in the world concerning control over the proliferation of missiles. None the less, even the Western countries themselves have admitted that the provision of the MTCR on restricting transfer are "far from enough" and are made "too late" because the missiles and missile technology possessed by many Third World countries have already surpassed the performance level restricted by the MTCR.

The reason why it is difficult for this regime established for the purpose of restricting the proliferation of missiles to yield results is that it contains many serious defects and loopholes. It is a regime intended to enable big countries to restrict small ones and to enable developed countries to restrict developing ones. It is not an international convention with broad representation concluded through consultation on the basis of equality by all countries of the world. Besides the seven founding nations, only eight other nations have acceded to the agreement. Many nations possessing missiles, including the Soviet Union, have not yet joined the MTCR. It is not an international legal instrument, neither a treaty nor an official agreement, neither with an international executive body nor with any verification provision or provision on sanctions against violations, so it has little binding force on the signatories. It is precisely for this reason that many munitions corporations of the signatories have apparently violated the agreement. Moreover, as most parts of the technology of the medium-range missile and especially of the inertia-guidance technology are roughly the same as those of satellite-carrying rockets for civilian use, which can hardly be distinguished from military ones, this regime discriminates against the right of Third World countries to develop space technology and to utilise outer space for peaceful purposes. In addition, the criteria relating to the restricting of the export of missiles as set forth in the MTCR legalize, in effect, the sale in large quantities of such short-range missiles as Lances and Scuds by the developed countries. This clearly contradicts the efforts made by the international community to halt the proliferation of missiles.

The occurrence of the Gulf crisis has made the international community demand more urgently than before the halting of the proliferation of missiles and of nuclear, biological and chemical weapons.

Not long after the end of the war in the Persian Gulf, the United Nations Security Council adopted resolution 687 (1991), which provides that Iraq shall destroy completely, under international supervision, all its weapons of mass destruction and their production facilities, including all ballistic missiles with a range in excess of 150 kilometres and their production facilities. This is undoubtedly an effective measure for preventing Iraq from developing and deploying ballistic missiles again. However, the scope of proliferating missiles in the present-day world is not limited to Iraq alone. Effective prevention of world-wide proliferation of missiles will be a very arduous, long-term task facing the entire international community. Member nations of the MTCR held a meeting in Tokyo late in March and have planned to hold another meeting in Washington in November this year to study specific measures for tightening control over missile technology.

Although the strengthening of the restrictive measures of the MTCR may perhaps play a positive role in preventing or slowing down the proliferation of missiles, people will still be sceptical about whether any new measure will produce the desired result because of defects in the regime itself. To halt the proliferation of missiles completely, attention should be paid to the following points:

1. Whether the proliferation of ballistic missiles can be halted will depend on the settlement of regional conflicts because these are the most direct stimulant to the proliferation of missiles to the Third World. As long as regional conflicts are not eliminated, the regional arms race will not stop. Therefore, overall, just and rational settlement of regional disputes and conflicts is the only fundamental way of preventing the proliferation of missiles. The international community should work unremittingly to this end.
2. The world process of arms control and disarmament is closely related to the halting and slowdown of the proliferation of missiles. The growth and decline of the armaments of the Super-Powers and the progress in their disarmament talks not only bring about a change in the United States-Soviet Union bilateral relations but also have an important impact on the changes in the world and regional security situation. The intensification of the arms race between the United States and the Soviet Union will inevitably stimulate the increase in the armaments of the regional countries while the progress in the United States-Soviet Union disarmament talks will promote the process of

regional arms control. Therefore, to halt the proliferation of ballistic missiles, the Super-Powers must assume the special responsibility of taking the lead in making a significant reduction of their nuclear and conventional weapons to improve the security environment of all regions in the world and to impel regional countries to give up the option of developing and possessing nuclear and conventional missiles and biological and chemical weapons.

3. To encourage the Third World countries to halt the proliferation of missiles of their own accord, the United States, the Soviet Union and other developed countries must discard completely their "dual policy" on the question of non-proliferation. Both "horizontal proliferation" and "vertical proliferation" should be stopped. On the question of "horizontal proliferation", the Super-Powers must take the lead in halting the proliferation of missiles and missile technology to their respective allies and friends. All developed countries must exercise strict control over the sale of weapons to foreign countries by their munitions enterprises and must prevent the proliferation of missiles and missile technology in all forms.
4. The exploration and development of effective measures to control the transfer of weapons must be conducted jointly by countries all over the world on the basis of equality so as to avoid the imposition on other countries of an agreement reached by a few countries as *a fait accompli* for their acceptance. The United Nations should play a full and positive role in organising and formulating laws and regulations concerning control over the world-wide and region-wide transfer of weapons and in carrying out the needed supervision and verification.

The proliferation of ballistic missiles has become an important problem of universal concern in the international community. As no really effective solution has been found to this date, judging from the current trend of development, people can by no means be optimistic about the prospects of halting the proliferation in the near future. Since the causes of the proliferation of missiles are complex, it is surely difficult for any simple restrictive measure to lead to success. Only when practical measures are adopted simultaneously in all aspects can the proliferation of ballistic missiles be checked fundamentally. The international community must make long-term and arduous concerted efforts to this end.

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LIMITED ABM: A WRONG SOLUTION FOR THE REAL PROBLEM

In 1990 and 1991, the Strategic Defense Initiative (SDI), which had been initially designed as a revolutionary breakthrough in doctrines of the nuclear age, has been squeezed into the traditional framework of "nuclear deterrence" strategy. Even in this role, SDI has become just a peripheral appendage to security arrangements.

In particular, the new version of the anti-missile system known as Global Protection Against Limited Strikes or GPALS, advanced by the United States Department of Defense in the aftermath of the Persian Gulf war, envisages defence only against limited, accidental, unauthorised missile launches and missile attacks by Third World countries. The more modest technical scale and less ambitious strategic vision of the current anti-ballistic missile (ABM) version create the appearance of a more realistic policy and a more rational programme. As distinct from President Reagan's "great dream" of the past, contemporary "SDI" is becoming a subject of more specific debates and technical estimates and forecasts. This means that, it may be implemented. But, the GPALS system will materialise only if strategic debates in the United States, budgetary considerations, follow-on negotiations on stability in Geneva and the overall situation in the USSR are conducive to implementing it.

Although technically still very vague, the GPALS concept envisions deployment of about 1,000 space-based kinetic, direct-impact infrared homing interceptors of the "brilliant pebbles" type, supported by 700-1,000 high-altitude ground-based missile interceptors with non-nuclear warheads. The former are to receive tracking information from the future "brilliant eyes" electronic-optical satellites, while the latter are to be guided by ground-based radars and homing systems. In addition, development of an anti-theatre ballistic missile (ATBM) system is continuing as a follow-up to the veteran Patriot, which was used in the Gulf war to intercept Iraqi Scud missiles. The new United States ATBM has to be transportable to any place in the world to defend United States troops and allies. The whole research and development, procurement and deployment programme might take from 10 to 15 years and require around $50 billion in addition to the $20 billion already spent on SDI.

In July 1991, the United States Senate approved the allocation of $4.6 billion for deployment of the first ABM base in North Dakota (which is not in violation of the 1972 ABM Treaty) and for the continued development of other elements of GPALS. Simultaneously, it was decided to start talks with the Soviets on amending the treaty to allow for later deployment of additional ground-based ABM sites (1,000-2,000 interceptors) and space-based sensors.

At first glance, internal instabilities in the Soviet Union and the proliferation of ballistic missiles in the Third World make the new ABM version politically plausible. Closer examination reveals, however, serious flaws in this new SDI concept. In principle, the probability of an unauthorised or accidental launch of a ballistic missile is very low and is diminishing. The command and communications systems of nuclear forces, which protect them against unauthorised or accidental use, are being improved. Special procedures and mechanical and electronic blocking devices are being enhanced in order to reduce as much as possible the danger of unauthorised launch.

On the other hand, this possibility should not be totally ruled out. The question is whether an ABM system is capable of rectifying the situation. Limited anti-missile systems permitted by the ABM Treaty can protect only limited areas. For these ABM systems to prove their worth, a missile launched in an unauthorised or accidental way would have to be targeted exactly on these areas, and that possibility is too negligible to take into account.

The building of a “thin” ABM system for the protection of a State’s entire territory, the deployment of space-based interception systems, might create greater problems than those it is intended to solve.

The extension of at least a “thin” defence to the entire territory would require major amendment of the ABM Treaty. This would involve serious political and legal difficulties. Another point to keep in mind is that, for some influential groups and institutions in both countries, the amendment would be just a pretext to completely dismantle the Treaty and proceed with unlimited deployment of defence and space systems.

The problems that stem from the asymmetry of the two countries' strategic offensive forces and that have complicated the Strategic Arms Reduction Treaty (START) would grow in geometric progression should disproportions in their respective ABM systems become an issue at the Geneva negotiations.

Owing to differences in technical characteristics and standards, it would be extremely difficult to ensure equality of the two sides—all the more so in that non-nuclear defence will make differences in technologies much more important.

Moreover, the location of ground-based anti-missile sites in relation to strategic offensive deployment areas and the administrative and industrial centres of the two countries must be quite different.

Anti-missile protection of United States allies would be another problem, extremely divisive in view of their differences in strategic vulnerability, economic and technical levels, and political significance of command and control arrangements. Space-based ABM interceptors would avoid many of those asymmetries. If technically feasible, a "brilliant pebbles"-type system would be able to intercept any ballistic missile above a certain altitude, regardless of its launch point or target location on the globe. But, it would create other, no less serious problems between the United States and the USSR involving space technology differences between the two States, variations in suitable orbits, mutual vulnerabilities of space-based interceptors and their sensors and communications links, and risks of breakout of space-based anti-missile weapons—even if limited by agreements.

Extension of the range of ground-based interceptors or construction of deployment sites (in addition to the one permitted under the ABM Treaty) would require the solution of many technical problems, especially for the Soviet Union in the light of its geography. What would be sufficient to cover United States territory would not suffice for that of the Soviet Union, which extends many thousands of kilometres beyond the Urals. To protect it, at least a dozen additional deployment areas would be required, depending on the range of the anti-missile interceptors, their acceleration and kill capabilities—an addition that would give rise to concerns regarding United States-Soviet asymmetries and possible break-out.

While the United States might want to emphasise space-based elements of the ABM system, suitable for its own protection and that of its allies, the USSR, for geostrategic and technical reasons, might prefer land-based options. If it is not successful in developing sophisticated non-nuclear interceptors, Moscow would feel entitled to deploy traditional nuclear types. How would United States allies react to this programme? How would thousands of extended-range nuclear anti-missile interceptors affect the limits imposed by the Treaty on intermediate-range and shorter-range missiles (INF) and by START?

The United States space-based interceptors would inherently possess anti-satellite capability against Soviet space assets. To balance this, Moscow might decide to deploy its own dedicated anti-satellite (ASAT) system, either land- or space-based, or both.

Americans would not need operational deployment of transportable ATBM defences on their territory in the absence of any obvious threat close by. The Soviet side would certainly choose to deploy ATBM systems in combat-ready forces to face threats from all directions and would acquire a non-dedicated strategic terminal defence layer, in particular against slower re-entering warheads on submarine-launched ballistic missiles (SLBMs). In and of itself this might not be of great strategic importance, but in combination with other defensive deployments, it would cause substantial concern.

The United States can afford to discount an air-delivered nuclear or chemical strike by a Third World country or terrorists. In the Soviet Union, this contingency would certainly be taken seriously, jointly with the United States, if the threat of limited attack were elevated to the highest defence priority. ABM and ATBM expansion would be senseless for the USSR without further improvements in its massive air-defence. For a number of technical reasons, the latter would be extremely hard to limit to a Third World threat, without affecting the United States-Soviet strategic or the Western-Soviet theatre nuclear balance. These and many other—as yet unpredictable—complications are in store if the ABM problem is reopened on the practical level.

The United States interest in defence against accidental launch is, to a large extent, motivated or justified by the possibility of a break-up of control over the Soviet nuclear arsenal as a result of the internal crisis in the Soviet Union. An ABM system would hardly provide a solution under such circumstances. At present, intercontinental ballistic missiles (ICBMs) and SLBMs are the least susceptible to unauthorised launch for purely technical reasons. In any case, strategic offensive weapons should be deployed only on Russian territory and the reductions under START may allow this to be done rationally and quickly. Tactical nuclear weapons pose problems that an ABM system cannot address. Other methods of ensuring tight control over nuclear weapons are, however, available.

Moreover, the time required for the development and deployment of GPALS does not correlate with the time required to settle Soviet domestic troubles—which will be sorted out in one way or the other in the next several years. Depending on the resolution of the current crisis, a United States ABM system against unauthorised launch, developed in response to Soviet domestic calamities, will be either insufficient or unnecessary.

The "normal" theoretical probability of unauthorised or accidental launches, inherent in the existence of vast strategic arsenals, especially in crisis situations, is aggravated by the concepts of launch-on-warning (LOW) or launch-under-attack (LUA). The principle of launching strategic forces upon receiving signals from early warning systems, without waiting until the strike is delivered on the targets, are justified by the vulnerability of a part of one's strategic offensive forces and their command and communications systems to a nuclear strike. The short flight time of sea- and land-based ballistic missiles (10 to 30 minutes) reduces the reaction time to a few minutes. This fact suggests almost preprogrammed decisions and actions, the transfer of nuclear forces to the highest state of alert, and removal and deactivation of most of the preventive systems. All this considerably increases the danger of an unauthorised or accidental launch.

The START talks may help if, in an effort to reduce strategic armaments, the two parties ensure greater survivability of the remaining strategic offensive forces and of their warning, command and communications systems. These goals may also be attained through dispersal of the remaining forces at highly survivable launchers and platforms and through reductions and limitations on weapons systems of higher counter-force capability. These measures would reduce and in the new political situation even eliminate the dependence of the two States on the concepts of LOW and LUA.

Of great importance are also further developments in strategic confidence-building measures (such as notifications about missile launches, above-normal patrol rates of strategic and attack submarines, and massive take-offs of bombers) and the modernisation of direct communication lines and nuclear risk reduction centres.

It is possible to visualise in the future direct talks on this problem, the development of reliable joint early warning systems, the permanent monitoring by one side's inspectors of the other side's strategic bases and command centres on a mutual basis, the common development of preventive and blocking devices, and controlled installations of self-destruct mechanisms on missiles. These measures are becoming thinkable in the new political situation after August 1991, and they would provide much better solutions to the problem, as compared with the deployment of GPALS-type systems.

On the contrary, deployment of defensive systems in parallel with reductions in offensive weapons might encourage greater reliance on LOW. This will be more likely if offensive systems become less survivable. Survivability is expensive, and the necessary resources might be consumed by new defences.

The defence against terrorist nuclear missile strikes deserves special attention. Clearly there is the danger of the continuing transfer of ballistic missiles and ballistic missile technologies to Third World countries. In addition, unstable, adventurist and fanatical regimes or terrorist groups may get access to nuclear (chemical or biological) munitions and mate them with ballistic missiles.

Within the framework of the limited systems that are at present permitted under the ABM Treaty, it is practically impossible to defend either of the two Super-Powers from a terrorist strike. The extension of at least a "thin" defence to the entire territory would require revision of the Treaty. As in the case of acquisition of ABM systems against accidental launches, these measures would involve serious political and legal problems.

Moreover, even if "thin" ABM systems did not destabilise United States-Soviet strategic deterrence, their effect upon the other nuclear Powers would be substantial. The United Kingdom, France and China would very likely perceive development of these systems by the Super-Powers as detrimental to their security for at least two reasons: new defensive capabilities would detract from their limited deterrent potentials and would never give them comparable protection. These States, having once acquired nuclear weapons at great economic cost for security and status, would not agree to lose this investment as a by-product of United States-Soviet manoeuvring over defence and space issues. The expansion of the Super-Powers' ABM systems would only spur the other nuclear weapon States to build up and improve their nuclear potentials and to unite their military efforts, which would make their participation in the nuclear-arms control process more difficult.

This reaction is manifest even in respect to the limited United States and Soviet ABM systems that are now permitted by the treaty for protection of the capital or one area of ICBM deployment. The nuclear force levels of the United Kingdom and France and their present modernisation programmes have in large measure been determined (or at any rate justified) by the need to overcome the existing ABM system around Moscow and, in the long run, by the need to counter possible larger-scale ABM deployments.

In the case of additional United States and Soviet defensive efforts, further expansion and modernisation of the French and British nuclear deterrent forces and possible steps towards closer cooperation would very soon raise the question of German participation. This issue would be extremely divisive for Western Europe, the North Atlantic Treaty Organisation and Western-Soviet relations as a whole.

Chinese reaction because of its non-aligned status would be even more negative, although largely unpredictable in practice. For instance, China could opt for larger ICBM and SLBM forces and hair-trigger launch systems, nuclear anti-satellite systems, long-range sea-, air-, or land-based cruise missiles, etc. Beijing's position on ballistic missile proliferation in the Third World might become less cooperative, either tacitly or openly.

Reaction of the Third World regimes is hardly predictable. If seen as a major step towards Super-Power condominium and a sign of their greater willingness to use force either jointly or unilaterally, the United States-Soviet defensive efforts might bring about results just the opposite of those intended: growing cooperation in missile development, proliferating transfers and trade in missile technology, and further nuclear and chemical proliferation.

Lastly, it should be borne in mind that even if effective GPALS-type systems are developed, adventurist regimes or terrorists might use other ways of delivering nuclear munitions, should they acquire them. Generally speaking, of all possible delivery vehicles, a long-range ballistic missile is the most complicated and unsuitable option for them. Organising the production of even one such vehicle requires the establishment of whole branches of machine-building and chemical and electronic industries, the construction of launching sites, the training of service personnel, etc. This activity would be noticed in good time and the missiles and the infrastructure connected with them would be extremely vulnerable even to conventional weapons.

In all probability, in this field as in many others, ABM defence would create additional difficulties rather than solve problems. During four decades, the two Super-Powers have learned the hard way in their bilateral relations that in the nuclear age there is no neat and final technical solution to the problems of national security. Probably the time has come to recognise the same truth in the relations of the two great Powers with the rest of the world. The great Powers, in countering possible threats, should rely much more on a sophisticated combination of their potentials of devastating nuclear retaliation and conventional preemption and of various political and economic "sticks and carrots" for preventing the proliferation of weapons of mass destruction and missile technologies.

To summarise the above considerations, the new version of SDI embodied in the GPALS system does refer to real problems: the danger of an unauthorised missile launch and the threat of ballistic missile proliferation in the Third World. But on the other hand, there is yet no evidence that these threats have become the first priority of the defence agenda or that there are no other, more effective ways of dealing with them. It seems that economic, political and technical impediments to SDI progress gave birth to new strategic justifications for a more limited version of the programme. Being virtually a system in search of a mission, anti-missile defence may paradoxically bring about materialisation of the threat that it is supposed to remove. Besides, the technical solution proposed may create significant new complications, reopen older issues and turn out to be ineffective in achieving stated goals.

At the same time, in the light of the experience of the Gulf war, an ATBM system might be useful for the United States and the USSR, if not against each other, then for probable future Third World contingencies. Besides, in Europe and in the Far East it would support force restructuring and reduction to implement the principles of defensive sufficiency. The problem for the negotiators in Geneva in the near future should be to make sure that the development, testing and deployment of ATBM systems do not undermine the ABM Treaty.

For instance, it would be expedient to define testing "in an ABM mode", in addition to the provisions of the Agreed Statement of 1978, as testing against real targets with re-entry speed in excess of 4 km/sec or intercepts at the altitudes higher than 40 km. To make the limitations even more stringent, qualitative limits are also suggested: burnout missile-interceptor speed no higher than 2 km/sec or an acceleration capability in excess of 100 G. The potential of the radars might also be limited, using the ABM Treaty precedent, for instance at 50,000 watt-metres-squared. Geographical limits could help to ensure that ATBMs are not deployed in the northern areas of the two States, where they are not really needed because of an absence of theatre ballistic missile threat. Additional verification and cooperative procedures would by required to establish these limitations.

It is just as clear that space-based interception systems would not be required against theatre missiles since most of them have an apogee below the effective interception altitude of "brilliant pebbles" type systems or could be fixed to fly lower with the sacrifice of a shorter range.

Contrary to justification for GPALS and the Senate's decision taken in the summer of 1991, it seems that, in view of the changing political and strategic environment, United States-Soviet strategic stability now more than ever requires preservation of the ABM Treaty as it was signed in 1972 and supplemented in 1974 and 1985. At the same time, it will be necessary, in order to remove mutual suspicions, to agree on limits on the experiments permitted or forbidden by the ABM Treaty in reference to ATBM technologies, space-based radar stations and space sensors based on new physical principles. Proceeding from such a mutual understanding it would be expedient to expand transparency, predictability and confidence-building measures related to the activities in the field of ABM defence.

LIMITED DEFENCES UNDER A MODIFIED ABM TREATY

President Bush's September initiative to de-emphasise nuclear weapons in United States security policy fanned hopes that the two Super-Powers would institute deep reductions not only in tactical nuclear weapons—the category on which President Bush's unilateral cuts focused—but in their strategic nuclear arsenals as well.

President Gorbachev responded by both matching the announced United States unilateral cuts in tactical nuclear weapons and indicating that the Soviet post-START (Strategic Arms Reduction Treaty) strategic arsenal would contain 5,000 accountable warheads, rather than the 6,000 allowed by the Treaty. Moreover, he proposed that the two sides negotiate additional reductions in strategic warheads down to approximately half the START-permitted levels. As with President Bush's proposal to eliminate multiple warhead land-based missiles, however, President Gorbachev's proposal will have to be negotiated to assure each side that vital security interests are not compromised. Such assurance, though, will be elusive so long as the future of strategic defences remains unresolved, since deep cuts in offensive forces could be a destabilising complement to large-scale defences, which the Bush Administration continues to advance as a goal in the United States-Soviet negotiations in Geneva.

The Administration's actual policy, however, like that of its predecessor, has evolved away from its declared position. While nominally clinging to the ultimate goal of rendering nuclear-armed ballistic missiles impotent and obsolete, the Reagan Administration set forth a "Phase I" plan for space-based and ground-based interceptors and associated sensors capable of intercepting a significant portion of the Soviet ballistic missile force. In his January 1991 State of the Union address, President Bush directed that United States strategic defence efforts be refocused on "providing protection from limited ballistic missile strikes, whatever their source". While the Phase I proposal nominally remains a "requirement" of the Joint Chiefs of Staff, the so-called Global Protection Against Limited Strikes (GPALS) system proposed by the Pentagon in response to President Bush's directive would have far more limited capabilities. Of a size to defeat an attack of up to 200 re-entry vehicles, the announced GPALS system would have approximately 1,000 space-based interceptors and 750 ground-based interceptors located at about 6 sites, as well as space- and ground-based sensors.

While GPALS represented an important truncation of United States objectives for strategic defence, it did not lessen debate in the United States over the proper role of strategic defence (especially space-based interceptors) or opposition from Soviet officials and analysts. Moreover, questions about ultimate United States objectives are accentuated by the fact the Administration's official position in the Defense and Space Talks continues to be that either party should be able, on three-and-one-half years' notice, to deploy missile defences without restriction.

United States Policy: From GPALS to Limited Defence

Notwithstanding declared policy, however, President Bush's September initiative marked another step in the evolution of his position on strategic defence. While his call for "immediate-concrete steps to permit the limited deployment of non-nuclear defences to protect against limited ballistic missiles—whatever their source" was similar to earlier statements of support for GPALS, it was made in a dramatically altered international and domestic context. During the eight months between the introduction of GPALS and the September initiative, Iraqi missile attacks were successfully countered by active defences; the Soviet Union was rocked by revolutionary changes, which generated a new spirit of cooperation with the United States; United Nations inspectors discovered that Iraq's nuclear and missile programme were far more advanced than had been suspected; and the United States Senate overwhelmingly adopted a new approach to strategic defence that directly addresses the requirements of the new international situation.

The impact of the Senate's plan on United States policy stems not only from the fact that it originated in Oval Office meetings between Senators and the President, but also from the Senate's powerful role in the making of treaties. Often thought of only in terms of approving or amending treaties after they are negotiated by the Executive, the Senate's treaty-making powers also extend to directing the initiation of and defining the objectives of treaty negotiations. History is replete with examples of the Senate exercising such powers. In the area of arms control, the environmental modification Convention is a notable example of a treaty for which the Senate took the initiative on the United States side. In early 1983, a "build-down" proposal linking strategic nuclear reductions to modernisation was crafted in the Senate and later that year was tabled by the United States in the Strategic Arms Reduction Talks. More recently, the 1984 resumption of bilateral United States-Soviet talks that led to the 1990 Agreement on Destruction and Non-Production of Chemical Weapons was the direct result of a Senate initiative that coupled a bipartisan resolution with a credible threat to halt the binary chemical modernisation programme if talks were not resumed.

Perhaps the most important point to note about the Senate's approach to strategic defence is that it is not synonymous with GPALS, especially with regard to space-based interceptors—the GPALS element often considered most critical by GPALS advocates and detractors alike. With numerous commentators in the United States failing to grasp this essential fact, it is understandable that *Krasnaya Zvezda* and *Izvestiya* have failed to do so as well.

The Senate set forth the goal of deploying an anti-ballistic missile system, including one or an adequate additional number of ABM sites and space-based sensors, capable of providing a highly effective defence of the United States against limited attacks of ballistic missiles while maintaining strategic stability, and providing highly effective theatre missile defences (TMD) to United States armed forces and allies.

Initially, the limited defence system would consist of a single anti-ballistic missile (ABM) site with 100 ground-based interceptors, fixed ground-based ABM radar, and optimal utilisation of space-based sensors that are not capable of substituting for ABM radars. The Senate unambiguously directed that this initial plan, including the use of space-based sensors, strictly adhere to the ABM Treaty.

The Senate also set forth a new negotiating strategy to reach agreements with the Soviet Union necessary to permit:

Additional ABM sites and ground-based interceptors;

Increased use of space-based sensors for direct battle management;

Increased flexibility for technology development of advanced ballistic missile defences;

Clarification of what constitutes permissible development and testing related to space-based missile defences;

Clarification of the distinction between TMDs and ABM defences, including interceptors and radars.

The first two negotiating objectives would require amendments to the provisions of the ABM Treaty, while the third might. The progress of technology requires that the last two subjects be addressed in any event, although the decisions the two sides make will be influenced by the negotiations on the first three points.

Deployment of more ground-based interceptors at additional ABM sites and space-based sensors capable of battle management are intended to be done in accord with negotiated ABM Treaty amendments defining what new activities would be permitted. Such amendments would define, for example, quantitative limits on deployments and their geographical distribution. While the Pentagon's GPALS proposal presumes the need for approximately four ABM sites to cover the contiguous United States, as well as one site each for Alaska and Hawaii, the Senate did not prejudge the outcome of these negotiations.

Amending the ABM Treaty

Some have questioned whether mutually acceptable quantitative limits for limited defence systems can be successfully negotiated, given the fact that the United States has less than half the land area of the Soviet republics. If the objective of a limited defence system were to provide highly effective protection for every square centimetre of territory, this concern would have merit. However, an analysis of the geographical distribution of population, the principal value such systems are intended to defend, reveals far less of a disparity. One recent analysis concludes that equal quantitative limits could provide the two sides with roughly equal population protection. Deployment constraints, however, need not be perfectly symmetric, and negotiations could seek to accommodate each side's unique characteristics and circumstances.

Another concern raised is whether a limited defence system is inherently inconsistent with the objectives of the ABM Treaty, in which case negotiations to amend the treaty to allow such a system will inevitably fail and, in the process, generate tensions between the two sides. In the introductory article of the treaty, each side "undertakes not to deploy ABM systems for a defense of the territory of its country" and subsequent articles place strict limitations on the development, testing, and deployment of ABM systems and components. The Treaty, of course, does not prohibit ABM defences but regulates them in order to curb "the race in strategic offensive arms and would lead to a decrease in the risk of outbreak of war involving nuclear weapons", according to the Treaty's preamble. The Treaty accomplishes this by ensuring that ABM defences do not threaten the strategic retaliatory capability of either side.

In considering the compatibility of limited defence systems with the ABM Treaty's fundamental objectives, it is important to note that when the treaty was negotiated, the two sides considered whether to place range limitations on the ABM interceptors that could be deployed under the Treaty. They deliberately chose not to set such range limitations and, in article VII, authorised modernisation and replacement of interceptors and other ABM components.

Absent range limitations, the interceptor deployments permitted by the ABM Treaty could provide each side a degree of protection for most of its territory from a limited attack by the other. Indeed, interceptors currently being developed by the United States could be deployed, consistent with the ABM Treaty, at the abandoned Grand Forks ABM site to protect almost the entire contiguous United States from small-scale Soviet intercontinental ballistic missile (ICBM) attacks with a moderate degree of confidence. (This, in fact, is the initial deployment plan recently endorsed by the Senate.) Under the terms of the original treaty, which permitted two ABM sites, each with 100 interceptors, the confidence level would be significantly higher.

The issue is not whether ABM interceptors, whose individual or collective footprint (the zone to which they provide protection) is continental in scope, are compatible with the treaty's objectives. Instead, the principal issue is at what level of deployment would limited ABM systems begin to threaten the credibility of strategic retaliatory capabilities under situations in which the retaliating offensive force is severely stressed.

The scope of the limited defence system was defined by the Senate as "providing a highly effective defense of the U.S. against limited ballistic missile threats, including accidental or unauthorised launches or Third World attacks, *but below a threshold that would bring into question strategic stability"*. Significantly, in his September initiative, President Bush adopted this criteria that limited defences should be deployed "without undermining the credibility of existing deterrent forces", which had not been a part of earlier policy statements on the GPALS plan.

The outer bound of the proposed limited defence system's capability is understood to be that intended for the GPALS proposal, that is, the ability to intercept up to 200 re-entry vehicles with very high confidence. By its nature, such a system would also possess a capability to engage a larger number of re-entry vehicles with a lesser degree of confidence. Quantitative, geographical and other constraints, however, could effectively prevent such a system from approaching the threshold at which it would threaten retaliatory capabilities. One key issue to be addressed in negotiations is whether space-based interceptors would be permitted, since they play an important role in determining the degree of protection a limited defensive system can provide against larger attacks. Unlike GPALS, the Senate did not conclude that a limited defence system would include space-based interceptors. Equally important, President Bush's September initiative raises the possibility of significant new United States flexibility on this issue.

MIRVed ICBMs and Space-based Interceptors

In his September initiative, President Bush proposed that the American and Soviet Governments negotiate a timetable for the mutual elimination of ICBMs having multiple, independently targetable re-entry vehicles (MIRVs). The United States view of MIRVed ICBMs as being the most destabilising strategic offensive weapons system has significant implications for United States policy on strategic defence, particularly concepts for space-based interceptors, which would be designed to attack ballistic missiles in the boost phase.

One motive to deploy space-based interceptors is that ballistic missiles are particularly vulnerable to lethal damage in the boost phase. More importantly, however, is the fact that intercepting a MIRVed ballistic missile during the boost phase allows the destruction of many re-entry vehicles at one time with a single interceptor. Once a MIRVed missile releases its many re-entry vehicles, the task of the defender becomes enormously more complicated. The number of objects to be attacked is significantly increased, and the release of penetration aids along with re-entry vehicles can further multiply this challenge immensely. Moreover, the actual task of attack becomes much more difficult since a re-entry vehicle has a signature that is orders of magnitude smaller than a boost-phase missile. In addition, it is more difficult to determine that a re-entry vehicle has been successfully attacked, and therefore no longer requires attention and possible further attack, than is the case for a boosting missile.

In short, the existence of MIRVed ballistic missiles constitutes one of the strongest arguments in favor of space-based interceptors designed to attack in the boost phase. If agreement could be reached to eliminate United States and Soviet MIRVed ICBMs, the rationale for space-based interceptors would be greatly weakened.

The conceptual linkage between MIRVed ICBMs and space-based interceptors offers an obvious basis for negotiation. Its potential importance should not be underestimated given the high priority the United States has attached to elimination of MIRVed ICBMs and the equally high priority the Soviet side has attached to prohibition of space-based ABM interceptors.

Theatre Missile Defences

Ensuring that limited defence systems do not undermine retaliatory forces requires effective regulation of theatre missile defences. The ABM Treaty prohibits giving theatre missile defence interceptors, launchers and radars capabilities to counter strategic ballistic missiles or their elements in flight trajectory or testing them in an ABM mode. Even with subsequent agreements between the two sides over the application of this provision, however, substantial ambiguity exists as to the appropriate interpretation of the "flight trajectory of a strategic ballistic missile" and "testing in an ABM mode".

Numerous proposals have been made to establish specific thresholds (as the United States, in fact, proposed in the original ABM Treaty negotiations). One concept proposed by the American analyst Herbert

Lin, which seems to have attracted the attention of Soviet analysts, would define testing in an ABM mode as testing against objects having either a speed in excess of 3 kilometres per second or an altitude of greater than 70 kilometres. This would leave a significant safety margin separating the tested capabilities of TMDs and the flight characteristics of the shortest-range strategic ballistic missile now in service, the Soviet SS-N-6 Mod I, whose 2,500-kilometre-range gives its re-entry vehicle a maximum velocity of about 4.5 kilometres per second.

National technical means currently used to monitor ICBM tests would also be able to monitor such restrictions. The parties, however, should not rule out additional cooperative measures, such as exchange of recorded test data, jointly operated radars and other monitoring equipment at ABM test sites, and/or reciprocal access to ABM test sites with such equipment. The agreement in the START Treaty to exchange recorded telemetry data from ballistic missile tests provides a useful precedent and starting point for such additional cooperative measures.

While the two sides might wish to establish such quantitative thresholds, careful consideration must be given to the numerical values chosen and the need to allow for adjustments to new situations. For example, the likely early retirement of the SS-N-6 and the United States Poseidon C-3, whose range of 4,000 kilometres gives a maximum re-entry vehicle velocity of 5.4 kilometres per second, suggests that the numerical values proposed by Lin and others could be significantly relaxed and still leave a margin of safety between tested TMD capabilities and deployed strategic ballistic missile characteristics.

Even with such a safety margin maintained through well-defined thresholds, the inherent ambiguity regarding the potential capabilities of TMDs whose testing presses up to the thresholds would raise concerns about break-out and creep-out potentials. Accordingly, quantitative constraints might have a role to play in regulating TMDs. Geographical constraints on the deployment of rapidly relocatable TMDs, which the United States intends to deploy, would have limited utility in reducing break-out potential, although they could serve as confidence-building measures.

As in the case of limited defence systems, perfect symmetry in all forms of constraints might not be appropriate, given the unique characteristics and circumstances of each side. For example, United States TMDs need to be rapidly relocatable in order to accompany United States expeditionary and forward deployed forces threatened by short or intermediate-range ballistic missiles. Since in many cases the threat these same ballistic missiles would pose to the Soviet Union would be to its homeland, it is not clear that all, or even any, Soviet defences against these threats need to be relocatable, and Soviet ABM defences would, of course, provide protection against some of these threats. Accordingly, offsetting asymmetries between TMD and ABM constraints might be considered.

Proliferating Threats Demand Prompt Action

United States policy on strategic defence is now principally shaped by the knowledge that the spread of ballistic missiles and weapons of mass destruction will pose a growing threat to American forces and friends overseas and, in time, to the American homeland itself. The Central Intelligence Agency estimates that by the end of the decade 15 to 20 developing countries will possess ballistic missile capabilities, with most of these nations producing their own missiles. At least six of these are expected to have missiles with ranges up to 3,000 kilometres, and at least three may develop missiles with ranges up to 5,000 kilometres. Many of these countries are now developing, or will soon have the capability to develop, nuclear, chemical or biological weapons that could be delivered on ballistic missiles.

These developments should be of equal or greater concern to Soviet officials. Most of the nations possessing, developing, or seeking to acquire ballistic missiles are in close proximity to Soviet borders. The threat to the Soviet homeland is much more immediate, extensive, and diverse than it is to the United States homeland. The Soviets have, in fact, expressed concern about Israel's Jericho II missile, whose tested range of roughly 1,300 kilometres puts Soviet territory within its reach. Such Soviet concerns can only have been exacerbated by Israel's placing a satellite in orbit, reportedly using a Jericho Il-derived launcher. This has led analysts to conclude the Jericho II could carry a 1,000-kilogram pay load to a range of 2,800 kilometres, or a 500-kilogram payload to a range of 4,000 kilometres.

Saddam Hussein's use of Scud missiles demonstrated the reality of the ballistic missile threat, while the allied use of the Patriot demonstrated the possibilities of active defence. While the threat to the United States (but not the Soviet) homeland is several years away, this is an argument to act while it will make a difference, not to delay until it is too late. The anti-missile version of the Patriot, whose development was begun with Soviet short-range missiles in mind at a time when few worried about a Third World missile threat, was deployed only months before coalition troops faced Saddam's Scuds. Moreover, postwar United

Nations inspections of Iraq suggest that proliferation is occurring much more rapidly than had been thought and the nuclear non-proliferation regime is far less effective than assumed.

United Nations inspectors have determined that Iraq was able to produce plutonium, in violation of the nuclear non-proliferation treaty, even though the facility where this was done was safeguarded by the International Atomic Energy Agency. Moreover, inspectors have found evidence that Iraq had made progress towards building a thermonuclear weapon.

However, the discovery in May 1991 that Iraq had built calutrons to enrich uranium demonstrated the shortcomings of the non-proliferation regime in even starker terms. Calutrons are low-technology devices that Iraq was apparently able to build without importing sophisticated materials or technology. The international non-proliferation regime is built on the assumption that renegade countries can be denied the fuel for a nuclear weapon if the rest of the world maintains effective controls on advanced technologies, such as centrifuge and gas-diffusion equipment, needed to enrich uranium or reprocess plutonium. Since these advanced technologies require materials and equipment available only from the industrialised world, this strategy has offered the prospect for success if stringently enforced.

The entire international non-proliferation regime has been called into question, however, by Iraq's resurrection of a half-century old technology that uses materials or equipment readily available to essentially any country.

This revelation does not mean that non-proliferation efforts are all for nought. But, it does mean that no matter how stringently we enforce the non-proliferation regime, we are henceforth going to be far less confident that the regime is effectively preventing the spread of nuclear weapon capabilities.

Beyond the threat posed by proliferation, United States policy must also address the situation in the Soviet Union. The prospects for cooperation are unprecedented as a result of Soviet reforms and the mutual desire to move away from military confrontation. However, the risk remains of an accidental or unauthorised launch of limited proportions, but catastrophic consequences. Soviet officials, themselves, in a thinly veiled effort to loosen Western purse strings prior to President Gorbachev's London meeting with the leaders of the industrialised democracies, fanned fears of such dangers resulting from Soviet disintegration if the West did not provide substantial aid.

TABLE 1

The proliferation of ballistic missiles and related programmes in 26 countries, 1989

Country/ Designation	*Type*[a]	*No. of stages*	*Weight (kg)*	*Range (km)*	*Year first fired*	*Current status*	*No. deployed*		*Technology supplier*	*Technology and assistance supplied*
							Launchers	*Missiles*		
Afghanistan										
ScudB[b]	BM	1	6370	280	1988	In service	12	>1 000	USSR	Launchers, missiles, training
Algeria										
FROG-4	BM	1	2000	50	Mid-1970s	Retired	12	32	USSR	Launchers, missiles, training
FROG-7	BM	1	2500	70	Mid-1970s	In service	12	32	USSR	Launchers, missiles, training
Argentina										
Belier-Centaure	SR	2	490	(50)	1966	Retired	—	—	France	Design, production assistance
Castor	SR	2	1268	(120)	1972	Retired	—	—	USA	Training
CAM (MAR 350)	AR	1	835	90	1987	Cancelled	—	—	Israel	Design, subsystems
									Egypt	Heat shielding, financing
									France	Inertial guidance
									FRG	Design, integration and simulation, launchers
Condor 1	BM	1	2500	150	1984	Development	—	—		
Condor 2	BM	2	4500	1000		Development	—	—		
									Iraq	Financing
									Italy	Propulsion
									Sweden	Warhead fusing
									Switzerland	Management
Brazil										
Sonda 3	SR	2	1581	(80)	1976	In service	—	—	FRG	Design, propulsion
									USA	Training
Sonda 4	SR	2	7300	(600)	1984	In service	—	4	FRG	Design, propulsion

SS-60	AR	1	595	60	1983	In service	>12	>100	—	—
X-40	AR	1	654	68	1979	In service	—	>20	—	—
EE-150	BM	1	4500	150	—	Development	—	—	—	—
SS-300	BM	1	8000	300	—	Development	—	—	—	—
EE-350	BM	1	(5500)	350	—	Development	—	—	—	—
EE-600	BM	1	(7000)	600	—	Planned	—	—	—	—
SS-1000	BM	2	(10000)	1000	—	Planned	—	—	—	—
VLS	SLV	4	49000	(6000)	—	Development	—	—	—	—
Cuba										
FROG-4	BM	1	2000	50	1961	In service	10	30	USSR	Launchers, missiles, training
FROG-7	BM	1	2500	70	mid-1980s	In service	12	36	USSR	Launchers, missiles, training
Egypt[c]										
Sakr 80	AR	1	660	80	1987	In service	>12	>100	France	Design, assistance
FROG-5	BM	1	2000	50	1968	In service	—	—	USSR	Launchers, missiles
FROG-7	BM	1	2500	70	1973	In service	12	72	USSR	Launchers, missiles
ScudB	BM	1	6370	280	1973	In service	12	>100	USSR	Launchers, missiles
									N.Korea	Production assistance
alZafir	BM	1	(4000)	370	1962	Cancelled	—	—	FRG	Design, assistance
Scud 100	BM	1	(7000)	(600)	1988	Development	—	—	USSR	Missiles
									N. Korea	Design, assistance
									Iraq	Financing
al Kahir	BM	1	(8000)	600	1962	Cancelled	—	—	FRG	Design, assistance
al Ahred	BM	1	(12000)	950	—	Cancelled	—	—	FRG	Design, assistance
Condor 2	BM	2	4500	1000	—	—	—	—	Argentina	Missiles
									Iraq	Financing
									USA	Equipment
									FRG	Equipment
Greece										
Honest John	BM	1	2640	37	1959	In service	8	24	USA	Launchers, missiles, training
India										
Centaure	SR	1	530	50	1968	In service	—	—	France	Production licence, assistance
									USA	Training
Rohini	SR	2	1391	130	1972	In service	—	—	France	Propulsion, assistance

Devil Program	BM	2	(3000)	140	1972	Cancelled	—	—	USSR	SA-2 (V-750 Dvina) missile
Prithvi	BM	1	4000	240	1988	Development	—	—	—	
Agni	BM	2	21000	2400	1989	Development	—	—	France	Propulsion, guidance
									FRG	Propulsion, guidance, heat shielding
SLV3	SLV	4	17300	(1200)	1980	In service	—	4	France	Propulsion, guidance, assistance
									FRG	Propulsion, guidance, heat shielding, materials
ASLV	SLV	4	39000	(4000)	1987	Development	—	2	—	—
PSLV	SLV	4	137000	(8000)	1991	Planned	—	—	—	—
GSLV	SLV	—	333000	(14000)	—	Planned		—	—	—
Indonesia										
RX-250	SR	3	(1200)	(100)	1987	Development	—	—	France	Training, assistance
SLV	SLV	—	(17000)	(1500)	1993	Planned	—	—	—	—
Iran										
Oghab	AR	1	360	45	1987	In service	—	Hundreds	China	Design, production assistance
									N. Korea	Production assistance
Shahin 2	BM	1	580	60	1988	In service	—	—	—	—
Nazeat	BM	1	950	120	1988	In service	—	Hundreds	—	—
—	BM	1	(1500)	160	—	Development	—	—	—	—
Scub B[d]	BM	1	6370	280	1985	In service	4	100	Libya	Missiles, launchers
									N. Korea	Missiles
									Syria	Missiles
Iraq[e]										
Ababil 50	AR	1	400	50	1988	Development	—	—	Yugoslavia	Design, assistance
SS-60	AR	1	955	60	1985	In service	30	—	Brazil	Launchers, missiles, training
Sijeel 60	AR	1	588	60	1987	Development	—	—	Frane	Design, assistance
									Brazil	Training
Ababil 100	AR	1	800	100	1989	Development	—	—	Yugoslavia	Design, assistance
FROG-7	BM	1	2500	70	—	In service	30	>90	USSR	Launchers, missiles and training
Laith	BM	1	2500	90	1988	Development	—	—	—	—
Nissan	BM	1	—	110	—	Development	—	—	—	—

Kassir	BM	1	—	150	—	Development	—	—	—	—
Baraq	BM	1	—	250	—	Development	—	—	—	—
ScudB	BM	1	6370	280	—	In service	20	>360	USSR	Launchers, missiles and training
Fahd	BM	1	—	500	—	Development	—	—	—	—
al Hussein	BM	1	7000	650	1987	In service	10	—	USSR	Launchers, missiles
									Brazil	Training
									Egypt	Personnel, assistance
al Abbas	BM	1	8000	900	1988	Development	—	—	USSR	Launchers, missiles
									Brazil	Training
									Egypt	Personnel, assistance
Condor 2	BM	2	4500	1000	—	Development	—	—	Argentina	Missiles
									Austria	R&D facilities
									Egypt	Equipment, assistance
									FRG	Equipment, assistance
									Sweden	Launchers
									USA	Equipment
Tamuz-1	BM	2	(12000)	2000	—	—	—	—	—	—
al Abed	SLV	3	48000	(6000)	1989	—	—	—	—	—
Israel										
MAR 350	AR	1	835	90	1987	In service	—	—	Argentina	Financing
Lance	BM	1	1527	120	1976	In service	12	160	USA	Launchers, missiles, training
Flower Project	BM	1	—	200	1977	Cancelled	—	—	Iran	Financing
Jericho 1	BM	1	(3000)	480	1968	In service	—	(50)	France	Design, production assistance
Pershing la	BM	1	4520	740	—	Refused 1974	—	—	USA	—
Jericho 2	BM	2	(6500)	750	1980	In service	—	(50)	—	—
Jericho 2B	BM	2	(8500)	1450	1987	Development	—	—	—	—
Shavit	SLV	2	(25000)	(7500)	1988	In service	—	—	—	—
Korea, North										
FROG-5	BM	1	2000	50	1969	In service	9	50	USSR	Launchers, missiles, training
FROG-7	BM	1	2500	70	1970	In service	18	54	USSR	Launchers, missiles, training
Scud B/	BM	1	6370	280	1976	In service	12	Hundreds	Egypt	Sample missiles
Scud PIP	BM	1	(7000)	(600)	1988	Development	—	—	Egypt	Assistance
									Japan	Electronics

Korea, South										
Honest John	BM	1	2640	37	1959	In service	7	36	USA	Launchers, missiles, training
Nike-Hercules	BM	2	5200	240	1978	In service	—	100	USA	SAM missiles
Centaur	SLV	1	16780	(1500)	—	Cancelled 1980	—	—	USA	Design
SLV	SLV	3	(30000)	(4000)	—	Planned	—	—	—	—
Kuwait										
FROG-7	BM	1	2500	70	1980	In service	4	12	USSR	Launchers, missiles, training
Libya										
FROG-7	BM	1	2500	70	Mid-1970s	In service	48	>144	USSR	Launchers, missiles, training
SS-21 Scarab	BM	1	1500	120	—	Refused 1980s	—	—	USSR	—
EE-150	BM	1	4500	150	—	Refused 1988	—	—	Brazil	—
Scud B[g]	BM	1	6370	280	Mid-1970s	In service	80	>240	USSR	Launchers, missiles, training
Otrag	BM	1	—	300	1979	Development	—	—	FRO	Personnel, design, components
M-9	BM	1	6200	600	—	Uncertain	—	—	China	—
Ittisalt	BM	1	(6000)	700	—	Development	—	—	FRG	Design, assistance, components
SS-12 Scaleboard	BM	1	9000	900	—	Refused 1980s	—	—	USSR	—
Pakistan										
Shahpar	SR	2	1200	(120)	1970s	In service	—	—	France	Missiles, training, assistance
									USA	Training
SUPARCO rocket	SR	2	(3000)	(400)	1980s	In service	—	—	—	—
Hatf 1	BM	1	(1500)	80	1987	In service	—	—	France	Missiles, training, assistance
Hatf 2	BM	1	(3000)	280	1988	In service	—	—	France	Missiles, training, assistance
—	BM	1	—	600	—	Development	—	—	—	—
SLV	SLV	3	(15000)	(1200)	—	Planned	—	—	—	—
Philippines										
Bon bong	AR	1	—	12	1975	Cancelled	—	—	—	—

Saudi Arabia[h]										
SS-60	AR	1	595	60	1985	In service	—	—	Brazil	Launchers, missiles, training
Lance	BM	1	1527	120	—	Refused 1985	—	—	USA	—
DF-3 (CSS-2)	BM	2	27000	2200	1988	In service	50	60	China	Launchers, missiles, training
South Africa										
Jericho 2B	BM	2	(8500)	1450	1989	Development	—	—	Israel	Missiles, assistance
SLV	SLV	—	—	—	—	Planned	—	—	France	Subsystems
									FRG	Training
									Israel	Missiles, assistance
									Taiwan	—
Syria										
FROG-7[i]	BM	1	2500	70	1971	In service	24	96	USSR	Launchers, missiles, training
SS-21 Scarab	BM	1	1500	120	1983	In service	12	36	USSR	Launchers, missiles, training
ScudB	BM	1	6370	280	1975	In service	18	54	USSR	Launchers, missiles, training
Ouag	BM	1	—	300	—	Cancelled 1981	—	—	Libya	—
SS-23 Spider	BM	1	4690	500	—	Refused 1987	—	—	USSR	
M-9	BM	1	6200	600	—	Negotiations	—	—	China	—
Taiwan										
Honest John	BM	1	2640	37	1961	In service	—	—	USA	Launchers, missiles training
Ching Feng	—	1	1500	120	1978	In service	—	—	Israel	Lance missile design
—	BM	2	(6000)	1000	—	Cancelled 1981	—	—	USA	Training
—	SLV	(3)	—	—	1996	Development	—	—	—	—
Thailand										
Thanu Fan	AR	1	—	—	—	Development	—	—	—	—
Turkey										
MLRS	AR	1	308	40	1990	In service	—	—	USA	Production assistance, components, training
Honest John	BM	1	2640	37	1960	Withdrawn	18	54	USA	Launchers, missiles, training

Yemen Arab Republic (North)										
SS-21 Scarab	BM	1	1500	120	1988	In service	4	12	USSR	Launchers, missiles, training
Yemen, People's Democratic Rep. of (South)										
FROG-7	BM	1	2500	70	1979	In service	12	36	USSR	Launchers, missiles, training
SS-21 Scarab	BM	1	1500	120	1988	In service	4	12	USSR	Launchers, missiles, training
Scub B	BM	1	6370	280	1979	In service	6	18	USSR	Launchers, missiles, training

— Unknown or not applicable ( ) Estimates

a Acronyms in this column: AR: artillery rocket (military); BM: ballistic missile; SLV: space launch vehicle; SR: sounding rocket.

b Since Oct 1988, the Soviet Union has supplied the Kabul Government with over 1000 Scud B missiles. Most of these were fired soon after delivery against suspected Mujahideen targets.

c There are reports that small quantities of al Zafir missiles were fired at Israel during the 1967 war. Several dozen FROG missiles and at least one Scud B were fired during the 1973 war.

d Iran received at least 100 Scud B missiles from Libya, North Korea and possibly Syria during its war with Iraq. Most of these were fired before the cease-fire began on 20 Aug. 1988. Iranian Scud B inventories may have been replenished since then, although this cannot be confirmed.

e During the 1980-88 war with Iran, Iraq fired approximately 67 FROG-7s, over 100 Scud-Bs and 190 al Hussein Scud versions. The number of Brazilian SS-60 and other large artillery rockets fired was in the thousands. Little is known about the state of Iraq's missile inventories after the 20 Aug. 1988 cease-fire.

f In 1985 North Korea agreed to supply 90-100 domestically manufactured Scud B missiles to Iran. Most of these were subsequently fired against Iraq.

g lthough Libya has not used its ballistic missiles in its fighting with Egypt in 1977 or in Chad from 1978-88, it has sold Scud B missiles to Iran for use against Iraq.

h Saudi Arabia may also help finance missile production programmes in Egypt and Iraq.

i Syria fired approximately 25 FROG-7 missiles at Israel during the 1973 war. Syrian efforts to purchase longer-range missiles in the 1980s were blocked by Western diplomatic pressure and, in the case of the SS-23, the unwillingness of the USSR to sell a weapon system proscribed under the 1987 INF Treaty.

The genuine possibility of Soviet disorder creates realistic risks the United States must address. While acknowledging the Soviet High Command's efforts to tighten its already strict control over nuclear weapons, one must also note the prospect for continued confusion over the ultimate political control over nuclear forces, as well as incidents such as the commandeering of a Soviet attack submarine during the August coup attempt and the Soviet missile submarine launch accident in the White Sea on the day of President Bush's initiative. Consultation and cooperation between the two sides on nuclear security, safety, and command and control should be pursued. But, this cannot be to the exclusion of limited defensive systems— which, given the proliferating threat, both sides would need even if they were to mutually eliminate their strategic nuclear arsenals.

Conclusion

The world has changed in the two decades since the ABM Treaty was signed. The ABM Treaty must be brought up to date to address these new realities. This can be done without undermining the ABM Treaty's objectives of preserving the credibility of each side's retaliatory deterrent, decreasing the risk of the outbreak of war involving nuclear weapons, and promoting the achievement of further limitations on strategic offensive nuclear weapons. Indeed, unless the question of strategic defences is resolved, the present opportunity to significantly reduce and restructure offensive forces could be lost.

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VERIFICATION AND COMPLIANCE

Verification is an integral part of arms limitation and disarmament agreements. In the interest of security, compliance with such agreements must be verifiable. Verification may be defined as a process which serves to provide confidence that the provisions of an agreement are being observed, that is, that the parties are complying with their obligations. Thus, compliance (the fulfilment of obligations) and verification (the process of gathering and analysing information with a view to assessing compliance) are two sides of the same coin.

As there are different modes and degrees of verification, a variety of terms may be employed, for instance, “monitoring”, “observation”, “control”, “investigation”, “inspection”, and “on-site inspection.” All these terms, although not equivalent, contain one or more of the elements of information-gathering, analysis and determination of compliance, which are the essential components of verification.

Indeed, the United Nations has dealt with problems of verification since its inception, at both the deliberative and the negotiating stages. Several arms limitation and disarmament agreements currently in force provide a role for the United Nations in ensuring compliance with agreements (see table). In the 1978 Final Document of the Tenth Special Session of the General Assembly, the first special session devoted to disarmament, the member states affirmed, by consensus, that disarmament and arms limitation agreements should provide for adequate measures of verification satisfactory to all parties concerned. Since the fortieth session of the General Assembly, in 1985, consideration of the question of verification has intensified. The deliberations on the subject have helped to clarify the concept of verification and make it more widely acceptable. At the third special session of the General Assembly devoted to disarmament, in 1988, the question of verification was one of the major subjects in the deliberations. At the forty-third session of the General Assembly, later that year, "Verification in all its aspects" was on the agenda as a separate item for the first time.

In the verification process, two main components can usually be found, namely, the fact-finding or gathering of data (monitoring), and the interpretation or evaluation of the data. These imply the availability of a verification system which possesses a highly accurate monitoring capability to recognize a violation and provide a timely warning—not just an *ex post facto* indication of a violation. The same high degree of accuracy and objectivity should be present in the evaluation of the data provided by the verification system. It should not be forgotten in this connection that, ultimately, judgements of compliance or non-compliance are essentially political judgements.

Unavoidably, any such judgements are subject to some degree of error. In the present circumstances, absolute verifiability is, in fact, impossible to achieve. Consequently, arms control and disarmament, whether bilateral or multilateral, involve some form of consultative procedure for addressing compliance questions, although in actual form such procedures vary greatly.

Thus, in practice, Governments cannot reasonably seek absolute verification, but rather "adequate" or "effective" verification, that is, verification to the extent necessary to safeguard national security adequately. The task of identifying acceptable and reliable measures at a sufficiently high level of verifiability can present challenging difficulties and has occasionally proved to be a serious obstacle to the conclusion of disarmament accords. It is, however, a vital task because only when the parties to an agreement are confident that the obligations deriving from it are being fulfilled by all concerned can the agreement fully achieve its goal, which is greater security for all.

The experience of the past thirty years has clearly indicated that when the negotiating parties were firmly decided to reach agreement, they were able to overcome the obstacles relating to the verification measures no less than those involved in the substantive arms limitation and disarmament measures to be verified. Since the late 1950s, many such accords have been reached. The experience gained during this time also tends to prove that it is an illusion" to think that adequate verification of a treaty is more difficult than routine monitoring in the absence of a treaty: when there is no treaty, what constitutes a significant threat remains to be determined, and the co-operative undertakings usually to be found in a treaty are not available.

Verification may be carried out by national or international means or by a combination of the two. The term "verification by national means" denotes the existence of a national system whereby relevant information is collected and presented to another party or other parties to the agreement. This could be done directly or through an international organisation. The term "international verification" is used when States together, or through an appropriate international framework, ascertain events or occurrences in the context of a given agreement within the territory of one or more States. Under a mixed system of verification, an international organisation may make use of the findings of a national authority made available to it, while also carrying out some degree of verification itself.

Whatever the form of verification—national, international or mixed—the verification process should, as far as possible, be free from recourse to "intrusive" measures, inasmuch as experience shows that Governments always seek minimum interference. Through the years, however, new verification technologies have been developed that have made verification less dependent on intrusive measures such as examination, demonstration or inspection. Thus, increasingly, information about compliance is collected by national technical means (NTMs), notably satellites, early warning systems, radar and other intelligence-gathering systems. Many different technologies may be used for the operation of an effective NTM system, including imaging, optics, sensors, infra-red, spectroscopy, seismology, satellites and detection of nuclear materials. On-site inspection has generally come to be viewed as an adjunct to national technical means, involving a reciprocal admission of designated observers of the parties concerned into areas under national control—an adjunct which will continue to play a very significant role in verification agreements.

Specific Provisions, Methods and Procedures

Negotiated solutions to determine what is adequate and effective can, of course, be found only on a case-by-case basis, taking into account the scope of the agreement and striking a balance between the technically feasible and the politically acceptable. As discussed below and in the table, quite different solutions have been adopted in pursuing the goal of effective verification in arms limitation and disarmament agreements. For each agreement, particular modes and degrees of verification have been agreed upon.

Agreement was reached in 1963, on the cessation of nuclear tests in three environments (though not under ground) through a decision that the parties would rely on national technical means of verification. The relevant treaty, known as the partial test-ban Treaty (PTBT), contains no provision concerning verification. That implied that the parties would monitor the implementation of the Treaty by using NTMs.

Similarly, the 1972 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction does not envisage specific verification measures, even though it introduces the mode of consultation. It simply provides that each State party shall, in accordance with its constitutional processes, take any necessary measures to prohibit and prevent within its own territory the development, production, stockpiling, acquisition or retention of the agents, toxins, weapons, equipment and means of delivery that are banned by the Convention. The States parties undertake to consult one another and to co-operate in solving any problems which may arise in the application of the provisions of the Convention. Consultation and co-operation may also be undertaken through international procedures within the framework of the United Nations. Ultimately, any State party which finds that any other State party is not complying with its undertakings may lodge a complaint with the Security Council.

A completely different solution was adopted in the Antarctic Treaty of 1959, which declares that Antarctica shall be used exclusively for peaceful purposes and that any measures of a military nature shall be prohibited. In order to promote international co-operation in scientific investigation in Antarctica, the relevant articles of the Treaty provide for an unprecedented system of exchange of information, scientific observation and personnel by the contracting parties. Observers designated by the parties shall, moreover, have complete freedom of access at any time to any or all areas of Antarctica. This is undoubtedly the most unrestricted on-site inspection provision of any arms control accord currently in force.

An analogous approach is found in the 1967 treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, which provides that outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, in accordance with international law, and that there shall be free access to all areas of celestial bodies. In order to promote international co-operation in the exploration and use of outer space, including the Moon and other celestial bodies, in conformity with the purposes of the treaty, 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. All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States parties to the treaty on a basis of reciprocity. The States parties also commit themselves to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of their activities in outer space. Appropriate international consultations are also envisaged by the treaty.

The 1971 treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil Thereof again offers a different approach to the problem of verification. In order to promote the objectives of the treaty and ensure compliance with its provisions, each State party has the right to verify, through observation, the activities of other parties on the sea-bed and the ocean floor and in the subsoil thereof, provided that observation does not interfere with such activities. Verification pursuant to this right 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. If after such observation reasonable doubts remain concerning the fulfilment of the obligations assumed under the treaty, consultation and cooperation between the parties concerned are envisaged by the treaty. If the doubts are not removed, a State party may, in accordance with the provisions of the Charter of the United Nations, refer the matter to the Security Council, which may take action in accordance with the Charter.

In the 1977 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, the assistance of a consultative committee of experts was also envisaged, prior to the lodging of a complaint with the Security Council.

In the case of the 1967 treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco) and the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) it was felt that their goal, namely, the prevention of the spread of nuclear weapons, could best be secured by entrusting an international organisation, IAEA, with a major verification role. This was a very significant innovation, one that was found fitting for a global treaty—the NPT—no less than for a regional one—the Treaty of Tlatelolco. At the same time, the specific verification provisions of the two Treaties were so drafted (those of the Treaty of Tlatelolco in a regional context and those of the NPT in the Geneva multilateral negotiating body, under United Nations auspices) as to meet the requirements of two distinct situations and guarantee maximum effectiveness. In the case of the Treaty of Tlatelolco some specific verification functions were entrusted to regional bodies.

In a more recent pact, the South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga), concluded in 1985, the control system established for the purpose of verifying compliance with the obligations under the Treaty is again based on a combination of regional measures and IAEA safeguards.

All the agreements to which reference has been made thus far, whether regional or global, are of a multilateral nature. Equally important can, of course, be the role of verification in bilateral arms control agreements. It is sufficient to recall the SALT I and SALT II agreements. In 1972, in their Treaty on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty) and in their Interim Agreement on Certain Measures with respect to the Limitation of Strategic Offensive Arms, the United States and the USSR agreed that for the purpose of providing assurance of compliance with the provisions of the Treaty and the Interim Agreement, each party shall use national technical means of verification at its disposal in a manner consistent with generally recognised principles of international law; each party shall not interfere with the national technical means of the other party; and each party shall not use deliberate concealment measures which impede verification by national technical means. These same principles were embodied in the Treaty on the Limitation of Strategic Offensive Arms of 1979, a treaty which has not formally entered into force.

The same language is also found in another USSR/United States treaty that has not yet entered into force, namely, the 1974 Treaty on the Limitation of Underground Nuclear Weapon Tests (threshold test-ban Treaty). In the USSR/United States Treaty on Underground Nuclear Explosions for Peaceful Purposes, of 1976, also not yet in force, the two powers, while agreeing once again that they would use national means of verification at their disposal for the purpose of providing assurance of compliance with the provisions of the Treaty, further agreed that each Party would "provide the other Party information and access to sites of explosions and furnish assistance" in accordance with the provisions set forth in a Protocol to the Treaty. Indeed, the Parties would “develop co-operation on the basis of mutual benefit, equality and reciprocity in various areas related to carrying out underground nuclear explosions for peaceful purposes”.

The verification provisions of the 1987 United States-USSR Treaty on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (INF Treaty) are particularly significant. This is true of the relevant provisions in the body of the Treaty itself and of the Protocols regarding Inspections and Elimination, which are integral parts of the Treaty. The INF Treaty builds upon verification arrangements previously agreed upon by the two sides, adding to the well-established practice of inspection by satellite important new ways, notably, on-site inspections, inspection by challenge and an extensive data exchange. Thus, the Treaty breaks new ground and opens up unprecedented avenues for future arms regulation and disarmament negotiations within both bilateral and multilateral frameworks.

Whatever the scope of verification provisions in arms limitation and disarmament agreements, there is at least one element that such provisions have in common: all are meant to deter violations of obligations, that is, to ensure that violations cannot occur without detection. The provisions have, however, an additional, equally important function, namely, to contribute to confidence-building. This is quite possible, since there is no basic contradiction between systematic and effective verification and the self-interest of each party in the continued life of an agreement it has freely accepted. Together, these two elements are likely to ensure effective compliance, develop trust, and strengthen political support for arms limitation and disarmament.

Co-operative measures by the parties to an arms limitation and disarmament agreement can contribute most significantly to confidence-building. Reference has been made above to the fact that, under the INF Treaty, the Soviet Union and the United States have agreed to an extensive data exchange. It seems reasonable to assume that this exchange, to be validated by the party receiving the data, can provide ample new ground for confidence-building.

In a multilateral context, the recent agreement known as the Document of the Stockholm Conference on Confidence- and Security-building Measures and Disarmament in Europe (CDE), signed on 19 September 1986 by 35 States, including the United States and Canada, is another accord in which the confidence-building element is very prominent. As stated in the Document, the aim of the parties is “to make progress in strengthening confidence and security and in achieving disarmament, so as to give effect and expression to the duty of States to refrain from the threat or use of force in their mutual relations as well as in their international relations in general".

Accordingly, a number of concrete measures are to be carried out by the parties to fulfil their aim. Such measures include: prior notification and observation of certain military activities; exchange of annual calendars of military activities subject to prior notification; additional communications concerning military activities subject to prior notification when the number of troops involved in such activities is in excess of agreed levels; and adequate forms of verification, both through monitoring by national technical means and through inspection.

United Nations and Verification

It should be evident from the many accords to which reference has been made above that the verification of arms limitation and disarmament agreements, whether bilateral or multilateral, calls for participation of the interested parties in the verification process. It must be noted, in this connection, that given the different technological levels attained by States, the contributions that the parties can make to the verification process of arms limitation and disarmament agreements are far from equal. Indeed, only a few States possess the advanced techniques that make verification, as it is known today, possible. The question then arises, in the context of multilateral agreements, how to satisfy the demands for verification systems that are universal and non-discriminatory in nature and available to all States on the basis of equality, that is, systems that are designed to compensate for the different levels of verification technology among the parties.

This is likely to imply that, once agreement has been reached on the principles and parameters of the verification system, the parties would have to entrust to a common body the management and implementation of the verification provisions—a body in which the parties would be duly represented. This, of course, raises a series of major political and technical questions, in particular the question how to reconcile the view which favours the existence of one single body with the fact that verification measures are treaty-specific. In addition, there are the technical and logistical aspects of verification, the analysis of the data obtained from monitoring, and then all the questions concerning personnel and training, and the overall question of cost.

This is a problem to which the members of the international community have come back repeatedly. At the third special session of the General Assembly on disarmament, in 1988, the General Assembly focused, to an unprecedented extent, on the role that the Organisation could constructively play in respect of verification of disarmament agreements and on the strengthening of its ability to respond to increased demands by the international community regarding arms limitation and disarmament agreements, notably multilateral agreements.

As the Secretary-General of the United Nations stated on that occasion, although certain aspects of verification would continue to be taken up in a bilateral framework, multilateral agreements on the limitation and reduction of armaments would require multilateral verification. He said:

> "This is an area in which the United Nations might be able to make an important contribution. The United Nations might be able to help apply, by all the means accepted by the parties concerned, the verification measures provided for in multilateral treaties. The United Nations might be able to co-ordinate international debates on questions related to verification, to provide technical advice and to carry out research. Generally speaking, the participation of our Organisation in the search for generally acceptable and effective verification measures for observance of the agreements and the expansion of the functions of information and advice might make it possible in the future to create, under its auspices, verification machinery."

Recent Developments

In 1988, the issue of verification of arms limitation and disarmament agreements received earnest consideration in the Disarmament Commission, the Conference on Disarmament and the General Assembly, and in particular, at the Assembly's third special session on disarmament, where the deliberations on the subject produced several new initiatives and an increased degree of understanding.

The Disarmament Commission was able to conclude its work on the subject of "verification in all its aspects" (initiated in 1987) by adopting general principles of verification, which were later endorsed by the General Assembly at its regular session, in resolution 43/81 B. The principles read as follows:

"Principles of Verification

"(1) Adequate and effective verification is an essential element of all arms limitations and disarmament agreements.

"(2) Verification is not an aim in itself, but an essential element in the process of achieving arms limitation and disarmament agreements.

"(3) Verification should promote the implementation of arms limitation and disarmament measures, build confidence among States and ensure that agreements are being observed by all parties.

"(4) Adequate and effective verification requires employment of different techniques, such as national technical means, international technical means and international procedures, including on-site inspections.

"(5) Verification in the arms limitation and disarmament process will benefit from greater openness.

"(6) Arms limitation and disarmament agreements should include explicit provisions whereby each party undertakes not to interfere with the agreed methods, procedures and techniques of verification, when these are operating in a manner consistent with the provisions of the agreement and generally recognised principles of international law.

"(7) Arms limitation and disarmament agreements should include explicit provisions whereby each party undertakes not to use deliberate concealment measures which impede verification of compliance with the agreement.

"(8) To assess the continuing adequacy and effectiveness of the verification system, an arms limitation and disarmament agreement should provide for procedures and mechanisms for review and evaluation. Where possible, time-frames for such reviews should be agreed in order to facilitate this assessment.

"(9) Verification arrangements should be addressed at the outset and at every stage of negotiations on specific arms limitation and disarmament agreements.

"(10) All States have equal rights to participate in the process of international verification of agreements to which they are parties.

"(11) Adequate and effective verification arrangements must be capable of providing, in a timely fashion, clear and convincing evidence of compliance or non-compliance. Continued confirmation of compliance is an essential ingredient to building and maintaining confidence among the parties.

"(12) Determinations about the adequacy, effectiveness and acceptability of specific methods and arrangements intended to verify compliance with the provisions of an arms limitation and disarmament agreement can only be made within the context of that agreement.

"(13) Verification of compliance with the obligations imposed by an arms limitation and disarmament agreement is an activity conducted by the parties to an arms limitation and disarmament agreement or by an organisation at the request and with the explicit consent of the parties, and is an expression of the sovereign right of States to enter into such arrangements.

"(14) Requests for inspections or information in accordance with the provisions of an arms limitation and disarmament agreement should be considered as a normal component of the verification process. Such requests should be used only for the purposes of the determination of compliance, care being taken to avoid abuses.

"(15) Verification arrangements should be implemented without discrimination, and, in accomplishing their purpose, avoid unduly interfering with the internal affairs of State parties or other States, or jeopardising their economic, technological and social development.

"(16) To be adequate and effective, a verification regime for an agreement must cover all relevant weapons, facilities, locations, installations and activities."

In the Conference on Disarmament, the means of verifying a global and comprehensive ban on chemical weapons remained the major concern. Some progress was achieved on specific provisions of the draft convention, but the pace of the negotiations remained slow. Representatives expressed the hope that the negotiations would be further facilitated by the numerous confidence-building measures taken by a number of participating States, as well as by the agreement to hold trial inspections of the chemical industry, with a view to testing the verification procedures envisaged in the draft convention.

Various verification proposals were considered by the General Assembly at its third special session devoted to disarmament. Five different proposals were formally submitted to the Assembly. One focused on the role that the United Nations could constructively play in that field, and proposed an in-depth study on the subject by a group of experts. A paper entitled "The role of the United Nations in contractual verification, investigation procedures and collection of space data" dealt with ways of producing practical results, possibly through a United Nations group of experts on verification. Another proposal encouraged an integrated multilateral verification system within the United Nations. Another comprehensive working paper suggested the establishment of an international verification mechanism under the auspices of the United Nations. Yet, another authored procedures for verification of alleged use of chemical weapons.

At the special session, there was overwhelming evidence that the principle that verification is an integral part of disarmament agreements was not questioned, and the idea of an integrated multilateral verification system within the United Nations had numerous supporters. With a view to clearing the ground for the achievement of practical results, the General Assembly, in its resolution 43/81 B, requested the Secretary-General to undertake, with the assistance of a group of qualified governmental experts, an in-depth study of the role of the United Nations in the field of verification of arms limitation and disarmament which would: identify and review existing activities of the United Nations in that field; assess the need for improvements of existing activities as well as explore and identify possible additional activities; and provide specific recommendations for future action by the United Nations in the verification context. Moreover, mindful of the fundamental importance of full implementation and strict observance of agreements on arms limitation and disarmament if individual nations and the international community are to derive enhanced security from them, the General Assembly adopted, by consensus, a resolution (43/81 A) on compliance with arms limitation and disarmament agreements.

The question of compliance was dealt with more specifically in connection with investigations of alleged use of chemical weapons. Within the context of the Iran-Iraq conflict, experts assigned by the Secretary-General have carried out on-site investigations following reports that chemical weapons had been resorted to, and in some instances the experts concluded that such weapons had been used. The Security Council unanimously adopted two resolutions, in May and August 1988 respectively, which vigorously condemned the use of chemical weapons and affirmed the urgent necessity of observing the Geneva Protocol. The Secretary-General was also encouraged to carry out promptly investigations in response to allegations concerning the possible use of chemical and bacteriological (biological) or toxin weapons that may constitute a violation of the Protocol. Furthermore, the Security Council also decided to consider appropriate and effective measures in accordance with the Charter of the United Nations should there be any future use of chemical weapons. In the General Assembly, there was also growing support, across all political and regional groups, for strengthening the Secretary-General's role in that area. This led to the adoption of resolution 43/74 A, entitled "Measures to uphold the authority of the 1925 Geneva Protocol and to support the conclusion of a chemical weapons convention", by which the General Assembly, *inter alia*, requested the Secretary-General to continue his efforts to develop further technical guidelines and procedures available to him for the investigation of reports of the possible use of chemical and biological weapons.

In the course of the general debate in plenary meetings, the President of the United States, Ronald Reagan, expressing concern at a growing number of cases of non-compliance with the obligations deriving from the Geneva Protocol of 1925 outlawing the use in war of chemical weapons, called upon the signatories of that Protocol, as well as other concerned States, to convene a conference to consider actions that could be taken by the international community to reverse the serious erosion of that agreement. He also urged all nations to co-operate in negotiating a verifiable, truly global ban on chemical weapons at the Conference on Disarmament in Geneva.

Again in the general debate, the President of France, Francois Mitterrand, stated that France, the depositary of the Geneva Protocol, favoured a meeting of the 110 signatories to that agreement. The purpose of such a meeting would be to solemnly reaffirm the commitment not to use chemical weapons, to prevent their proliferation, to encourage new accessions to the Protocol, to improve investigative procedures—in short, to express a common desire for the success of the work which was being carried out at Geneva within the context of the Conference on Disarmament.

As a result, it was agreed to hold a conference on the Geneva Protocol, in Paris, early in January 1989. The Conference of States Parties to the Geneva Protocol of 1925 and Other Interested States on the Prohibition of Chemical Weapons (Paris 7-11 January 1989) was able to adopt by consensus a Final Declaration which, *inter alia,* stated the following:

> The participating States confirm their full support for the United Nations in the discharge of its indispensable role, in conformity with its Charter. They affirm that the United Nations provides a framework and an instrument enabling the international community to exercise vigilance with respect to the prohibition of the use of chemical weapons. They

confirm their support for appropriate and effective steps taken by the United Nations in this respect in conformity with its Charter. They further reaffirm their full support for the Secretary-General in carrying out his responsibilities for investigations in the event of alleged violations of the Geneva Protocol. They express their wish for early completion of the work undertaken to strengthen the efficiency of existing procedures and call for the co-operation of all States, in order to facilitate the action of the Secretary-General.

Conclusion

It has long been recognised that verification is an integral part of arms limitation and disarmament agreements. Yet, until recent years, there has been little movement on the subject. More often than not, during the forty-year period between 1946 and 1985, verification proved to be a rather contentious subject, and often a serious obstacle to the conclusion of disarmament accords. The obstacle, however, was not insurmountable. A number of treaties—bilateral, regional or multilateral—concluded between 1959 and 1985 (see table) are there to prove that when the parties were firmly decided to reach agreement, they were ultimately able to overcome the obstacles relating to the verification measures no less than those involved in the substantive arms limitation and disarmament measures to be verified.

Since 1985 the interest in the subject of verification has quickened considerably and much more attention has been paid to it. The concept of verification of multilateral agreements has been clarified and has become more widely acceptable. Two accords, one multilateral and one bilateral—the Document of the Stockholm Conference on Confidence-and Security-building Measures and Disarmament in Europe (1986), and the INF Treaty between the United States and the Soviet Union (1987)—have made major contributions to the practice of verification, with a view to ensuring compliance and strengthening security.

Current multilateral negotiations on chemical weapons in the Conference on Disarmament, bilateral negotiations between the Soviet Union and the United States on strategic and space arms, and regional negotiations on conventional arms and forces in Europe are likely, furthermore, to produce new wide-ranging verification and compliance provisions and systems. Thus, it is no exaggeration to say that both the theory and the practice of verification are being affected by new dynamic forces currently at work.

In particular, as far as multilateral verifiction is concerned, the General Assembly clearly recognised at its forty-third session that the United Nations, in accordance with its responsibilities under the Charter, might develop further its role in the field of verification of multilateral agreements. In that context, the General Assembly requested the Secretary-General to undertake, with the assistance of a group of governmental experts, an in-depth study of the role of the United Nations in the field of verification.

As a result of all these developments, the security role of verification—this basic component of arms limitation and disarmament agreements—is likely to be enhanced.

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INTERNATIONAL VERIFICATION SYSTEM: TECHNICAL AND DIPLOMATIC ASPECTS

Introduction

Since its inception, the United Nations has addressed the question of verification at both the deliberative and the negotiating forums. Disarmament proposals put forward since then, regardless of which State or group of States sponsored them, included reference to the need for an effective system of control. A testimony to the ever-increasing attention this area has received within the United Nations is reflected in the three special sessions of the General Assembly devoted to disarmament as well as in the work on this subject that has been done in various United Nations bodies. The introduction of an item entitled "General and complete disarmament" in the agenda of the General Assembly, in 1959, also attracted increased attention to the issue of control/verification in the disarmament process. General Assembly resolution 1378 (XIV) of 20 November 1959 explicitly stated for the first time that "general and complete disarmament under effective international control" was the goal of the United Nations disarmament efforts.

The importance of the control/verification of disarmament measures was further reiterated in the Joint Statement of Agreed Principles for Disarmament Negotiations (the so-called McCloy-Zorin Agreement) submitted by the Union of Soviet Socialist Republics and the United States of America to the General Assembly on 20 September 1961. The Statement pointed out that ''disarmament measures should be implemented from beginning to end under such strict and effective international control as would provide firm assurance that all parties are honouring their obligations". To implement the proposed system of control, the sponsors recommended the creation of an international disarmament organisation, within the framework of the United Nations, composed of all parties to the agreement.

During the 1960s and 1970s, consideration of the question of verification of multilateral arms limitation and disarmament agreements was primarily carried out within the framework of the various partial measures which were then being pursued concurrently with the more far-reaching objectives of general and complete disarmament. Even so, adequate verification provisions were not present in some of the agreements concluded during those years.

In 1978, the General Assembly, at its first special session devoted to disarmament, identified in the Final Document of the Tenth Special Session of the General Assembly (Assembly resolution S-10/2), adopted at the conclusion of the session several broad principles on which verification provisions should be based in order to serve their intended purposes and gain general support of the parties to an agreement.

The growing recognition by the international community that disarmament and arras 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 led the General Assembly to adopt, on 16 December 1985, a new resolution (40/152 O) entitled "Verification in all its aspects".

By that resolution, the Secretary-General was requested to prepare and submit to the General Assembly at its forty-first session a report containing the views and suggestions of member states on verification principles, procedures and techniques tor promoting the inclusion of adequate verification in arms limitation and disarmament agreements and on the role of the United Nations in the field of verification. That report was issued in 1986 as a document of the General Assembly (A/ 41/422 and Add.l and 2).

General Assembly resolutions 41/86 Q of 4 December 1986 and 42/ 42 F of 30 November 1987 followed. By those resolutions the Disarmament Commission was requested to consider the issue of verification in all its aspects, including the role of the United Nations and its member states in the field of verification, and to report on its deliberations, conclusions and recommendations to the General Assembly. The Secretary-General was also requested to prepare for the 1987 and 1988 sessions of the Disarmament Commission compilations of the views received from member states on the issue (A/CN.10/87 and Add.l and 2 and A/CN.10/106 and Add.l to 3). Assembly resolution 42/42 F was particularly significant as it established for the first time the subject of "Verification in all its aspects" as an independent item in the provisional agenda of the forty-third session of the General Assembly.

In its 1988 substantive session, the Disarmament Commission reached agreement on a text containing a set of 16 principles of verification, a section on provisions and techniques of verification, and views on the role of the United Nations and its member states in the field of verification. That text was contained in the report of the Disarmament Commission transmitted to the General Assembly at its Fifteenth Special Session, the third special session devoted to disarmament held in June 1988. Deliberations on the issue of verification at the special session revolved primarily around the question of the role of the United Nations in the field of verification. Although there seemed to be an emerging consensus on the formulations regarding the verification study, the special session as a whole was inconclusive.

At its forty-third session, the General Assembly had before it two draft resolutions dealing with the question of verification at the multilateral level, one initiated by Canada, France and the Netherlands, the other sponsored by the countries represented in the Six-Nation Initiative: Argentina, Greece, India, Mexico, Sweden and United Republic of Tanzania. Extensive negotiations between the sponsors of the two drafts resulted in the introduction of a third draft which reflected the willingness of the parties involved to compromise on their differing approaches in order to obtain the broadest possible support in the General Assembly.

The new draft was adopted by the General Assembly, on 7 December 1988, as resolution 43/81 B. In the resolution, the General Assembly, inter alia. reiterated its view that agreements should provide for the participation of parties directly or through the United Nations organs in the verification process and stated that it was conscious of the fact that the United Nations is already playing a useful role in the field of verification. The resolution further recognised that the United Nations, in accordance with its role and responsibilities established under the Charter of the United Nations, can make a significant contribution in the field of verification, in particular of multilateral agreements. It requested the Secretary-General to undertake, with the assistance of a group of qualified governmental experts, an in-depth study of the role of the United Nations in the field of verification that would: (a) identify

TABLE

Disarmament-Related Agreements: Verification and Compliance Provisions

Name of agreement[a]	*Signed*	*Entered into force*	*Objective*	*Specific verification provisions*	*Verification methods*	*Compliance procedures*	*United Nations role*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Geneva Protocol	1925	b	Prohibit use in war of CB weapons	None	None	See col. (7)	Investigation of alleged use[c]
Antarctic Treaty	1959	1961	Antarctica to be used for peaceful purposes only	Art. III, VII	Exchange of information. General on-site inspection by designated observers. Aerial observation	Consultation (Art. VIII and XI). ICJ settlement (Art. XI)	Development of co-operative working relations with United Nations specialized agencies having a scientific or technical interest in Antarctica (Art. III, para. 2)
Partial Test Ban Treaty	1963	1963	Prohibit any nuclear-weapon test in atmosphere, outer space and under water	None	National technical means	None	
Outer Space Treaty	1967	1967	Protect common peaceful interest of all mankind in the exploration and use of outer space	Art. X, XII	Observation of flights of space objects on a basis of equality. General on-site inspection with respect to the Moon and other celestial bodies, on a basis of reciprocity.	Consultations (Art. IX)	Parties to inform Secretary-General of their activities in outer space (Art. XI)
Treaty of Tlatelolco	1967	d	Establish a nuclear-weapon-free zone in Latin America	Art. 12-16	IAEA safeguards. Special inspections by IAEA or regional organs	Various measures (Art. 20). ICJ settlement (Art. 24)	Reports to Security Council and General Assembly, through Secretary-General, in connection with inspections (Art. 16) and

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
							in the event of violations of the Treaty (Art. 20)
Non-Proliferation Treaty	1968	1970	Prevent wider dissemination of nuclear weapons	Art. III	IAEA safeguards	Review conferences (Art. VIII, X)	Role in connection with review conferences
Sea-Bed Treaty	1971	1972	Prevent a nuclear arms race on the sea-bed and the ocean floor	Art. III	Observation of activities on the sea-bed using own means, or with the assistance of any other party, or through international procedures.	Consultations, Lodging of complaint with Security Council (Art. III). Review conference (Art. VII)	See col. (6). Also, role in connection with review conference
Biological Weapons Convention	1972	1975	Total on bacteriological (biological) and toxin weapons. Destruction of any such weapons	None	National technical means	Consultations (Art. V). Lodging of complaint with Security Council (Art. VI, VII)	See col. (6). Also, role in connection with review conferences
SALT I ABM Treaty	1972	1972	Limit ABM system and nor deploy them for defence of the national territory	Art. XII, XIII	National technical means	Standing Consultative Commission (Art. VIII)	
Interim Agreement	1972	1972	Limit strategic offensive arms	Art. V, VI	National technical means	Standing Consultative Commission (Art. VI)	
Threshold Test Ban Treaty	1974	e	Prohibition of any underground nuclear-weapon test exceeding 150 kt	Art. II	National Technical means	Consultations; inquiries; information in reponse to inquiries (Art. II)	
CSCE: Document on CBMs and certain aspects of security and disarmament	1975	f	Increase stability and security in Europe	Sect. I	Prior notification of major military manoeuvres and move-	Observation on a reciprocal basis. Confidence-building	

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
					ments. Exchange of observers (Sect. I)	measures (sect. I)	
PNE Treaty	1976	e	Deveop co-operation in the fieldof undergroudn nuclear explosions for peaceful purposes	Art. IV-VI	National technical means	Joint Consultative Commission (Art. V and VI). Co-operation on the basis of reciprocity (Art. VI)	
Environmental Modification Convention	1977	1978	Prohibit military or any other hostile use of environmental modification techniques	Art. V	Naional Technical means	Consultation/Co-operation procedure, including Consultative Committee of Experts. Lodging of complaint with security Cuncil (Art. V); Review conferences (Art. VIII)	See col (6). Also, role in connection with review conferences
Salt II Treaty	1979	g	Limited and reduce strategic offensive arms	Art. XV-XVII	National technical means	Advance notification of ICBM launches (Art. XVI). Standing Consultative Commission (Art. XVII)	
Agreement on the Moon and Othe Celestial Bodies	1979	1984	Govern the activities of State on the Moon and other celestical bodies	Art. 15	General on-site inspection with respect to the Moon and other celestial bodies, using own means, or with the assistance of any other party, or through international procedures	Consultations, Settlement of disputes by peaceful means, with or without assistance of Secretary-General (Art. 15). Review confer ences (Art. 18	Secretary-General to receive information from States parties carrying out activities (various articles). Settlement of disputes with assistance of Secretary-General. See col. (6). Also specific role in ocnnection with review conferences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treaty of Rarotonga	1985	1986	Establishment of a nuclear-free zone in the South Pacific	Art. 8-10	Reports and exchange of information; IAEA safeguards	Consultations (Art. 8 and 10); Consultative Committee (Art. 10). Complaints procedure (Art. 8)	
Docuemnt of the CDE Stockholm Conference, 1986	1986	h		Strengthen confidence and security and make progress towards disarmament in Europe	Section on compliance and verification and other relevant sections of the Document	Prior notification and observation of certain military activities. National technical means; inspection.	Timely clarification, communications etc.
INF Treaty	1987	1988	Elimination of intermediate-range and shorter-range ground-launched missiles	Art. XI-XIII, plus Protocol on Inspection and Protocol on Eliminaiton	On-site inspection; inspection by challenge; national technical means	Special Verification Commission (Art. XIII)	

a. ln abbreviated form. The full name is given in the annex.

b. For each signatory as from the date of deposit of its ratification; accessions take effect on the date of the notification of the depositary Government.

c. Pursuant to General Assembly resolutions 35/144 C, 36/96 C, 37/98 D, 37/98 E, 38/187 C, 39/65 E, *42/37 C,* 43/74 A. See also Security Council resolutions *582* (1986), *612* (1988) and *620* (1988).

d. For each Government individually.

e. Not yet ratified, but it is generally understood that the two signatories are adhering to it.

f. In the Helsinki Final Act, of which the Document forms a part, the participants declared their resolve, "in the period following the Conference [CSCE], to pay due regard to and implement the provision of the Final Act of the Conference". The Final Act is not eligible, in whole or in part, for registration with the Secretariat under Article *102* of the Charter of the United Nations, as would be the case were it a matter of a treaty or international agreement.

g. Not ratified, but it is understood that the Treaty has been generally observed.

h. The measures adopted in the Document are politically binding and came into force in 1987.

TABLE

Multilateral Disarmament-Related Agreements Verification Provisions and Compliance Procedures*

Name of agreements a/	*Signed*	*Entered into force*	*Objective*	*Specific verification provisions*	*Verification methods*	*Compliance procedures*	*United Nations role*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			A. Global Multilateral Agreements				
Geneva Protocol	1925	b/	Prohibit use in war of CB weapons	None	None	See col. (7)	Investigation of alleged use c/
Antarctic Treaty	1959	1961	Antarctica to the used for peaceful purpose only	Arts. III VII	Exchange of information. General on-site inspection by designated observers. Aerial observation	Consultation (arts. VIII and XI). ICJ settlement (art. XI)	Development of co-operative working relations with United Nations specialized agencies having a scientific or technical interest in Antarctica (art. III, para. 2)
Partial Test Ban Treaty	1963	1963	Prohibit any nuclear-weapon test in atmosphere, outer space and under water	None	d/	None	
Outer Space Treaty	1967	1967	Protect common peaceful interest of all mankind in the exploration and use of outer space	Arts. X, XII	Observation of flights of space objects on a basis of equlity. General on-site inspection with respect to the Moon and other celestial bodies, on a basis of reciprocity	Consultations (Art. IX)	Parties to inform secretary-General of their activities in outer space (art. XI)
Non-Proliferation Treaty	1968	1970	Prevent wider dissemination of nuclear weapons	Art. III	IAEA safeguards	See col. (5); also, review conferences (art. VIII, X)	Role in connection with review conferences
Sea-Bed Treaty	1971	1972	Prevent a nuclear-arms rade on the sea-bed and the ocean floor	Art. III	Observation of activities on the sea-bed using own means, or with the assistance or any other party, or through international procedures	Consultations. Lodging of complaint with Security Council (art. III). Review conference (art. VII)	See col. (6). Also, role in connection with review conferences. In addition, Secretary-General to report on technological developments relevant to the Treaty and to the verification of compliance with the Treaty e/

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Biological Weapons Convention	1972	1975	Total ban on bacterio-logical (biological) and toxin weapons. Destruction of any such weapons	None	d/	Consultations (art. V) Lodging of complaint with Security council (arts. VI, VII)	See col (6). Role in connection with review conferences. Also, role in the exchange of information with regard to art. V t/
Environmental Modification Convention	1977	1978	Prohibit military or any other hostile use of environmental modi-fication techniques	Art. V	d/	Consultation/co-opera-tion procedure, includ-ing Consultative Commi-ttee of Experts. Lodging of complaint with Security Council (art. V); review conferences (art. VIII)	Secretary-General is sole depositary, and Chairman of Consultative Committee of Experts. See col. (6) Also, role in connection with review conferences
Agreement on the Moon and other Celestial Bodies	1979	1984	Govern the activities of States on the Moon and other celestial bodies	Art. 15	General on-site inspection with respect to the Moon and other celestial bodies, using own means, or with the assistance of any other party, or through international procedures	Consultations. Settle-ment of disputes by peaceful means, with or without assistance of Secretary-General (art. 15). Review conferences (art. 18)	Secretary-General is sole depositary. Secretary-General to receive infor-mation from States parties carrying out activities (various articles). Settle-ment of disputes with assistance of Secretary-General. See col. (6). Also, specific role in connec-tion with review conferences
Certain Conventional Weapons	1981	1983	Prohibit or restrict use of certain conven-tional weapons which cause unnecessary suffering or have indis-criminate effects	None g/	None	Review conferences (art. 8)	Secretary-General is sole depositary
B. Regional Multilateral Agreements							
Treaty of Tlatelolco	1967 h/		Establish a nuclear-weapon-free zone in Latin America	Arts. 12-16	IAEA safeguards. Special inspections by IAEA or regional organs	Various measures (art. 20). ICJ settle-ment (art. 24)	Reports to Security Council and General Assembly, through Secretary-General, in connection with inspec-tions (art. 16) and in the event of violations of the Treaty (art. 20)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CSCE: Document on CBMs and certain aspects of security and disarmament	1975	i/	increase stability and security in Europe	Sect. I	Prior notification of major military manoeuvres and movements. Exchange of observers (sect. I)	Observation on a reciprocal basis. Confidence-building measures (sect. I)	
Treaty of Rarotonga	1985	1986	Establishment of a nuclear-free zone in the South Pacific	Arts. 8-10	Reports and exchange of information. IAEA safeguards	Consultations (arts. 8 and 10); Consultative Committee (art. 10). Complaints procedure (art. 8)	
Document of the Stockholm Conference	1986	j/	Strengthen confidence and security and make progress towards disarmament in Europe	Section on comp-liance and verific-ation and and ot-her relevant section of the Document	Prior notification and observation of certain military activities. National technical means inspection	Timely clarification. communications, etc.	

Source : Based on 1988 *United Nations Disarmament yearbook*, chap. V, pp. 138-142.

* Inclusion of this table does not necessarily imply endorsement of its contents by members of the Group of Experts.

a/ In abbreviated form. The full name is given in the glossary.

b/ For each signatory as from the date of deposit of its ratification; accessions take effect on the date of the notification of the depositary government.

c/ Pursuant to General Assembly resolutions 35/144 C of 12 December 1980, 36/96 C Of 9 December 1981, 37/98 D and E of 13 December 1982, 38/187 C of 20 December 1983, 39/65 E of 12 December 1984, 42/37 C of 30 November 1987 and 43/74 A of 7 December 1988. See also Security council resolutions 582 (1986), 612 (1988) and 620 (1968).

d/ The treaty text makes no provisions for agreed methods of verification. It was understood by the parties that any verification that might be possible would be carried out using national technical means.

e/ In accordance with decision made by States parties at the third review conference of the Treaty held in 1989 and request contained in General Assembly resolution 44/116 O of 15 December 1989.

f/ Sec paras. 518-521 for relevant description.

g/ Several States have expressed their concern regarding the lack of verification provisions and procedures for dealing with compliance with the terms of the Convention. Some of those States reserved the right to make proposals to that end, should that prove to be necessary, at a later date.

h/ For each government individually.

i/ In the Helsinki Final Act, of which the Document forms a part, the participants declared their resolve, "in the period following the Conference (CSCE), to pay due regard to and implement the provisions of the Final Act of the Conference." The Final Act is not eligible, in whole or in part, for registration with the Secretariat under Article 102 of the Charter of the United Nations, as would be the case were it a matter of a treaty or international agreement.

j/ The measures adopted in the Document are politically binding and came into force in 1987.

and review existing activities of the United Nations in the field of verification of arms limitation and disarmament; (b) assess the need for improvements in existing activities as well as explore and identify possible additional activities, taking into account organisational technical, operational, legal and financial aspects; and (c) provide specific recommendations for future action by the United Nations in this context. The Secretary-General was requested to submit a comprehensive report on the subject to the General Assembly at its forty-fifth session.

The present report has been prepared pursuant to General Assembly resolution 43/81 B. The Group of Governmental Experts, while taking fully into account the mandate of the resolution that is, to prepare a study that addresses the role of the United Nations in the field of verification of arms limitation and disarmament, has also taken into consideration approaches, methods procedures and techniques relating to other arrangements in the area of international peace and security which might otherwise be useful to the process of verification of arms limitation and disarmament agreements.

VERIFICATION: DEFINITION AND FUNCTIONS

A. Definition of Terms

Verification is a process which establishes whether the States parties are complying with their obligations under an agreement. The process includes: collection of information relevant to obligations under arms limitation and disarmament agreements; analysis of the information, and reaching a judgement as to whether the specific terms of an agreement are being met. The context in which verification takes place is that of the sovereign right of States to conclude and their obligation to implement arms limitation and disarmament agreements. Verification is conducted by the parties to an agreement, or by an organisation at their request.

This agreement-specific approach to defining verification for arms limitation and disarmament does not preclude useful research into and examination of general concepts and even particular verification techniques in advance of negotiated agreements. This type of generic, anticipatory or complementary work, however, is essentially of an exploratory nature, focused on developing new knowledge that can be employed subsequently in designing, implementing and strengthening agreement-specific verification systems. Sometimes it may be aimed at actually setting up operating verification systems in advance of relevant arms limitation and disarmament agreements with a view to promoting their conclusion. However, the expense of operational verification systems may hamper their formation in advance of actual agreements, given that there are no obligations to be verified until specific agreements are concluded and that verification depends on the purpose, scope and nature of the agreement.

Compliance refers to the actual behaviour of a party with respect to the provisions of a binding agreement. It denotes behaviour that is in accordance with the forms and requirements of the agreement.

The process of verifying compliance with arms limitation and disarmament agreements consists of multiple steps that can be either unilateral or co-operative in nature, or a combination of both. The initial steps involve monitoring, examining and analysing information relating to compliance.

Monitoring/data collection: monitoring is the process of watching, observing or checking objects, activities or events, for a specific purpose. It is one generic form of information collection, which can include other activities such as exchanges of information. Monitoring, and data collection in general, constitute the first step in the verification process. In verification, this information is collected for the purpose of assessing compliance with a binding agreement.

Monitoring/data collection and analysis can be undertaken for a much wider range of purposes than verification including, *inter alia,* crisis prevention, peace-keeping and general intelligence gathering. Verification procedures must be carefully designed to prevent, as far as possible, collection of data unrelated to the purpose of verifying the treaty concerned.

Verification arrangements for arms limitation and disarmament agreements may entail co~operative measures, or provisions between States parties that simplify or facilitate monitoring of compliance with an agreement's provisions. As trust in faithful compliance with agreements between States increases over time, the relative importance of monitoring can change., without necessarily leading to changes in treaty obligations.

Arms limitation and disarmament agreements may require asymmetrical reductions to arrive at equal levels of armament, or differing verification burdens, reflecting the specific provisions agreed to by States parties. Whatever the verification arrangements that are agreed, they must not, however, be implemented in a discriminatory manner; otherwise, they can generate mistrust or resentment over time.

States parties must have the right to participate fully in co-operative verification arrangements agreed upon during the course of negotiations.

Terms such as "adequate", "effective", or "appropriate" are often used to express the standard of verification deemed necessary for States to consent to limitations on their military capabilities and freedom of action. Whatever the terminology used, there is widespread recognition that no verification regime can uncover every conceivable problem. Instead, verification provisions and monitoring capabilities should be designed so that violations are detected in time for the States parties to take appropriate action.

The definitions reviewed here suggest that verification entails political as well as technical considerations. States parties commit themselves to carrying out agreed obligations fully, including the obligation to permit verification of compliance and to resolve concerns over non-compliance in a satisfactory manner. The importance of the political elements of the verification process is also underscored by the co-operative arrangements that accompany the implementation of agreed obligations, including highly intrusive verification arrangements such as on-site inspections (OSIs). As will be discussed below, agreed obligations may take legal or moral form, depending on the nature of the agreements reached. As is evident from the discussion above, there is also an essential role for expertise in monitoring the implementation of agreed obligations. Future advances in verification technologies would facilitate the conclusion of arms limitation and disarmament agreements. International cooperation in the development of verification technologies would therefore be most valuable.

B. Principles of Verification

An important aspect of efforts in the field of arms limitation and disarmament undertaken within the United Nations has been the development of broad principles on which verification provisions should be based. The General Assembly at its tenth special session, the first special session devoted to disarmament, held in 1978, formalised some basic concepts on the subject. Included in the Final Document of the Tenth Special Session of the General Assembly were three paragraphs that can be regarded as the precursors, within the United Nations framework, of later efforts to develop a full set of principles of verification. The three paragraphs read as follows:

> "Disarmament and arms limitation agreements should provide for adequate measures of verification satisfactory to ail parties concerned

in order to create the necessary confidence and ensure that they are being observed by all parties. The form and modalities of the verification to be provided for in any specific agreement depend upon and should be determined by the purposes.-scope and nature of the agreement. Agreements should provide for the participation of parties directly or through the United Nations system in the verification process. Where appropriate, a combination of several methods of verification as well as other compliance procedures should be employed.

"......

"In order to facilitate the conclusion and effective implementation of disarmament agreements and to create confidence,' States should accept appropriate provisions for verification in such agreements.

"In the context of international disarmament negotiations, the problem of verification should be further examined and adequate methods and procedures in this field be considered. Every effort should be made to develop appropriate methods and procedures which are non-discriminatory and which do not unduly interfere with the internal affairs of other States or jeopardize their economic and social development.

In 1988, the General Assembly endorsed a set of 16 principles of verification developed by the Disarmament Commission (Assembly resolution 43/81 B). The 16 principles resulted partly from the preceding three paragraphs of the Final Document, which were used as a basis for the work of the Commission. The principles/ which could be useful guidelines in the negotiations of arms limitation and disarmament agreements, are:

"(1) Adequate and effective verification is an essential element of all arms limitation and disarmament agreements.

"(2) Verification is not an aim in itself, but an essential element in the process of achieving arms limitation and disarmament agreements.

"(3) Verification should promote the implementation of arms limitation and disarmament measures, build confidence among States and ensure that agreements are being observed by all parties.

"(4) Adequate and effective verification requires employment of different techniques, such as national technical means, international technical means and international, procedures, including on-site inspections.

"(5) Verification in the arms limitation and disarmament process will benefit from greater openness. life;

"(6) Arms limitation and disarmament agreements should include explicit provisions whereby each party undertakes not to interfere with the agreed methods, procedures and techniques of verification, when these are operating in a manner consistent with the provisions of the agreement and generally recognised principles of international law.

"(7) Arms limitation and disarmament agreements should include explicit provisions whereby each party undertakes not to use deliberate concealment measures which impede verification of compliance with the agreement

"(8) To assess the continuing adequacy and effectiveness of the verification system, an arms limitation and disarmament, agreement should provide for procedures and mechanisms for review and evaluation. Where possible, time-frames for such reviews should be agreed in order to facilitate this assessment.

"(9) Verification arrangements should be addressed at the outset and at every stage of negotiations on specific arms limitation and disarmament agreements.

"(10) All States have equal rights to participate in the process of international verification of agreements to which they are parties.

"(11) Adequate and effective verification arrangements must be capable of providing, in a timely fashion, clear and convincing evidence of compliance or non-compliance. Continued confirmation of compliance is an essential ingredient to building and maintaining confidence among the parties.

"(12) Determinations about the adequacy, effectiveness and acceptability of specific methods and arrangements intended to verify compliance with the provisions of an arms limitation and disarmament agreement can only be made within the context of that agreement.

"(13) Verification of compliance with the obligations imposed by an arms limitation and disarmament agreement is an activity conducted by the parties to an arms limitation and disarmament agreement or by an organisation at the request and with the explicit consent of the parties, and is an expression of the sovereign right of States to enter into such arrangements.

"(14) Requests for inspections or information in accordance with the provisions of an arms limitation and disarmament agreement, should be considered as a normal component of the verification process. Such requests should be used only for the purposes of the determination of compliance, care being taken to avoid abuses.

"(15) Verification arrangements should be implemented without discrimination, and, in accomplishing their purpose, avoid unduly interfering with the internal affairs of State parties or other States, or jeopardising their economic, technological and social development.

"(16) To be adequate and effective, a verification regime for an agreement must cover all relevant weapons, facilities, locations, installations and activities."

C. Functions

1. General

Verification provisions have several important functions, beginning with the assessment of how implementation of arms limitation and disarmament is proceeding. For this process to succeed in the long term, verification provisions must provide for confidence in compliance. Confidence in compliance is based not just on being able to detect violations in time for States parties to take appropriate action, but also on I confidence that verification provisions are so well designed that they will help prevent cheating from taking place.

While nations enter into arms limitation and disarmament agreements as an expression of their sovereign rights and in anticipation of benefits to be derived, some States parties might come to the conclusion that an agreement places them at an unfair disadvantage, in part because some parties are not complying fairly and fully with agreed obligations. Questions over non-compliance on marginal issues may also lead to deeper concerns over non-compliance on more central security issues. If parties to an agreement come to believe, over time, that an agreement's provisions are no longer in their national security interest, concerns by others will arise over potential non-compliance.

2 . Assessing Implementation

A primary function of verification is assessing the day-to-day pattern of implementation of an agreement's provisions. Monitoring capabilities must be sufficiently adequate and effective to provide assurance that nations are faithfully and fully carrying out their obligations. Explicit provisions for doing so vary from the Antarctic Treaty, where signatories have the right to designate observers to carry out inspections with complete freedom of access, to the Partial Test Ban Treaty, which has no specific verification provisions.

Over time, monitoring techniques have improved considerably and have become more widely available. In addition, many new co-operative verification provisions have been agreed to, including detailed inspection provisions for both multilateral and bilateral agreements. These approaches, methods, procedures and techniques, which are discussed below, provide signatories with many tools to assess day-to-day implementation of arms limitation and disarmament agreements. Moreover, additions to this verification "tool box" can be expected in the future.

3. Generating Confidence

Verification arrangements must serve another function by generating confidence rather than distrust within participating States that others are fulfiling their obligations under an agreement. An Important element for building confidence is the ability to collect information relative to the agreement in question sufficient to assess the compliance practices on other States. Confidence can also be built when verification provisions allow others to demonstrate clearly their commitment to compliance. For both of these reasons, provisions prohibiting deliberate concealment relative to an agreement's provisions and expressly permitting monitoring by national technical means and by co-operative measures have become widely used components of new accords.

Trust between States could be eroded if verification provisions are abused or misused - or if States come to believe so - in order to gather information; not required to assess compliance with obligations under existing agreements. Under these circumstances, resentment rather than confidence could be generated, making a long-term process of arms limitation and disarmament difficult to sustain. For this reason, it is important to avoid misuse of verification.

As in the case of discouraging non-compliance yet allowing appropriate monitoring for treaty implementation, a balance must be struck that allows sufficient transparency to build confidence in compliance, yet protects national security-related information that has no direct bearing on obligations undertaken by participating States. This balance will vary from one agreement to the next, depending on the scope and specific nature of the accord, and the degree of trust or distrust existing between parties to each agreement.

4. Dealing with Uncertainties

Yet another function of verification is to provide procedures for dealing with uncertainties associated with implementation and compliance. States parties need such procedures because no agreement, regardless of the specificity and intrusiveness of its terms, can anticipate every conceivable eventuality. Nor can verification provisions completely prevent "false alarms". If agreements are worth while, they will remain in effect long after they are signed, even when new conditions arise that were not anticipated fully by the negotiators.

Verification provisions can help minimize uncertainties and false alarms associated with compliance, and the possibility of increasing distrust arising from such uncertainties, by providing for data exchanges, greater transparency between participating States through enhanced verification measures and a wide range of co-operative arrangements designed to alleviate concerns over non-compliance. Collateral constraints may also be agreed upon that elaborate treaty provisions or that apply to weapons systems not directly covered by an agreement, but that none the less build confidence in compliance. Consultative procedures are of special importance to solve questions of treaty compliance in a co-operative manner.

Agreed verification procedures have been used to help defuse crises that could lead to conflicts that all parties wished to avoid. These efforts have been outside the scope of arms limitation and disarmament agreements, yet the techniques involved may prove to be suitable for future arms limitation and disarmament efforts. In sensitive areas of the globe, crisis prevention and resolution mechanisms are essential if these efforts are to succeed over time. In such regions, military exercises can be a special cause of concern, creating fears of a surprise attack and generating alerts and other compensating actions that can exacerbate an already tense situation. In such cases, agreed monitoring arrangements between the parties have been employed to alleviate concerns over military intentions or to monitor the mutual removal of troops from sensitive areas, helping to prevent armed conflict and loss of life. In this regard, extremely important work has been done and useful experience has been gained in the context of United Nations peace-keeping operations. Agreed verification procedures have been carried out by the parties themselves, with or without the assistance of third countries, by the United Nations, its affiliated operations or other multilateral efforts.

Another function of verification procedures is to provide confidence in compliance with disengagement agreements between parties that have been in conflict and wish to improve relations. As such, disengagement agreements can serve as important steps leading to the resolution of more central points of contention, permitting more significant steps towards improved relations, including arms limitation and disarmament agreements. As with crisis prevention and resolution mechanisms discussed above, verification provisions for disengagement agreements could be carried out by the parties themselves, with or without the help of third parties, and by the United Nations, its affiliated operations or other multilateral efforts.

5. Discouraging Non-Compliance

Agreed verification provisions can create confidence in compliance by discouraging non-compliance. Guaranteed inspection rights at production sites most suitable for prohibited activities are particularly helpful in this regard, forcing nations contemplating on-compliant behaviour and wishing to avoid detection to carry out such activity in new locations, requiring added investments and new patterns of military activities that leave many telltale signs for those monitoring compliance.

Highly intrusive verification measures can also provide timely warning. They require a great deal of co-operation between the parties. Existing patterns of co-operation might have to be altered in order to protect troubling preparations or on-compliant activities from being detected. For example, routine inspections at short notice or inspections of suspect sites may be denied, raising concerns over non-compliance and triggering more intensive monitoring efforts.

Well-designed verification provisions can also discourage non-compliance in instances where the party contemplating on-compliant behaviour can be swayed by political costs and by international public opinion. For these circumstances to be met, the party contemplating non-compliance must have clear knowledge that existing verification provisions will produce evidence that can be used in public as well as in diplomatic forums, evidence that will be readily understandable and convincing.

Verification provisions must, in general, be proportional to the obligations undertaken. A balance must be struck between the effort needed to discourage non-compliance, by attempting to ensure detection, and the verification measures necessary to carry out the provisions of an agreement, without producing an excessive number of false alarms.

In addition, over-intrusive verification measures can become an impediment to improved relations. The standard set for verification of specific agreements is not immutable and may vary, depending on the nature of the agreement.

6. Timely Warning

Well-designed verification provisions can help prevent non-compliance by providing a timely warning of potential compliance problems. In such circumstances, other States wishing to uphold the agreement in question can consult, make representations to the country or countries contemplating prohibited activities, and clarify the benefits of remaining in compliance or the penalties associated with on-compliant activities.

Provisions for intrusive verification, when called for, provide for timely warning in many ways. By providing timely access to sensitive military installations, as well as facilities and areas where activities of most concern are likely to take place, intrusive verification can make surreptitious non-compliance more difficult, expensive, time-consuming, or obvious. If verification provisions raise the financial, opportunity, and political costs of non-compliance high enough, they could discourage non-compliance. Properly devised challenge inspections can be particularly helpful in this regard.

All the functions of verification reviewed above serve to create the necessary confidence that agreements are being properly observed by all parties, a pre-condition to a successful, long-term process of arms limitation and disarmament.

It is also generally understood that verification measures cannot provide complete certainty in evaluating compliance or non-compliance. Inevitably, some provisions of an agreement will be easier to monitor with high confidence than others. Even if abundant monitoring capabilities were widely available and acceptable to States parties, the terms of an agreement may not lend themselves to certain judgements with respect to compliance. In those cases States parties to an agreement accept that the benefits of the agreement outweigh such difficulties.

D. Dynamics of the Process of Verification

The various phases of the verification process are often interactive and it is not always possible to distinguish clearly between them. It is, however, useful to identify three major elements (although they are not necessarily exhaustive):

(a) Collection of relevant information, which includes monitoring the behaviour of other countries relative to their obligations under arms limitation and disarmament agreements;

(b) Analysis of information collected;

(c) Reaching a judgement, on the basis of that information, about whether or not obligations under an agreement are being met. Once a determination is made that a violation has been committed, deciding what to do about it (i.e., "enforcement") is not part of the verification process.

Special expertise is necessary to operate information-gathering devices and to process and analyse the data they provide. Nonetheless, a great deal of useful information concerning compliance can also be obtained through far less sophisticated methods. For example, trained observers of military activities and skilled interpreters of pictures taken by aircraft can be especially important in monitoring multilateral agreements governing troop exercises or troop withdrawals.

The initial steps in the process of monitoring the activities of parties to an agreement as they relate to obligations undertaken in multilateral or bilateral agreements are dominated by technical and operational considerations. Experts involved in this stage of the process as a rule are not asked and do not seek to make judgements of compliance or non-compliance on the basis of the data they are collecting and analysing. Judgements with respect to compliance or non-compliance can have considerable political significance, and are thus the normal province of political officials rather than technical experts.

Only in the final stages of the verification process do political officials render judgements on the compliance practices of other States parties to agreements, utilising the data, examination and analysis provided by technical experts. Declarations of non-compliance do not end the process, however. Instead, they can lead to further discussion with other States parties, the provision of additional data or institution of new co-operative arrangements to resolve compliance concerns. Alternatively, concerns over non-compliance may remain unresolved.

Numerous sources of data are examined and analysed during the verification process, including data provided by States parties in fulfilment of their obligations under the agreement. Indeed, as negotiated agreements have become more and more complex, the provision and gathering of data has become a sine qua non for the verification process and for the proper implementation of agreements.

New provisions, measures and practices for data exchanges have emerged for multilateral and bilateral agreements, for example, with the conclusion of the "Stockholm Document" by the Conference on Confidence- and Security-building Measures and Disarmament in Europe, and the INF Treaty. As a result of both agreements, unprecedented amounts of data, whether on military exercises or force deployments and infrastructure, are now routinely exchanged between participating States. These co-operative data exchanges could also be supplemented by unilateral methods of gathering data, permitting States to assess proper implementation of arms limitation and disarmament agreements.

The unilateral provision and co-operative exchange of data, even when not required by specific agreements, can also be helpful. The extension of this practice can promote confidence and security, and lay the ground work for subsequent arms limitation and disarmament agreements. Examples of such voluntary measures are the submission of data regarding national military expenditures by States Members of the United Nations to the Secretary-General and international experiments for the exchange of seismic data in the framework of the Conference on Disarmament.

An important example of additional data gathering has been the Secretary-General's fact-finding missions to investigate allegations of the use of chemical weapons in contravention of the 1925 Geneva Protocol. Such activities, although not verification procedures as part of an existing arms limitation and disarmament agreement, have been a practical illustration of the international community's demand to determine whether or not a specific convention is being observed.

In order to generate confidence in disarmament agreements and to make the process of arms limitation and disarmament sustainable, it is important to focus data collection solely on activities related to the specific obligations to be verified. With the consent of parties involved, this can be done in a number of ways, including:

(a) Determining the access to locations for data collection, e.g., limiting. flight paths of aircraft and confining OSIs to specific areas determined in the relevant agreements;

(b) Restricting the categories of sensors that may be used, e.g., allowing only certain types of sensors on aircraft;

(c) Designating specific sensor characteristics, e.g. specifying sensors in order to restrict powers of resolution;

(d) Developing appropriate procedures with a view to protecting sensitive information.

Information gathered by national technical means (NTM), data exchanges, and other measures agreed to by States parties to arms limitation and disarmament agreements are then analysed by experts. Their reports are then processed at the policy level. Ambiguous events or troubling activities or practices that raise questions concerning non-compliance will lead to additional data gathering and further analysis by technical experts. Data gathering and diplomatic initiatives may ameliorate concerns and resolve the issue in a satisfactory way, instead of leading to protracted impasses.

E. Bilateral/multilateral Dimensions

Bilateral negotiations and agreements between the United States and the Soviet Union continue to be of the utmost importance, as the States parties build on the progress achieved in the INF Treaty. When significant reductions in strategic arms are realised, it is widely, recognised that such reductions will demand stringent bilateral measures of verification.

Constructive interaction between bilateral and multilateral efforts has already established more favourable conditions for progress in arms limitation and disarmament. While bilateral efforts remain, by definition, bilateral in character, they may also involve other countries, as is evident from the INF Treaty. Although a bilateral agreement, it necessarily involves third parties that have consented to base the weapons systems being eliminated and host foreign inspection teams. The Treaty also utilises the same concept of registers of experts to serve as inspectors that the International Atomic Energy Agency (IAEA) has long employed to advantage. The same arrangement is now available to the Secretary-General in carrying out investigations of alleged use of chemical weapons.

As new agreements are negotiated, States parties can apply experience gained in the past to new accords. Thorough data exchanges have become common to both types of negotiations, including the concept of exchanging data during negotiations, after ratification (when applicable), as well as during the implementation period. Since the inception of the United Nations, one of the early instances in which the concept of on-site inspections was agreed upon in the multilateral context was the Antarcti; Treaty. Short notice inspections without a right of refusal were first agreed upon in a multilateral forum (the Stockholm Document) and then adopted shortly thereafter in the INF

Treaty. While verification provisions will necessarily be keyed to the specific (and sometimes unique) requirements of an agreement, these examples suggest that the growing similarity of verification techniques for multilateral and bilateral accords will help both kinds of negotiations in the future.

Adequate and effective verification measures are no less important for multilateral agreements than for bilateral accords. Indeed, in some respects, verification arrangements are even more critical in a multilateral context, where new complexities can be added in the negotiation of new accords. Monitoring arrangements of multilateral accords must also effectively bridge the diverse verification capabilities of individual States parties.

Multilateral accords require intense co-operation between the States parties for agreements to be implemented effectively. Appropriate consultative arrangements and concerted efforts to resolve compliance questions expeditiously and effectively might be incorporated where necessary into multilateral as well as bilateral accords. Multilateral agreements that include many parties may require verification arrangements that address a broad range of different conditions. At the some time, multilateral verification arrangements may offer organisational economies and efficiencies as the number of parties to an agreement grows.

To date, bilateral and multilateral agreements have produced various institutional mechanisms to implement the accords and to handle compliance questions. Specified verification procedures, both bilateral and multilateral, vary according to the scope and purposes of individual accords, as well as the degree of intrusive verification that States parties are willing to accept. The United Nations system supports and facilitates these efforts in several ways, as detailed in section IV below. Ways in which new types of assistance might be rendered are discussed in section V below.

F. Legal Aspects

One of the fundamental principles of international law is that of respect by each sovereign State for the territorial integrity and political independence of other States. States have the sovereign right to enter into arms limitation and disarmament agreements, and in doing so, permit verification of obligations undertaken therein. The exercise of verification must be based on the principles of international law.

When States fulfil constitutional processes to become parties to arms limitation and disarmament agreements, under international law they are obligated to take measures necessary for the proper implementation of provisions negotiated and agreed to in good faith. The Latin phrase, pacta sunt servanda, embodies this principle: every treaty in force is binding upon the parties and must faithfully be performed by them. The preamble to the Vienna Convention of the Law of Treaties specifically notes that "the principles of free consent and of good faith and the pacta sunt servanda rule are universally recognised".

The principle of pacta sunt servanda is closely associated with verification provisions of a treaty. According to the Vienna Convention of the Law of Treaties, "a material breach of a bilateral or multilateral treaty entitles the other party or parties to invoke the breach as a ground for terminating the treaty or suspending its operations in whole or in part". Accurate forms of verification are therefore necessary to determine compliance with treaty provisions and the continued viability of the principle of pacta sunt servanda.

Credible means of verification are furthermore of fundamental importance when one or several parties to a treaty seek to invoke the principle of rebus sic stantibus. i.e., a fundamental change of the circumstances prevailing at the time of the treaty's conception which would render it invalid. The termination of, or withdrawal from a treaty owing to a fundamental change of circumstances should not be exclusively a matter of political judgement. Appropriate verification measures may prevent the misuse of the rebus sic stantibus principle by providing all parties to a treaty with means to establish whether a fundamental change in circumstances has actually taken place.

In some cases, implementing legislation might be required to conform domestic law with international obligations newly undertaken. Though nothing in current international law is opposed to the monitoring for verification purposes from space, a specific mandate would be necessary to charge an international organisation such as the United Nations with this responsibility. Treaties may also provide specific authority to States or organisations for monitoring elsewhere in areas under national sovereignty, e.g., in territorial waters, in the atmosphere or on the ground, for the purpose of monitoring arms limitation and disarmament agreements. The acceptance of on-site inspections, the utilisation of foreign monitoring devices, as well as the obligation not to interfere with or impede verification measures for treaty obligations constitute procedures essential to determining whether treaty obligations are being faithfully and fairly implemented. These verification measures, like all others, must be pursued in a manner consistent with generally recognised principles of international law. Increased openness and transparency within and between States can also encourage strict compliance with obligations under arms limitation and disarmament, agreements.

The progressive development of international law can be helpful in this regard. Under Article 13 of the Charter of the United Nations, the General Assembly may initiate studies and make recommendations for the purpose of encouraging the progressive development of international law and its codification. In addressing the issue of compliance with arms limitation and disarmament agreements, on 15 December 1989, the General Assembly adopted resolution 44/122, which expressed the profound concern of all member states for maintaining respect for rights and obligations arising from treaties and other sources of international law.

The role of the United Nations in the area of arms limitation and disarmament verification is contingent upon the request and the explicit consent of the States parties to an arms limitation and disarmament agreement, as stated in principle 13 of the Disarmament Commission's principles of verification endorsed by the General Assembly.

G. Verification and Treaty Specificity

Arms limitation and disarmament verification is agreement-specific and is the responsibility of States parties to such agreements, unless they explicitly consent to the involvement of other States or organisations in the verification process. Monitoring and data collection are not necessarily treaty-specific. In specific cases, monitoring and data collection efforts, such as peace-keeping, crisis management, or fact-finding by the Secretary-General of the United Nations, can provide useful lessons that might be of value to the verification of future arms limitation and disarmament agreements.

As noted above, there is a growing similarity of verification procedures and techniques for both bilateral and multilateral agreements. For example, data exchanges, co-operative measures, on-site inspections, and registers of experts to monitor implementation and investigate concerns over non-compliance are generally applicable regardless of the number of parties to an agreement. At the same time, it is generally understood that verification procedures and techniques can be somewhat different from one agreement to the next, depending on the specific objects and purposes of each accord and the number of parties involved. Other techniques and means may be multi-purpose in nature.

The process of the Conference on Security and Co-operation in Europe (CSCE) has generated considerable thought about various kinds of confidence- and security-building measures (CSBMs), some of which have already been put into practice. Over time, partial and voluntary measures have been expanded and made compulsory, to the benefit of all parties to these accords. The implementation of similar procedures, especially with respect to the provision of annual calendars of military exercises and the exchange of observers under certain conditions, could help defuse tensions in other areas and pave the way for formal accords. In this way, lessons drawn from verification arrangements devised for specific accords may be useful in other agreements.

As discussed in section IV below, the United Nations system has specific responsibilities in the area of arms limitation and disarmament under existing accords. But, the United Nations can also facilitate and co-ordinate efforts to promote future arms limitation and disarmament agreements. Data exchanges, co-operative measures and on-site visits by experts need not necessarily be tied to specific agreements in order to be of value. They can also ease concerns over national security, build confidence about non-threatening intentions of neighbouring or distant States, and help lay the groundwork for new accords with enhanced verification measures.

The application of these generic functions is, for the most part, not treaty-specific at present; they may or may not become more treaty-specific in the future. In either event, the objective of these activities is not to interfere with existing agreements or ongoing negotiations, but to facilitate them.

VERIFICATION APPROACHES, METHODS, PROCEDURES AND TECHNIQUES

A. Descriptive Survey

1. National Technical Means

"National technical means" (NTM) are devices under the control of a State party that can be used for monitoring at a distance compliance with arms limitation and disarmament agreements. NTM include observation satellites, aircraft-based systems, such as radars and cameras, as well as sea- and ground-based systems. The important role of NTM is acknowledged in arms limitation and disarmament agreements that include obligations not to interfere with these devices.

Monitoring methods by national technical means capable of collecting relevant data at long ranges are an essential component of verifying many arms limitation and disarmament agreements. These methods do not disrupt activities within the State being monitored nor do they require a physical presence within that State. When appropriate, and for great effectiveness. States might agree to co-operate by avoiding the use of camouflage and other types of deliberate deception, by refraining from jamming or blinding monitoring devices, or by refraining from the encryption of telemetry or from transmitting it in ways that foil its reception by others.

Disparities in observation capabilities have been a cause of concern for some, especially in the context of multilateral negotiations. This concern, as well as a broader interest in providing the international community with information relating to issues of common security, has led some States to advocate the use of observation satellites as a central component for an international verification mechanism. In the future, verification systems that are currently under national control could involve the participation of several States, or new "Multi-national technical means" such as imaging or telecommunications satellites, could be developed.

Observation satellites have proven to be instrumental in bilateral accords between the Soviet Union and the United States. These satellites have made it easier for arms limitation agreements to be negotiated and implemented during periods when co-operative verification arrangements were minimal. Observation satellites continue to be essential in times when wide-ranging co-operative measures are in place, as they provide an important basis for assessing compliance, including the faithful implementation of co-operative arrangements. While a growing number of countries currently operate observation satellites or will do so in the near term, only two — the United States and the Soviet Union — are now in a position to acquire data from high resolution observation satellites.

As monitoring tools, satellites, though they have their limitations, provide broad coverage over areas of concern, and provide analysts with an important tool to detect changes over time, on the ground, that may be of military significance. Satellite coverage has been particularly useful for monitoring large objects, such as naval combatants, bombers, and most types of strategic weapons launchers, as well as military installations. The smaller and more mobile the object, the harder it is to observe from space and the more other methods of coverage become necessary. Discussion of the advantages and disadvantages of international satellite monitoring is found in section V, below.

States possessing satellites with sensors to detect nuclear explosions in the atmosphere and outer space have found them to be useful in monitoring compliance with the Partial Test Ban Treaty and the Treaty on the Non-Proliferation of Nuclear Weapons. Satellites can also provide important information that, while not directly linked to arms limitation and disarmament accords, help lay the groundwork for them by providing continuing assurance of non-hostile intent and timely warning of concerns that may require urgent consultations.

The diffusion of observation satellite technology and launch capabilities has created new opportunities for additional States to monitor crises and arms limitation and disarmament agreements. The launch of SPOT I by a French, Belgian, and Swedish consortium in 1986 is particularly noteworthy in this regard, as it provided for the first time an ability to detect objects at least 10 metres across ("10-metre imagery") on a commercial basis. Subsequently, the Soviet Union announced the availability for sale of five-metre imagery, and the United States announced a new policy permitting its firms to sell imagery comparable to that available elsewhere. Other States, such as China, India and Japan, currently operate earth-observation satellites; they will launch new satellites with improved capabilities over time, and other member states will undoubtedly follow suit.

States that do not at present operate satellites may unilaterally employ manned aircraft or camera-carrying remotely piloted vehicles (RPVs) to collect data. The technology utilised by these more modest monitoring tools is far less sensitive and expensive than for satellites. They are also inherently mere flexible to the tactical requirements of those monitoring various types of agreements: unlike satellites, the ground tracks of aircraft are not predictable and they can be more easily redirected to an area of interest.

Many States possess another kind of NTM: seismic stations that provide data concerning underground explosions. Properly equipped and operated, stations can detect very distant seismic events. It is widely considered that the effectiveness of these stations has grown significantly with new configurations, especially the use of national arrays. States that have participated in co-operative arrangements to improve seismic monitoring capabilities have found them useful. An example of such arrangements is the large-scale experiments being carried out as part of the work of the *Ad Hoc* Group of Scientific Experts to Consider International Co-operative Measures to Detect and to Identify Seismic Events (described in sect. IV).

Other types of NTM include aircraft- and ship-borne sensors, ground-based radars and listening stations, as well as satellites. Taken together, these NTM can provide a composite picture of events on the ground, providing experts with large amounts of data concerning compliance.

2. Co-operative Measures

In addition to data generated by technical devices under national control and data exchanged by States parties to arms limitation and disarmament agreements, the verification process is facilitated by co-operative measures that simplify the collection of evidence, whether from the ground, air, or space.

Even though NTM have become increasingly sophisticated, co-operative measures have grown in importance for both multilateral and bilateral accords. The complexity of current and prospective negotiations, together with the small size, mobility or dual purpose nature of many of the weapons systems and military capabilities negotiators seek to prohibit, limit or reduce, have progressively demanded co-operative approaches.

The forms such co-operative arrangements have taken are quite varied, as is to be expected for agreements that undertake substantially different tasks. Co-operative arrangements could include, but are not limited to, designing weapons systems and their deployment modes in ways that simplify verification; permitting aircraft overflights to observe military-related installations and activities; pre-notifying certain weapons tests to allow others to monitor them more effectively; conducting joint verification experiments to assist monitoring efforts; arranging for foreign representatives to observe or inspect, with an appropriate degree of intrusiveness and timeliness, installations or activities; and non-interference with NTM. As negotiated agreements become increasingly complex, the need for co-operative measures will grow. As the list of co-operative measures grows, so, too, will their applicability to new accords and efforts that facilitate subsequent arms limitation and disarmament agreements.

The provision and exchange of data can be an extremely important co-operative measure: it can build confidence and increase transparency. It can also lay the groundwork for more intrusive measures of co-operation, especially on-site inspections (OSIs).

National systems for control which provide a basis for the implementation of arms limitation and disarmament inside the respective countries are a special kind of national measure in the field of verification.

National systems of accounting for and control of nuclear materials are, *e.g.,* part of the IAEA-safeguards system. Under a future convention on chemical weapons, States parties may be required to designate or establish national authorities to implement treaty obligations. These authorities would have, *inter alia,* such tasks as data collection and reporting to the international organisation established by the convention, and providing assistance for international on-site inspections in the respective country.

Other forms of co-operative measures allow for in situ monitoring devices of various kinds, whether static or mobile. Sensors could be employed to cover a wider range of production facilities, weapons deployment areas, secured storage and destruction facilities, A wide variety of sensors could also be utilised for various confidence- and security-building measures in concert with substantive measures of arms limitation and disarmament, in particular in the fields of armed forces and conventional armaments. In specific cases, tagging techniques for military equipment could be of use.

On-site inspections are intrusive co-operative measures. OSIs require close co-operation to work properly, both by the host country and by the inspectors. Detailed procedures should be worked out in advance to clarify the rights and obligations of the inspectors as well as their hosts, although some flexibility is warranted to allow for the clarification of questions on site. OSIs can be very important for verifying compliance and for building confidence in the arms limitation and disarmament process; on the other hand, one must recognize that OSIs have certain limitations. For the promise of OSIs to be met, great care and commitment by all parties to an agreement are required to make the inspection process serve its intended purposes.

An important breakthrough in OSI was achieved in the Stockholm Document, wherein the parties agreed to mandatory inspections without a right of refusal under certain conditions. This accord also expressly allows observers to be present at military exercises when the number of troops engaged meets or exceeds certain thresholds. The participating States have stated that they are encouraged by the initial implementation of the measures adopted in the Stockholm Document.

OSIs can take many different forms. They can be systematic or *ad hoc.* For example, in the INF Treaty, five different types of inspections were agreed upon: baseline inspections to help verify the initial exchange of data; close-out inspections to confirm that treaty-prohibited activities have ceased; elimination inspections to observe the destruction of treaty-limited items; short-notice inspections without right of refusal at agreed facilities; and continuous portal monitoring at selected production facilities. Routine inspections of industrial enterprises are being elaborated in the negotiations taking place regarding a chemical weapons convention.

In a joint statement issued on I June 1990 by the President of the Union of Soviet Socialist Republics and by the President of the United States of America, the verification provisions for a treaty on the reduction and limitation of strategic offensive arms were described as including:

(a) "On-site inspections: for the purpose of ensuring verification of compliance with the Treaty, each side will, on the basis of reciprocity, conduct 12 kinds of on-site inspections, as well as continuous monitoring of mobile ICBM production facilities, in accordance with agreed procedures. *Inter alia.* each side will conduct short-notice inspections at facilities related to strategic offensive arms, including inspections to verify the numbers of re-entry vehicles on deployed ballistic missiles, inspections to verify elimination of strategic offensive arms and facilities related to them, suspect site inspections, and various exhibitions;

(b) "National technical means of verification: for the purpose of ensuring verification, each side will use national technical means of verification at its disposal in a manner consistent with generally recognised principles of international law. The treaty will include a series of co-operative measures to enhance the effectiveness of national technical means of verification. There will be a ban on interference with such means;

(c) "Ban on denial of telemetric information; the sides agreed to make on-board technical measurements on ICBMs and SLBMS and to broadcast all telemetric information obtained from such measurements. Except for strictly limited exemption, there will be a ban on any practice, including the use of encryption, encapsulation or jamming that denies full access to telemetric information;

(d) "Information exchange: before signature of the treaty the sides will exchange data on the numbers, locations and technical characteristics of their strategic offensive arms. These data will be updated on a regular basis throughout the lifetime of the Treaty;

(e) "A comprehensive agreement on the manner of deployment of mobile, ICBM launchers and their associated missiles and

> appropriate limitations on their movements so as to ensure effective verification of adherence to the numerical limitations provided for in the treaty. In addition, the number of non-deployed ICBMs for mobile launchers will be limited and mobile ICBMs will be subject to identification through the application of unique identifiers, or tags.

"To promote the objectives of the Treaty, the sides will establish the Joint Compliance and Inspection Commission."

Other types of inspections may be developed when new agreements are concluded. For example, manned control posts have long been considered in the context of multilateral conventional arms reductions and they have proven useful for the implementation of cease-fire, disengagement, and other agreements by United Nations peace-keeping forces; provisions for challenge inspections at suspect sites are under consideration in both multilateral and bilateral negotiations; and concepts for zonal inspections have also been advanced.

A valuable supplement to compulsory and intrusive OSIs can be found in voluntarily inviting qualified observers to visit, within a sufficient period of time and with an appropriate degree of intrusiveness, relevant facilities or areas where questions concerning compliance or troubling military activities have taken place. Invitational inspections can also help participating States gain a better understanding of improved verification procedures for existing or new agreements. Prominent examples of such invitations include site visits to chemical weapons-related facilities in the United States and the Soviet Union, and invitations to visit radar facilities in the Soviet Union.

A multilateral system which incorporates several of the aspects described above is the safeguards arrangements carried out by IAEA. Involving co-operative agreements between individual States and IAEA, the collection of data by IAEA, a system of on-site inspections using modern technology and inspectors from many countries, the safeguards system is widely regarded as having been highly successful.

Mutually agreed consultative provisions can provide States with procedures for dealing with ambiguities and uncertainties over compliance that will naturally arise during the implementation process. Consultative provisions can provide a forum for the private exchange of additional data clarifying existing practices bearing on compliance. Consultative bodies can also permit States to devise new common understandings for unforeseen developments or to develop more precise guidelines for permitted activities.

Multilateral procedures for dealing with disputes over non-compliance in a number of past agreements have included seeking the assistance of the Secretary-General, lodging complaints with the Security Council, holding review conferences to consider ways to strengthen existing agreements, and referring unresolved issues to the International Court of Justice. In addition, the South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga) establishes a multilateral consultative committee to which compliance questions relating to the establishment of a nuclear free zone in the South Pacific may be addressed.

Consultative procedures have been developed in considerable detail in bilateral agreements between the Soviet Union and the United States. The Standing Consultative Commission (SCC) was established in the SALT I Interim Agreement and the Anti-Ballistic Missile (ABM) Treaty, with jurisdiction over the Accident Measures Agreement, as well. Subsequently, its jurisdiction was expanded with the Protocol to the ABM Treaty and the unratified SALT II Treaty. A second bilateral consultative body, the Special Verification Commission (SVC), was established to address implementation and compliance questions associated with the 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).

This descriptive survey of verification or verification-related approaches, methods, procedures and techniques is far from exhaustive; new ideas for verification are being generated in ongoing conferences and negotiations and in analyses by governmental and non-governmental experts. In addition, consultative arrangements are being refined, while new monitoring tools, techniques and approaches with multi-purpose applications can provide important lessons for future arms limitation and disarmament agreements. The fact that many choices for securing adequate and effective verification are available to negotiators augurs well for the future. While difficult negotiating problems must be overcome, there is an unprecedented array of monitoring tools and techniques to apply to the tasks at hand.

B. Interaction and Co-ordination

No single verification tool is likely to be sufficient for any accord; adequate and effective verification arrangements will require the synergistic and overlapping application of numerous approaches and devices, such as those described above. For example, questions arising from information gathered by satellites can be addressed by on-site inspections. Continuity is an essential component of successful verification approaches and methods.

The importance of impartial, professional analysis is underscored by the potential costs of misinterpreting data: detection of significant compliance problems may be missed, or a State may be unfairly charged with non-compliance. Luilding up an infrastructure of highly trained professionals to collect and analyse data is just as important as having technical devices in place for those purposes. Therefore, highly trained experts are required to analyse the data properly, it being understood that these experts will provide their services in an impartial way, divorced from personal, national, or political biases.

Together with the verification tools end professional experts required to analyse the data, it is essential to be able to utilize necessary information in a timely manner. For some techniques, such as on-site inspections, this means a requirement for quick access to the area of interest; for some technical devices, such as satellites, this may mean a requirement for multiple platforms.

Adaptability is also an essential component of verification approaches and methods. Devices for verifying compliance can perform more than one monitoring task and they can be utilised for new tasks that are assigned. For example, an optical imaging satellite can be utilised for many different kinds of arms limitation and disarmament agreements as well as for efforts to defusa crises. A satellite having multiple sensors can be more useful than one having a single sensor requiring daylight viewing and minimal cloud cover. The larger the number of capabilities inherent in devices to verify compliance, the more adaptable (and expensive) they will be. Difficult choices are therefore unavoidable between cost and adaptability.

Data exchanges and monitoring efforts by States or organisations that are not parties to existing agreements can have an interactive role with arms limitation and disarmament efforts. Increased transparency that reduces concerns over military activities may encourage new States to enter into arms limitation and disarmament agreements, and co-operative arrangements between States based on consultative procedures can have similar effects. Fact-finding missions undertaken by the Secretary-General are necessarily based on and contribute to information derived from other sources.

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THE ROLE OF THE UNITED NATIONS IN THE FIELD OF VERIFICATION

SUMMARY OF A UNITED NATIONS STUDY (JAN. 1991)

Background

By resolution 43/81B of 7 December 1988, the General Assembly requested the Secretary-General to undertake, with the assistance of a group of qualified governmental experts, an in-depth study of the role of the United Nations in the field of verification and to submit a comprehensive report on the subject to the General Assembly at its forty-fifth session. In accordance with the resolution the study should: (a) identify and review existing activities of the United Nations in the field of verification of arms limitation and disarmament; (b) assess the need for improvements in existing activities as well as explore and identify possible additional activities, taking into account organisational, technical, operational, legal and financial aspects; and (c) provide specific recommendations for future action by the United Nations in this context.

Twenty governmental experts were appointed by the Secretary-General to assist him in carrying out the study. They were from the following States: Argentina, Brazil, Canada, China, Czechoslovakia, France, the German Democratic Republic, Hungary, India, Japan, Kenya, Mexico, the Netherlands, Nigeria, the Soviet Union, Sweden, the United Kingdom, the United States, Yugoslavia and Zaire. The Group held four sessions from February 1989 to July 1990, during the course of which it prepared the study report under the chairmanship of the Canadian participant, the Assistant Deputy Minister for Political and International Security Affairs, Mr. Fred Bild.

In August 1990, the Secretary-General transmitted to the General Assembly the unanimously approved report of the experts. In his foreword to the report, the Secretary-General notes that “there can be no doubt that for participating States in a multilateral arms limitation and disarmament agreement, multilateral verification arrangements will be essential to create and develop mutual confidence in compliance”. The Secretary-General adds that “as an organisation with global membership and a recognised responsibility for the maintenance of international peace and security, it is entirely appropriate that the United Nations should be at the forefront of international efforts regarding such arrangements”.

Highlights of the Report

The report is structured in six chapters and contains a bibliographical appendix on technical aspects of verification. The Introduction provides a brief historical background on the development of the question of verification in the United Nations context, culminating with the adoption by the General Assembly of resolution 43/81B, which requested the study.

Chapters II and III address the definition and functions of verification and the various approaches, methods, procedures and techniques used in the process of verification. Chapters IV and V examine the existing activities of the United Nations in the field of verification, possibilities for improvements in those activities as well as possible additional activities, while addressing the organisational, technical, legal, operational and financial implications of each of the possibilities discussed. Chapter VI presents the conclusions and recommendations of the Group.

The following is a summary of the various issues discussed in the report.

Verification: Definition and Functions

The report describes verification as a process which establishes whether States parties are complying with their obligations under an agreement. It takes place in the context of the sovereign right of States to conclude arms limitation and disarmament agreements and their obligation to implement those agreements.

The process of verification consists of multiple steps which include monitoring/collection of information relevant to obligations under arms limitation and disarmament agreements; analysis of the information; and reaching a judgement as to whether the specific terms of an agreement are being met. These various phases of the verification process are often interactive and it is not always possible to distinguish clearly between them.

Monitoring/data collection is defined as the process of watching, observing or checking objects, activities or events for a specific purpose. Monitoring/data collection and analysis can be undertaken for a wider range of purposes than verification, including, for instance, crisis prevention, peace-keeping and general intelligence gathering. According to the report, verification procedures must be carefully designed to prevent, as far as possible, collection of data unrelated to the purpose of verifying the treaty concerned.

The initial steps in the process of verification are dominated by technical and operational considerations. Technical experts involved in this stage of the process as a rule are not asked and do not seek to make judgements of compliance or non-compliance on the basis of the data they are collecting and analysing. Such judgements are normally within the province of political officials and are rendered only in the final stages of the verification process. Once a determination is made that a violation has been committed, deciding what to do about it (i.e., "enforcement") is not part of the verification process.

"Adequate", "effective" or "appropriate" are the words which, according to the report, are often used to describe the standard of verification considered necessary by States in the context of a given agreement, as there is widespread recognition that no verification regime can uncover every conceivable problem. Therefore, it is essential that verification provisions and monitoring capabilities are designed not only to allow for the detection of violations in time for States parties to take appropriate action, but also to help to prevent cheating from taking place.

Discussing the general framework in which verification provisions could be agreed upon and implemented, the Group of Experts draws attention to the 16 principles of verification developed by the United Nations Disarmament Commission and endorsed by the General Assembly in 1988 as useful guidelines in the negotiation of arms limitation and disarmament agreements.

The study also discusses five specific functions fulfilled by verification which serve to create the necessary confidence for a successful and sustainable process of arms limitation and disarmament. A primary function of verification is *assessing the day-to-day pattern of implementation* of an agreement's provisions. Monitoring capabilities must be sufficiently adequate and effective to provide assurance that nations are faithfully and fully carrying out their obligations. Another function of verification is to *generate confidence*, rather than distrust, within participating States that others are fulfilling their obligations under an agreement. An important element for building confidence is the ability of States parties to collect information relating to an agreement sufficient to assess compliance practices of other States. Ascertaining that verification provisions are not abused or misused for collecting information that has no direct bearing on obligations undertaken by participating States is another important element in building confidence through the process of verification.

Yet another function of verification is to provide procedures for *dealing with uncertainties* and false alarms associated with implementation and compliance since no agreement, regardless of the specificity and intrusiveness of its terms, can anticipate every conceivable eventuality. Agreed verification provisions can also *discourage non-compliance* by raising the financial, opportunity and political costs of non-compliant behaviour. This latter function of verification is very much related to that of providing *timely warning* of potential compliance problems. For instance, intrusive verification measures such as timely access to sensitive military installations can make surreptitious non-compliance more difficult, expensive, time-consuming, or obvious.

Several other relevant aspects of the process of verification are discussed in the study—its bilateral/multilateral dimensions, the legal aspects involved in the process and the question of the treaty-specific nature of verification.

In the view of the experts, adequate and effective verification measures are no less important for multilateral agreements than for bilateral accords. While verification provisions will necessarily be keyed to the specific requirements of an agreement, the growing similarity of verification techniques for multilateral and bilateral agreements could help both kinds of negotiations in the future.

In some respects, verification arrangements at the multilateral level can be even more critical, the report notes, as new complexities can be added in the negotiation of new accords and verification provisions may have to address a broad range of different conditions. Monitoring arrangements of multilateral accords must also effectively bridge the diverse verification capabilities of individual States parties. At the same time, multilateral verification arrangements may offer organisational economies and efficiencies as the number of parties to an agreement grows. Regardless of the type of accord or arrangements which are agreed upon by States parties, the exercise of verification must nevertheless be based on the principles of international law. A fundamental principle is that of respect by each sovereign State for the territorial integrity and political independence of other States. At the same time, when States fulfil constitutional processes to become parties to arms limitation and disarmament agreements, under international law they are obligated to take measures necessary for the proper implementation of provisions negotiated and agreed in good faith.

Verification of arms limitation and disarmament is also agreement-specific, that is, verification procedures and techniques are somewhat different from one agreement to the next, depending on the specific objects and purposes of each accord and the number of parties involved. Furthermore, verification is the responsibility of States parties to such agreements, unless they explicitly consent to the involvement of other States or organisations in the verification process.

Verification Approaches, Methods, Procedures and Techniques

In the study, verification approaches are divided into two main categories—national technical means (NTM) and co-operative measures.

NTM are devices under the control of a State party that can be used for monitoring at a distance compliance with arms limitation and disarmament agreements; thus NTM do not disrupt activities within the State being monitored nor do they require a physical presence within that State. NTM include observation satellites, aircraft-based systems, such as radars and cameras, as well as sea- and ground-based systems. Many States possess another kind of NTM: seismic stations that could be used to provide data concerning underground explosions.

Co-operative measures, on the other hand, could include, but are not limited to, designing weapons systems and their deployment modes in ways that simplify verification; permitting aircraft overflights to observe military-related installations and activities; pre-notifying certain weapons tests to allow other States to monitor them more effectively; conducting joint verification experiments to assist monitoring efforts; arranging for foreign representatives to observe or inspect, with an appropriate degree of intrusiveness and timeliness, installations or activities; and non-interference with NTM. In addition, the provision and exchange of data can be an extremely important co-operative measure: it can build confidence and increase transparency.

Continuity and adaptability are essential components of successful verification approaches and methods, notes the report. First, no single verification tool is likely to be sufficient for any accord; adequate and effective verification arrangements will require the synergistic and overlapping application of numerous approaches and devices. For example, questions arising from information gathered by satellites can be addressed by on-site inspections. Secondly, the same device can perform more than one monitoring task and it can be utilised for new tasks that are assigned. That is the case, for instance, with optical imaging satellites which can be utilised for many different arms limitation and disarmament agreements as well as for efforts to defuse crises.

The study notes that, as monitoring tools, observation satellites, though they have their limitations, provide broad coverage over areas of concern and provide analysts with an important means of detecting, over time, changes on the ground that may be of military significance. Satellite coverage has been particularly useful for monitoring large objects, such as naval combatants, bombers, and most types of strategic weapons launchers as well as military installations. The smaller and more mobile the object, the harder it is to observe from space and the more other methods of coverage become necessary.

The report further notes that disparities in observation capabilities have been a cause of concern for some, especially in the context of multilateral negotiations. This concern, as well as a broader interest in providing the international community with information relating to issues of common security, has led some States to advocate the use of observation satellites as a central component for an international verification mechanism.

Even though NTM have become increasingly sophisticated, the experts point out that co-operative measures have grown in importance for both multilateral and bilateral accords. The complexity of current and prospective negotiations, together with the small size, mobility or dual purpose nature of many of the weapons systems and military capabilities negotiators seek to prohibit, limit or reduce, have progressively demanded co-operative measures.

National systems of accounting for and control of specific materials, such as nuclear, are a special kind of national, co-operative measure in the field of verification. One such example is the national control authorities which co-operate with the International Atomic Energy Agency (IAEA) in the implementation of its safeguards system. Under a future convention on chemical weapons, States parties may be required to designate or establish national authorities to implement treaty obligations.

An example of an intrusive co-operative measure is on-site inspections (OSI). In order to work properly, OSI require close co-operation between the host country and the inspectors. Detailed procedures should be worked out in advance to clarify the rights and obligations of the inspectors as well as of their hosts.

OSI can take many different forms. They can be systematic or *ad hoc.* For example, in the INF Treaty (the Soviet-United States Treaty on the elimination of their intermediate- and shorter-range missiles), five different types of inspections were agreed upon: “baseline inspections” to help verify the initial exchange of data; ”close-out inspections” to confirm that treaty-prohibited activities have ceased; ”elimination inspections” to observe the destruction of treaty-limited items; ”short-notice inspections” without right of refusal at agreed facilities; and “continuous portal monitoring” at selected production facilities. Routine inspections of industrial enterprises are being elaborated in the negotiations taking place regarding a chemical weapons convention.

Existing Activities of the United Nations in Verification

After recalling the various proposals relating to a United Nations role in verification which were submitted by member states to the first (1978) and second (1982) special sessions of the General Assembly devoted to disarmament and other disarmament forums, the study focuses on the four proposals which were presented at the third special session devoted to disarmament, held in 1988. The proposals were submitted, respectively, by the countries represented in the Six-Nation Initiative—Argentina, Greece, India, Mexico, Sweden and the United Republic of Tanzania—and by Canada and the Netherlands, by France, and by Bulgaria, Czechoslovakia and the Soviet Union.

The proposal of the Six-Nation Initiative was a follow-up to an earlier initiative introduced by the six countries in the Stockholm Declaration of January 1988. In a joint working paper, the sponsors called for the special session to endorse the principle of an integrated multilateral verification system within the United Nations and to request the Secretary-General to prepare, with the help of qualified experts, an outline of such a system.

The proposal by Canada and the Netherlands focused on the constructive role which the United Nations could play in multilateral verification by functioning as an information clearing-house and providing assistance and expertise in the area of verification. In that connection, an in-depth United Nations study was proposed to help the development of an appropriate role for the Organisation in verification.

France's paper proposed, among other things, the establishment of a group of experts to study the relationship between verification and security, prepare an inventory of verification methods, techniques and procedures and reflect on the future role of the United Nations in the field of verification. At the time, France indicated its readiness to combine this proposal with that made by Canada and the Netherlands. The establishment, within the United Nations, of an agency for the processing and interpretation of space images was also proposed in the French paper.

Bulgaria, Czechoslovakia and the Soviet Union called for the consideration of the establishment, under the auspices of the United Nations, of a mechanism for wide-ranging international verification of compliance with agreements aimed at reducing international tension and limiting armaments, and for monitoring the military situation in regions of conflict.

A decision by the General Assembly on the subject of verification and the United Nations was taken only later that year, during the forty-third regular session of the Assembly, when resolution 43/81B was adopted. The resolution was in reality a composite text, the result of delicate and extensive negotiations between the countries represented in the Six-Nation Initiative, on the one hand, and Canada, France and the Netherlands, on the other, following the respective submissions by the two groups of States of separate draft resolutions on verification at the multilateral level.

As regards verification provisions which involve the United Nations under existing agreements, the Group observes that there is a number of arms limitation and disarmament agreements, as well as some disarmament-related agreements, which include provisions referring to the United Nations or the Secretary-General, to specialised agencies, or to the International Court of Justice. In most cases, those provisions relate to a monitoring or co-operative role, as through certain types of exchange of information, and to the settlement of disputes regarding the interpretation or application of a given treaty. These provisions do not involve, however, the actual rendering of compliance judgements and have for the most part not been activated. A table outlining the respective multilateral agreements and their provisions is contained in pages 46-48 of the report for detailed reference.

In the subsequent paragraphs of the report, the experts discuss the exchange of information which has been carried out by States parties to the biological weapons Convention since 1987 through the Secretary-General. Under the exchange, which was called for at the Second Review Conference of the Convention, States parties provide data on research centres and laboratories involved in permitted biological activities directly related to the Convention and on all outbreaks of infectious diseases and similar occurrences to the Secretary-General. In turn, he circulates the information among the parties to the Convention.

The study also describes the safeguards system of the International Atomic Energy Agency, which is authorised under its Statute "to establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities and information made available... are not used in such a way as to further any military purpose". The Secretary-General's investigative role in connection with the alleged use of chemical weapons is also broadly discussed. As pointed out in the report, the 1925 Geneva Protocol contains no specific provisions regarding verification arrangements. Nevertheless, allegations of use of chemical warfare, from time to time, led the General Assembly to adopt, for the first time in 1980, a resolution calling upon the Secretary-General to carry out an investigation of such allegations with the assistance of qualified medical and technical experts. Further requests were made to the Secretary-General, both by the General Assembly and the Security Council, for additional fact-finding missions as well as for criteria and procedures to facilitate his role.

Other activities are described which, though not considered verification tools for arms limitation and disarmament agreements in and of themselves, are nevertheless regarded as relevant to the process as a whole. One such activity is the standardised instrument for international reporting of military expenditures. The instrument has been developed by the United Nations as part of a broad effort to develop a set of specific measures that would facilitate the reduction of military expenditures while contributing, at the same time, to openness of information and confidence. Since 1981, an increasing number of member states have provided the Secretary-General with information on their military expenditures by using the standardised reporting instrument.

Another activity discussed in the report in this context is the work of the *Ad Hoc* Group of Scientific Experts to Consider International Co-operative Measures to Detect and Identity Seismic Events. Established in 1976 by the Conference of the Committee on Disarmament (CCD), the *Ad Hoc* Group has been working on the development of a global seismic data exchange system aimed at expeditiously providing comprehensive information on seismic events, collected on a global basis and processed according to agreed procedures. In this connection, the report adds that, although some States have a different position on a comprehensive nuclear- test ban, it is widely considered that a modern international seismic data exchange system could contribute to verification of compliance with a possible future nuclear-test-ban treaty by its States parties.

The study report further cites the peace-keeping operations of the United Nations which, as monitoring tools, are in a very real sense multilateral co-operative measures — they require the co-operation of the parties concerned and the continuing support of the States contributing troops and the Security Council.

Activities of the Department for Disarmament Affairs and the United Nations Institute for Disarmament Research (UNIDIR) relevant to verification are also reviewed.

Improvements in Existing Activities and Possible Additional Activities

According to the study, a point of departure for assessing the need for United Nations involvement in the verification of arms limitation and disarmament agreements should be the fact that it is universally recognised that such agreements should be adequately and effectively verified and that all States have equal rights to participate in the process of international verification of agreements to which they are parties. In addition, as no other international organisation with comparable status and universal coverage exists in this field, it is appropriate, says the Group, to explore possible contributions that the United Nations might make to the universal and non-discriminatory application of available means of verification.

Noting that the list of possibilities examined is not exhaustive, the report provides a descriptive survey of proposals where, according to the experts, the organisational, technical, operational, legal and financial aspects can be readily assessed, and where short-, medium-, and long-term implications can be considered carefully. The proposals discussed by the experts cover six areas: (1) United Nations capability for data collection; (2) promotion of exchanges between experts and diplomats; (3) possible expansion of the Secretary-General's fact-finding activities;

(4) possible uses of aircraft for verification purposes; (5) possible uses of satellites; and (6) possible creation of an international verification system. The study further notes that cost estimates for these proposals will vary as they depend on the tasks at hand, the specific configuration of the equipment employed and the manner of its use. Thus, the estimates presented in the study are only illustrative of the magnitudes of the sums involved.

Conclusions and Recommendations

After a brief summary of the findings, the study presents conclusions and recommendations in connection with the six areas of activities discussed in chapter V of the report, as follows:

A. Data Collection Capability

The study suggests that, in the short term, in anticipating further advances in the field of treaty-specific verification, the United Nations can play a useful role in making research and data relating to co-operative arrangements and verification available to wider audiences. A United Nations data collection capability could assist governmental experts and negotiators on verification provisions and confidence- and security-building measures. This impartial and non-discriminatory capability would facilitate their work and help to lay the foundation for their eventual involvement in future negotiations or existing multilateral agreements. Such United Nations services should not entail significant new expenditures or the creation of new bodies. Voluntary contributions, on an objective and non-discriminatory basis, can be made by member states; these could include bibliographies and existing published materials by member states, including the provision of rosters of experts and organisations to whom questions could be addressed and with whom verification research projects could be discussed.

The study recommends that the United Nations, through the Department for Disarmament Affairs, develop a consolidated data bank of published materials and data provided on a voluntary basis by member states on all aspects of verification and compliance. The data bank might include, *inter alia:* the history of negotiations and treaty compliance; procedures for verification and monitoring; information on techniques and instrumentation for verification and monitoring; lists of contacts and experts on verification and addresses of institutions, organisations, companies and individuals which can provide expertise, technologies, advice on aspects of verification, bibliographic information and data—including data connected with the biological weapons Convention and the future chemical weapons convention.

The study also recommends that the United Nations should make the data easily accessible to all member states by regularly publishing the lists and additions in the data bank. For instance, *The United Nations Disarmament Yearbook* could cover, by way of dedicated chapters, the range of data, in particular new developments, held in the data bank. Special reports, with a wide circulation, could be prepared as a result of data collected by the United Nations. Particular emphasis might be given to the use of computers for data storage and retrieval, on-line data access, devices for mass data storage and interfacing with relevant data bases to which member states provide access.

The study further recommends that the United Nations should take an active part in facilitating the operational international exchange of data contributing to treaty verification upon request of States parties and to confidence-building.

In this context, the study discusses whether such an exchange could include the collection, compilation and distribution of data obtained by a variety of means such as may be appropriate to the requirements of a future treaty or treaties. Included among the issues discussed were seismological and radiological measurements, overhead imagery obtained from satellites and aircraft, and the proposed agency for the processing of satellite images (APSI). The Group of Experts did not pass definitive judgement on these issues, as it felt that decisions on them should be left to the appropriate multilateral forums.

B. Exchanges between Experts and Diplomats

The study further suggests that, in the short term, in anticipation of further advances in the field of treaty-specific verification and new agreements increasing confidence and transparency between States, the United Nations can play a constructive role in promoting exchanges between experts and diplomats to help the latter to address negotiating problems, and to help experts focus on needed solutions. Such exchanges can contribute to the creation of general overall awareness of verification issues, enabling States to have a fuller appreciation of the role of verification in alleviating their security concerns. The States may thus also reach a better appreciation of difficult verification problems and of the appropriate monitoring methods for their solution. The exchanges could also promote international co-operation in the development of verification procedures and technology. Responsibility for carrying out a wider exchange programme could be assumed by the Department for Disarmament Affairs. In this regard, the Department could seek co-operation with national institutions as well as international non-governmental organisations and scientific research institutes such as the Pugwash Conferences on Science and World Affairs and the Stockholm International Peace Research Institute (SIPRI).

The study recommends that the United Nations, through the Department for Disarmament Affairs and, when appropriate, in co-operation with UNIDIR, promote workshops, seminars and training programmes on verification and compliance. In addition, it would be useful for the United Nations Disarmament Fellowship, Training and Advisory Services Programme to give increased attention to the subject of verification and compliance.

The study further recommends that the United Nations explore ways to provide expert advice to States, at their request, to establish and implement verification structures, thereby increasing their effective participation in agreements.

The study proposes further that the United Nations, through UNIDIR, increase its support to ongoing multilateral negotiations by undertaking specific research on verification topics, responsive to the needs of those negotiations. UNIDIR could, for example, undertake research tasks that address specified problems encountered during the negotiations. UNIDIR could also continue to commission research into new verification technologies, methods and procedures as well as legal aspects of verification and compliance.

C. The Role of the Secretary-General in Fact-Finding and Other Activities

The study suggests that the experience gained from the Secretary-General's fact-finding activities could be helpful in connection with certain arms limitation and disarmament, agreements that lack explicit verification provisions. The study reflects the view that, in the short term, the Secretary-General's capabilities may be further strengthened and broadened, provided he is granted a mandate to do so. Such enhancement could be achieved either by broadening the scope of the Secretary-General's capabilities or by expanding the means through which the existing mandate is carried out. For example, the Secretary-General's fact-finding mandate could be extended to cover the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects. Proper care must be taken to ensure that whatever organisational arrangements are agreed upon, they should not hinder the Secretary-General's flexibility to conduct fact-finding missions in a manner most appropriate to the circumstances at hand. The determination of what actions the Secretary-General may undertake to strengthen his fact-finding capabilities will be dependent upon the mandate he is given and must be made on a case-by-case basis.

In addition, the complementary role played by bilateral and multilateral arms limitation and disarmament efforts can be further strengthened through the United Nations. To this end, the study recommends that States parties to future multilateral arms limitation and disarmament agreements should consider depositing those instruments with the Secretary-General of the United Nations, as is the case, for instance, of the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies. In this connection, States parties should also consider providing to the Secretary-General and the General Assembly periodic reports regarding the implementation of those agreements for subsequent dissemination to all member states. As has been the case in several multilateral agreements, review conferences could also be organised with the assistance of the United Nations.

D. Use of Aircraft for Verification Purposes

The possible use of aircraft by the United Nations as a verification tool is also discussed. Such United Nations use of aircraft would of course require the consent and support of States parties to the agreements concerned. Where existing agreements lack thorough verification procedures, aircraft could be used in conjunction with fact-finding missions on the ground. Where established verification procedures already exist, the use of aircraft by the United Nations would require careful co-ordination. The use of aircraft for verification purposes by the United Nations would have significant organisational and financial implications which would require appropriate governmental approval and support. The question of processing the data acquired through the use of aircraft must also be properly addressed. Costs might be reduced if member states were prepared to donate the use of specialised aircraft for verification purposes on a temporary basis as required. The Group did not pass definitive judgement on this issue.

E. Use of Satellites

Noting that the use of satellites has played a key role in verifying arms limitation and disarmament agreements and is likely to have continued relevance for the future, the study further discusses the development and launching of a United Nations satellite network for arms limitation and disarmament verification. Such a network would involve not merely providing the necessary satellite hardware but also major investments in acquiring relevant expertise and an image analysis capability. These undertakings would have very great organisational and financial implications. Because of the lead-time required to design, develop and build such a network, the use of its own satellites by the United Nations for arms limitation and disarmament verification appears unlikely, at least in the short term, unless donations in kind are made by member states. However, a first step in that direction could be the decision to organize, within the existing architecture, a "clearing house" for data gathered from existing satellites, where training would also be offered in the field of basic photo-interpretation. The Group of Experts did not pass definitive judgement on this issue.

F. Towards an International Verification System

The study further addresses the issue of an international verification system. The same basic reasons which have led to a multilateral approach to certain arms limitation and disarmament questions also raise the issue of a multilateral framework to ensure the verification of resulting disarmament agreements. Many nations do not have the means to perform the full range of tasks nor do they have access to the necessary expertise.

It is suggested in the study that the development of a United Nations verification system will depend in large measure on further changes in the political environment and on the verification requirements emerging from continued advances in arms limitation and disarmament agreements. Moreover, the development of appropriate multi-purpose verification techniques would greatly facilitate this process. The development of a United Nations verification organisation must be seen as an evolutionary process. There are several possible ways in which an international verification system could come into existence, one of which might be as an "umbrella" verification organisation resulting from the co-ordination or merging of two or more future verification systems. The Group of Experts did not pass definitive judgement on this issue; however, it recognises that the subject will continue to be considered in the light of future developments.

The report concludes by stating that the present international situation provides the right environment to engender a dynamic multilateralism. Indeed, the present situation and the complexity of the problems faced by the international community suggest the need to develop a system which can cope with the problems of security and disarmament in a multilateral framework. The United Nations is unique in its global scope, its membership and its Charter. The role played by the United Nations in the recent past in addressing crisis situations is a sign that it is likely to be called upon in the coming years to deal with a number of such situations. With the prospect of greater attention being given to achieving multilateral agreements on arms limitation and disarmament, an enhanced United Nations capability to assist in verification, with the consent of all States parties to such agreements, could be a significant contribution to international security and co-operation.

Decision of the General Assembly, 1990

On 4 December 1990, the General Assembly adopted without a vote resolution 45/65. Among the provisions of the resolution, the General Assembly recognised that the United Nations, in accordance with its role and responsibilities established under the Charter, can make a significant contribution in the field of verification, in particular of multilateral agreements; affirmed its support for the 16 principles of verification drawn up by the Disarmament Commission; and noted that recent developments in international relations have underscored the importance of effective verification of existing and future arms limitation and disarmament agreements. The General Assembly also welcomed the report and requested the Secretary-General to give it the widest possible circulation and to take appropriate action within available resources on the recommendations of the Group. Furthermore, the Assembly encouraged member states to give active consideration to the recommendations contained in the concluding chapter and to assist the Secretary-General in their implementation where appropriate.

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VERIFICATION PROBLEMS: THE EXPERIENCE OF BILATERAL NEGOTIATIONS

Ever since disarmament problems began to be actively discussed in the late 1950s, verification issues have occupied as important a place as arms limitation itself. They have in any case largely determined the framework for the discussion of arms limitation. It is now widely accepted that without effective verification no serious steps can be taken towards safeguarding international security, strengthening strategic stability and curtailing the arms race.

The bitter, often ideological, quarrels over the problem of verification in the 1950s to 1970s and the early 1980s have been replaced by a business-like partnership among States. In fact, a kind of contest is going on between the Soviet Union and the United States as to who will take or demand the most far-reaching verification measures. As far as the conceptual development of the question of multilateral verification is concerned, the Soviet Union presented to the General Assembly of the United Nations, at its third special session devoted to disarmament, the idea of establishing under United Nations auspices a mechanism for wide-ranging international verification of compliance with agreements aimed at reducing international tension and limiting armaments and for monitoring the military situation in regions of conflict, and proposed that consideration be given to the idea of eventually instituting an international verification agency.

As the many verification regimes provided for in recent agreements and treaties are implemented, it is becoming clear that if we are to make the transition from verification as a political and propaganda slogan to verification as a genuine process, we must consider the complex realities of today's world. Verification cannot be total: it must allow for the need to limit intrusiveness and to ensure that verified facilities are able to go on functioning normally. This does not, of course, mean reviving the idea of limiting the scope of verification measures or establishing some sort of closed areas. Treaty verification must clearly be adequate.

A number of considerations have arisen from the development and implementation of measures to verify bilateral arms limitation and disarmament agreements in the last five years. Soviet-United States bilateral efforts in the area of verification have become a kind of laboratory for measures to verify future comprehensive multilateral agreements. Without question, the first and, so far, most important contribution to solving verification problems was made by the Treaty between the USSR and the United States on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (the INF Treaty), the first agreement in history to eliminate an entire class of Soviet and United States nuclear arms.

The signing of the INF Treaty demonstrated that with political will even the most complex verification issues can be resolved. Under the Treaty, 117 facilities in Soviet territory and 72 facilities in United States territory are subject to inspection. In the territory of the USSR and its allies, up to 300 inspections of the elimination of INF weapons will be carried out within three years and, in all, some 420 inspections over a period of 13 years. In the territory of the United States and its allies, around 100 and 250 inspections respectively will be carried out.

The verification regime under the treaty can be divided into two categories of measures: notification and inspection. What makes the INF Treaty special is its clearly developed system of on-site inspections both in the territory of the USSR and the United States and in the territories of Soviet and United States basing countries.

The main components of this system are the following:

1. Inspections to verify baseline data, which are carried out in all missile operating bases and missile support facilities referred to in the treaty;
2. Inspections to verify the elimination of missile operating bases and missile support facilities;
3. Inspections, on a quota basis, of active and eliminated missile operating bases and missile support facilities;
4. Inspections through permanent monitoring that weapons limited by the INF Treaty are not being produced in production facilities specified in the treaty;

5. Inspections of the elimination process at locations referred to in the treaty;
6. Inspections to determine that the process of eliminating weapons limited by the treaty is complete.

In order to verify compliance with the provisions of the Treaty, each side uses the national technical means of verification at its disposal while undertaking not to interfere with the other side's national technical means. Both Soviet and United States specialists emphasize that the INF Treaty is being implemented carefully and that any questions that arise are being settled within the Special Verification Commission established by the treaty.

The INF Treaty and the Memorandum of Understanding on the application of the Treaty's verification provisions can serve as a model for the solution of verification problems in future disarmament agreements.

Work is proceeding on the protocol on inspection under the Soviet-United States Agreement of 1 June 1990 on Destruction and Non-Production of Chemical Weapons and on Measures to Facilitate the Multilateral Convention on Banning Chemical Weapons. Most of its provisions have now been drafted.

A number of the verification mechanisms provided for in the INF Treaty have been included in the substance of the Soviet-United States treaty on the reduction and limitation of strategic offensive arms (START treaty).

Building on the INF Treaty, the two sides agreed, in the course of the Washington and Moscow summit meetings, to a number of measures for verifying compliance with the future START treaty, in particular exchanges of baseline data; inspections of baseline data; on-site observation of the elimination of strategic arms; continuous on-site monitoring of the perimeter and portals of major production facilities; short-notice on-site inspections of deployment areas in the process of reducing remaining weapons, deployment areas where such weapons have been stored and presumed areas of secret deployment, production, storage or repair; a ban on the use of covert or other measures to interfere with verification; procedures for verifying the number of warheads on deployed ballistic missiles of each different type, including on-site inspections; and more extensive monitoring, with the assistance of national technical means, of the reduction and limitation of strategic offensive arms. To help achieve the goals of the treaty, the two sides agreed to set up a joint compliance and inspection commission. They also began an exchange of data on their strategic forces.

The Soviet Union responded positively to the June 1989 initiative by United States President George Bush concerning verification and stability and measures in the field of strategic offensive arms, in the belief that such measures might contribute to confidence-building. At the September 1989 meeting between the United States Secretary of State and the Soviet Foreign Minister in Wyoming, an agreement encouraging the development of such measures and outlining the principles for implementing them was signed which envisages, in particular, the development of procedures for verifying the number of warheads on deployed intercontinental ballistic missiles of each specific type, including on-site inspections. On the basis of this document, the corresponding procedures are being worked out at the Geneva negotiations on nuclear and space arms. The two countries tested a procedure for verifying the number of declared warheads in the course of trial inspections at each other's military bases in 1990.

One major problem is verification of long-range nuclear sea-launched cruise missiles (SLCMs). Although the two countries agreed that this type of strategic weapon would not be constrained by the treaty on strategic offensive arms, they will provide each other with unilateral declarations of their policy concerning nuclear SLCMs and annually, for the duration of the Treaty, with politically binding unilateral declarations regarding their planned deployments of such weapons—that is, those with a range in excess of 600 kilometres—provided that the number declared does not exceed 880.

The development of on-site verification methods with the assistance of gamma-spectrometry equipment is also of definite interest.

Despite the complexities of bringing the Soviet and United States positions closer together on another major problem of their strategic relations, namely compliance with the ABM Treaty and prevention of the stationing of weapons in space, it is possible to find areas of agreement, among them verification measures, confidence-building and predictability. This offers an opportunity to expand areas of agreement and to do substantive work. The Soviet Union is in favour of developing, in the course of negotiations, a set of measures for building confidence and ensuring predictability, which would help increase the two countries' confidence that the obligations they assumed under the ABM Treaty are being strictly fulfilled. Contrary to the United States position that such measures must be aimed at facilitating a joint transition to a regime that is more heavily reliant on defence, the Soviet Union sees such an approach as contradicting the ABM Treaty and as liable to destroy strategic stability and undermine security.

Clearly, the American proposal for an independent agreement about predictability measures which would be separate from a draft treaty on defence and space—earlier the United States had insisted that predictability measures were an integral part of such a treaty—is in the nature of a tactical manoeuvre. Its goal seems to be to highlight dialogue with the Soviet Union on space questions and to create the impression that the Soviet Union is about to reach agreement with the United States position on a joint transition. In addition, of course, work must be continued on the establishment of a verification mechanism and of confidence-building measures for future agreements relating to the ABM Treaty and outer space. Of specific interest in this connection are the visits by a group of Soviet experts, at the invitation of the United States, to laboratories in Los Alamos and San Juan Capistrano and by American experts to the Soviet test site at Sary-Shagan.

Some sort of conceptual foundation for effective ways of preventing an arms race in outer space, *inter alia* through bilateral negotiations and including, of course, verification questions, could also be laid at the multilateral level. This could be done for example in the Conference on Disarmament, where increasing support is being given to the idea of working out, as a first step, measures to build confidence and increase openness in space activity, especially in the context of the Soviet concept of "open space" and the interesting proposals of the Federal Republic of Germany, France, Australia, Canada, Sweden and other countries.

The USSR and Canada are currently working on a project for the development of a joint experiment which would explore the possibility of monitoring the non-emplacement of weapons in outer space.

A nuclear test ban continues to be the major focus of efforts to bring about the step-by-step elimination of nuclear weapons and complete disarmament. The Soviet Union is the consistent advocate of a multilateral treaty on the complete and general prohibition of nuclear tests. For example, it will be recalled that a draft treaty on the subject was introduced in 1975 in the United Nations General Assembly.

In continuation of the efforts made at the end of the 1950s and the beginning of the 1960s, practical work was carried out at the tripartite negotiations between the Soviet Union, the United States and the United Kingdom at Geneva in the years 1977 to 1980.

The course of the negotiations convincingly demonstrated that verification is not an obstacle in the way of a complete ban on nuclear testing, which depends purely on the necessary political will. This is borne out both by the history of the negotiations and by the conclusions of experts.

When the negotiations were broken off by the United States in November 1980, the problem was taken up by the Geneva Conference on Disarmament, which established, in April 1982, an *ad hoc* working group with a view to considering questions relating to the treaty on the complete prohibition of nuclear testing, including the question of verification. On 1 October 1982, the Soviet Union submitted for the consideration of the General Assembly at its thirty-seventh session the basic provisions of a treaty on the complete and general prohibition of nuclear weapon tests, which contained some new proposals on, *inter alia,* verification.

In 1987, the Soviet Union and a number of other Eastern European States submitted to the Conference on Disarmament a document entitled "Basic provisions of a treaty on the complete and general prohibition of nuclear weapon tests", which synthesised the contributions of many States with respect to the pressing problem of disarmament.

Since, despite a number of unilateral moratoriums by the Soviet Union, the United States and other nuclear Powers were persistently moving away from the idea of an immediate ban on nuclear testing, the step-by-step approach agreed in 1986 at the meeting of the United States and Soviet leaders at Reykjavik was the most conducive to progress towards the ultimate goal of the complete cessation of testing.

The year 1987 saw the adoption of the joint Soviet-United States statement on the initiation, prior to 1 December 1987, of full-scale negotiations regarding this question. The step-by-step approach demonstrated its effectiveness. Because of that decision, the most significant practical progress to date was made with respect to nuclear testing. As a result of complex bilateral negotiations, the two countries were able to agree on verification Protocols to the 1974 Treaty on the Limitation of Underground Nuclear Weapon Tests and the 1976 Treaty on Underground Nuclear Explosions for Peaceful Purposes, thereby establishing an effective system for monitoring the aforementioned agreements of the 1970s.

In the course of the negotiations, the two countries worked out in principle new verification methods. The Protocols set forth an effective triad for the verification of the threshold limitation of tests, combining hydrodynamic and seismic methods for measuring explosive yield with on-site inspection.

From a technical standpoint, these methods can, of course, be criticised on account of their high cost and complexity. At the same time, the combination of technology has, in our opinion, proved successful since, for the first time, it allows the limitation of nuclear testing to be monitored with a high degree of reliability.

According to the hydrodynamic method, explosive yield is calculated on the basis of direct measurements of the characteristics of the shock wave generated by the underground explosion, such measurements to be taken in a special drill-hole, shaft or tunnel situated in immediate proximity to the explosive device. According to the seismic method, the verifying party has the right to carry out independent measurements at three seismic stations specially selected for the purpose in the territory of the party being verified and, if it so wishes, may also obtain the requisite data from other seismic stations belonging to the latter party.

As a result of the negotiations, a new interpretation has been given to traditional methods, such as the seismic means of verification.

For the first time, it is possible to speak of the improvement of international verification procedures. As is known, the experts consider that nuclear explosions with a yield of more than 1 or 2 kilotons carried out in rocky ground can be distinguished with a reasonable degree of reliability from earthquakes. With a view to monitoring compliance with the 1976 Treaty on Underground Nuclear Explosions for Peaceful Purposes, the verifying party is entitled, in the case of a group explosion whose planned aggregate yield exceeds 150 kilotons, to use the local seismic network, in addition to the hydrodynamic method of measuring yield and on-site inspection, in order to verify the number of explosions in the group.

A new form of verification under the partial Test-Ban Treaty is the use of on-site inspection for any test by the other Party with a yield of over 35 kilotons. The United States ultimately recognised the effectiveness of this method. In carrying out on-site inspection, the personnel of the verifying party have the right to make a detailed investigation, with the use of equipment if desired, of the emplacement hole and to obtain rock samples therefrom. This enables the verifying party to have a clear picture of the conditions in which the explosion was conducted, to dispel suspicion concerning possible ways of distorting the true explosive yield, for example by what is known as decoupling (that is, carrying out the explosion in a large underground cavity), and to obtain all the necessary data for an objective estimation of the explosive yield measured by its national seismic monitoring facilities.

What is important is the exchange of geological data and rock samples, since these can help to determine the explosive yield, allowance being made for the characteristics of the ground in the area of the site.

In addition, inspections provide the assurance that nothing is being done to distort the real magnitude of an explosion. As regards the implementation of the 1974 Treaty and its Protocol, the latter provides for the establishment, immediately after the Treaty's entry into force, of a bilateral consultative body which would resolve specific questions connected with the practical implementation of verification measures provided for in the Protocol.

A positive feature of the bilateral negotiations which deserves mention is the *rapprochement* of the two countries with respect to the potential of the hydrodynamic method, earlier dismissed by the United States, and the seismic method, the effectiveness of which it had repudiated.

In the course of the joint verification experiment (JVE) in August 1988 in Nevada and in September at the Semipalatinsk test site, the two countries successfully tested their verification methods and were convinced of the need to combine them for the effective avoidance of a possible violation of the treaty. The results of the experiment were largely responsible, in the final analysis, for the adoption of the two methods. Under the agreement reached by the two countries, the Protocols to the 1974 and 1976 Treaties open up the way for the next stage of the negotiations. The Soviet Union and the United States will begin to consider further limitations on nuclear testing, thereby moving closer to the ultimate goal of the complete cessation of all nuclear tests, as part of the effective process of disarmament.

The verification system provided for in the Treaties, namely, the use of the network of seismic stations and on-site inspection, provides a solid technological base which will also be useful in devising a verification regime for the future treaty on the general and complete cessation of nuclear tests.

A UNITED STATES PERSPECTIVE ON BILATERAL VERIFICATION

The Verification Function

Verification is a process which establishes whether the States parties are complying with their obligations under an agreement. With respect to bilateral arms control agreements, verification is necessarily a unilateral process; that is, one party to the agreement seeks to ensure that the other party is complying with the provisions of that agreement.

United States policy requires that arms control agreements be effectively verifiable. Effective verification has three components—deterrence, detection and assurance. First, beyond the weight of legal obligation to comply, we seek to deter the other party from violating an agreement by persuading it that if it commits a violation it will get caught. Verification helps deter violations by increasing the risk of detection and by complicating any scheme of evasion to the point where it becomes impractical. An essential element of deterrence is the knowledge that detection of a violation will entail some concrete response—a penalty that outweighs the benefits of the potential violation.

The second component of verification is detection. The monitoring processes that support verification are designed to detect violations of an agreement, and hence to furnish, to the extent possible, timely warning of emerging threats to a nation's security arising from a violation of a treaty. Even so-called "minor" or "technical" violations could be of concern, inasmuch as they could represent the initial stages of large-scale cheating or be part of an effort to probe the other side's monitoring capabilities for deficiencies. Accordingly, United States policy requires effective verification and strict compliance with the provisions of an arms control agreement.

The third component of verification is assurance. Verification seeks to provide an assurance that an arms control agreement is being complied with. In this manner, it seeks to build confidence in the validity of the agreement and in the reliability of the other party to the agreement. Violations of the agreement rapidly erode this confidence.

Arms control agreements that are not effectively verifiable and not complied with can be more detrimental than beneficial to national security. Depending upon their nature, undetected violations could pose a serious threat to national security. Even the suspicion of a violation— based on ambiguous evidence—could breed distrust and undermine the benefits of an arms control agreement.

Determining Verifiability

Verification is a two-stage process. The first stage involves a legal and technical assessment of the degree to which a proposed arms control agreement, or a particular provision of such an agreement, can be verified. This assessment must measure present and anticipated future monitoring capabilities against the specific actions to be limited by the agreement or provision. It must consider credible "cheating scenarios", and take into account the standards of evidence required to make a determination of non-compliance.

The second stage addresses the question whether the postulated verification scheme for an arms control agreement is effective. This assessment is based upon the limitations specified in the agreement and the available verification monitoring capabilities. It is both an analytical effort—focused on such factors as the extent to which the provisions of an arms control agreement raise the potential risks of cheating—and a political evaluation—concerned with the past compliance record of the other party and the impact of potential non-compliance on national security and foreign-policy objectives.

Bilateral Verification

Most arms control agreements have been "bilateral", with verification based on one country's use of its own resources to verify the other signatory's compliance. "Multinational" and "international" verification are fairly specialised in application—the newly concluded Treaty on Conventional Armed Forces in Europe is illustrative of the former, while the work of the International Atomic Energy Agency (IAEA) inspectorate is representative of the latter. Bilateral verification consists of one country's capacities and efforts to monitor another party's compliance with the provisions of an arms control agreement. Verification of arms control agreements involves the use of both national means and negotiated measures.

National means of verification include all monitoring capabilities available to the verifying party. In recent years, this term has come to imply the technical collection assets known as national technical means (NTM). These include photographic, radar and electronic surveillance systems, as well as seismic instrumentation and atmospheric sampling capabilities (this last to detect radioactive particles from nuclear explosions). These national technical means systems are exclusively under national control. Their operation does not depend upon the co-operation of the other party to the agreement.

The term "national technical means" was first coined in the United States-Soviet Strategic Arms Limitation Talks (SALT) in the early 1970s. Both the Treaty on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty) and the SALT I Interim Agreement on Strategic Offensive Arms specify that

> "For the purpose of providing assurance of compliance with the provisions . . . each Party shall use national technical means of verification at its disposal in a manner consistent with generally recognised principles of international law" (article XII of the ABM Treaty, article V of the Interim Agreement).

In order to enhance the effectiveness of national technical means, the parties to arms control agreements have negotiated measures banning interference with the operation of these systems, and prohibiting the deliberate use of concealment measures intended to defeat monitoring by national technical means. More recently, arms control agreements have included provisions requiring active co-operation with national technical means. An example of such a "co-operative measure" is the provision in the 1988 Treaty between the United States and the Soviet Union on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (the INF Treaty) requiring that roofs of fixed structures for missile launchers at select mobile intercontinental ballistic missile bases be left open for a given period of time while the actual missiles and their launchers are displayed in the open. The clearly stated purpose of this requirement is "to enhance observation by national technical means" (article XII).

The other principal negotiated measure employed in bilateral verification is on-site inspection, which provides the verifying party with direct access to the facilities and treaty-limited equipment of the other side. It can provide information in great detail, but is limited in space and time to the specific facility and occasion of the actual inspection. Nevertheless, on-site inspection can be a very useful complement to national technical means. It can be used to establish an accurate count of treaty-limited equipment, directly monitor the elimination of treaty-limited equipment as may be required by an agreement, and deter violations at known, agreed locations. More generally, it can provide an overview of whether the holdings at a given site are consistent with what is known of the other side's force structure.

Multilateral and International Verification

Technical collection systems could conceivably be jointly owned and operated by two or more States, becoming, in effect, "multilateral technical means". Likewise, an international body could be established to operate or coordinate the use of technical monitoring systems on behalf of the international community as a whole, such as, for example, the international satellite monitoring agency (ISMA) concept proposed by France in 1978. As originally proposed, ISMA was to be responsible for collecting, processing and disseminating information obtained by Earth observation satellites. Its mandate was to include fact-finding and verification. On-site inspection is also possible in both the multilateral and the international context. Inspection teams could be composed of persons from more than one country, and the information collected on the inspection could be shared equally among the participants. Alternatively, inspection teams could be wholly national in composition, but the results of the inspection could still be shared with other parties. Currently under consideration in NATO are plans to co-ordinate inspections and share information under the regime established in the Treaty on Conventional Armed Forces in Europe. An international inspectorate made up of "international civil servants" already exists under the auspices of IAEA. They perform inspections at more than 600 nuclear facilities world-wide to determine whether nuclear material has been diverted from peaceful uses.

The fundamental difference between multilateral and international verification on the one hand, and bilateral verification on the other, is the degree of national control. The former necessitates reliance on monitoring means that in whole or in part are not under the exclusive control of any one verifying party. Bilateral verification is a wholly national undertaking.

The United States Experience with Bilateral Verification

The ABM Treaty

Two major elements of the ABM Treaty verification regime are particularly relevant to this discussion. The first is that verification of this Treaty is dependent entirely upon national means. These have proved adequate to the task, and have, for example, provided the United States with sufficient information to make a determination that Soviet construction of a large phased array radar near Krasnoyarsk was a significant violation of the Treaty. The Soviet Union admitted this violation, and has agreed to dismantle the radar completely. This Soviet admission was the direct result of United States verification efforts, strenuous objections to the violation, and repeated demands for corrective action. It clearly illustrates the importance and propriety of the United States policy that arms control agreements must be strictly complied with.

A second element of the ABM Treaty verification regime to be noted was the creation of the Standing Consultative Commission. Article

XIII of the Treaty specified that a joint United States-Soviet commission should be established to "consider questions concerning compliance with the obligations assumed", and to consider possible measures for "further increasing the viability" of the Treaty. Each Government is represented by a commissioner, a deputy commissioner, and other staff as required. The Commission meets at least twice a year. The first session was held in 1973, and forty sessions have been convened since then. The Commission provides a forum in which questions may be raised about activities that could be at variance with provisions of the treaty. It can also be used to clarify ambiguous situations and, potentially, to induce corrective actions with respect to activities that are not in compliance with the agreement. Notwithstanding this useful function, the Commission remains a consultative body rather than an enforcement mechanism. It cannot, by and of itself, compel compliance.

The INF Treaty

As with the ABM Treaty, the INF Treaty verification regime includes a bilateral consultative mechanism—the Special Verification Commission—and is reliant upon national technical means. With respect to the latter, as mentioned earlier, it also includes co-operative measures designed to enhance the effectiveness of national technical means.

Unlike the ABM Treaty, however, the INF Treaty is not solely dependent upon national technical means for verification. The INF Treaty incorporates a new element in the verification of United States-Soviet bilateral arms control agreements: an extensive and elaborate on-site inspection regime. For over 40 years, beginning with the 1946 Baruch Plan to control the spread of nuclear weapons, the United States has sought to establish on-site inspection as a means of verifying compliance with arms control agreements. Although in the late 1970s the Soviet Union exhibited some willingness to accept on-site inspection on a limited basis, it was not until the signing of the INF Treaty that it was established as a major component of verification in United States-Soviet bilateral arms control agreements.

The INF Treaty and its integral Protocol on Inspections provide for five types of on-site inspections: baseline, close-out, quota or short notice, elimination, and portal monitoring. The baseline inspections were intended to assist in verifying the exchange of data between the two sides referred to in the Memorandum of Understanding appended to the treaty. The Memorandum included numerical and locational data on some 8,000 pieces of INF equipment—nearly 6,000 Soviet and

2,000 United States— as well as the technical characteristics of the intermediate-range missiles and launchers of the two sides. Between 1 July and 31 August 1988, United States and Soviet inspectors carried out a combined total of 146 baseline inspections at facilities in the United States, the Soviet Union, Belgium, Italy, the Federal Republic of Germany, the Netherlands, the United Kingdom, Czechoslovakia, and the former German Democratic Republic. They successfully inventoried the Treaty-limited equipment detailed in the Memorandum of Understanding, and confirmed the technical characteristics of the Treaty-limited weapons systems.

After all items of Treaty-limited equipment are removed from a facility designated in the INF Treaty, and all activity related to the Treaty has ceased, a close-out inspection may be conducted to confirm that the facility is no longer engaged in prohibited operations. As of late 1990, the United States had conducted close-out inspections at 98 of the Soviet Union's 133 facilities, while the Soviet Union had confirmed the close-out of 7 of the 31 United States facilities. Additional inspections of all facilities covered in the INF Treaty are permitted for 13 years. For the first three years of the Treaty regime, each side is permitted 20 such inspections per year. Each side is allowed 15 inspections annually during the next five years, and 10 annual inspections in the final five years. These inspections are intended to confirm compliance with the terms of the INF Treaty. They are sometimes referred to as "short-notice inspections", since the stringent time-lines specified in the Treaty's Protocol regarding inspections permit such inspections to be launched within as little as 30 hours. The United States and the Soviet Union have each conducted about 45 of these inspections.

Elimination inspections are intended to confirm the dismantling or destruction of Treaty-limited equipment in accordance with procedures stipulated in the Protocol on procedures governing the elimination of missile systems. The Soviet Union began eliminating its equipment in August 1988. The United States began the following month. By late 1990, United States inspectors had carried out some 110 elimination inspections, confirming the elimination of over 1,700 Soviet INF missiles and some 4,000 pieces of other Treaty-limited equipment. In the same period, Soviet inspectors confirmed the elimination of approximately 570 of the United States' 846 missiles, as well as of over a thousand pieces of other Treaty-limited equipment.

Portal monitoring inspections consist of reciprocal, continuous, on-site inspection activities at two former missile production facilities—

the United States Hercules Plant near Salt Lake City, Utah, where the Treaty-limited Pershing II missile was produced, and the Votkinsk Machine Building Plant in the Soviet Union, which formerly assembled the SS-20. The Treaty permits both sides to maintain a 24-hour-a-day watch outside the gates, or "portal", of the designated plants. Inspectors at the portal are entitled to inspect shipments leaving the plant that are large enough to hold the relevant Treaty-limited equipment. These inspections are intended to preclude the possibility that Treaty-banned missiles could continue to be produced in the guise of missiles or space-launch vehicles not covered by the Treaty. Both sides began portal monitoring in the summer of 1988.

It is clear from this exposition that the INF Treaty verification regime has borne out the utility of on-site inspection for verification purposes. However, it has also shown the limitations of on-site inspections. The INF regime does not permit "anytime, anywhere" inspections. The sides are limited to designated INF facilities. Likewise, the sides cannot carry out an inspection beyond the boundaries of a given facility. Accordingly, notwithstanding the benefits of on-site inspections, it will continue to be necessary to depend upon national technical means for verification of arms control agreements.

Efforts to Enhance Bilateral Verification

In addition to co-operative measures negotiated as part of arms control agreements, the United States has actively sought other methods of enhancing bilateral verification. In June 1989, for example, President Bush proposed a comprehensive package of verification and stability measures. His proposal called for the United States and the Soviet Union to undertake joint steps to provide greater military "transparency" in their relations, and to examine verification procedures that could facilitate negotiation of a new strategic offensive arms control agreement. This proposal led, in September 1989, to a United States-Soviet Agreement on Verification and Stability Measures providing for "pilot trials". The preamble to this Agreement states in part that it is designed "to achieve maximum confidence that the measures being negotiated... to verify compliance... will be both practical and sufficient for effective verification".

As a direct result of this Agreement, teams of United States and Soviet technical experts travelled to each other's countries in May and June of 1990 to witness proposed inspection procedures to enhance verification of strategic arms limitations. The procedures demonstrated by both sides involved means to distinguish heavy bomber aircraft carrying cruise missiles from bombers not so equipped, and to count the warheads on deployed intercontinental ballistic missiles and submarine-launched ballistic missiles. These trial verification efforts have directly contributed to the negotiation of effective on-site inspection procedures in the Strategic Arms Reduction Talks.

Conclusion

Even with multilateral or international arms control regimes, verification will remain a national prerogative. Each party to an arms control agreement must decide for itself the standards of evidence that would be required in determining whether another party is in compliance with the agreement. Indeed, the withdrawal clause included in most arms control agreements is invariably predicated on a determination that one's "supreme national interests" are in jeopardy. No nation is apt to allow an outside power to determine for it whether its supreme interests are endangered by violations of an arms control agreement.

As for the United States, its position is clear. The United States will comply with all provisions of arms control agreements to which it is a party, and will insist upon like behaviour from the other signatories. From the United States perspective, effective verification is the means to this end.

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EXISTING ACTIVITIES OF THE UNITED NATIONS IN VERIFICATION

A. Introduction

The United Nations has had a longstanding interest and concern over compliance with provisions of international agreements and treaties, dating back to the adoption of the first resolution by the General Assembly (1 (I) of 24 January 1946), which established the Atomic Energy Commission. In recent years, the question of verification, as an essential element in the process of achieving arms limitation and disarmament agreements, has attracted increased attention.

B. Development of General Principles and Other Initiatives Within the United Nations

1. Consideration by the General Assembly and Studies Carried out by the Secretary-General

In 1978, the holding of the tenth special session of the General Assembly, the first special session devoted to disarmament, provided an opportunity for a closer look into the question of verification. Not only was verification the subject of several proposals discussed at the special session, but it was also given specific attention in the Final Document adopted at that session.

Proposals submitted by Governments addressed issues ranging from the establishment, in one form or another, of an international disarmament organisation as the operational framework for the implementation of international arms limitation and disarmament treaties, with functions mainly in the field of verification (Netherlands (A/AC.187/108); Sri Lanka (A/S-10/AC.1/9)), to the creation of an international satellite monitoring agency which would participate in monitoring the implementation of international disarmament and security agreements and in the investigation of specific situations (France (A/S-10/AC.1/7)); and from recommendations on the seismological verification of a comprehensive nuclear-test ban (Federal Republic of Germany (A/S-10/AC.1/12)), to a request that the Secretary-General conduct a study on all aspects of verification and control of arms limitation and disarmament measures (Austria (A/AC.187/101)). *Of* these, the French proposal for the establishment of an international satellite monitoring agency was later the subject of a study carried out by the Secretary-General ((A/AC.206/14) of 1982). The study was submitted to the twelfth special session of the General Assembly, the second special session devoted to disarmament, held in 1982.

During the twelfth special session, the General Assembly considered several proposals regarding verification made by member states. The majority of those proposals addressed, though in varying ways, the concept of establishing an international body entrusted with the verification of implementation of arms limitation and disarmament agreements. Discussions were inconclusive, including those in connection with the report of the Secretary-General on the question of the establishment of an international satellite monitoring agency. A year later, the Secretary-General submitted a further report on the subject, this time addressing, as requested by the Assembly, the practical modalities for implementing the institutional aspects of an international satellite monitoring agency (A/38/404). The Secretary-General's report noted that, as recommended by the experts participating in the original study, the creation of such an agency would have to follow the same legal framework as for other international intergovernmental organisations. A treaty or convention among participating States should therefore be the appropriate process for the establishment of the agency and it would be up to the General Assembly to decide when it wished to initiate action to that end.

Other proposals have been made in this context. These have included, *inter alia:*

(a) In August 1987, at the International Conference on Disarmament and Development, Hungary proposed that consideration be given to establishing a disarmament agency to co-ordinate effective procedures for the international verification of compliance with disarmament agreements, to use available means and methods of monitoring disarmament and military activities subject to control, and to promote peaceful co-operation among States (statement of 27 August);

(b) In March 1988, the USSR presented at the Conference on Disarmament a detailed proposal on the establishment of an international system of verification of the non-deployment of weapons of any kind in outer space (CD/817-CD/OS/WP. 19) In December 1988, the Soviet Union stressed the need to develop a comprehensive regime for peaceful activity in space and suggested that control over the observance of that regime be a prerogative of a proposed world space organisation (A/43/PV.72)

(c) In July 1990, at the Conference on Disarmament, the German Democratic Republic proposed that consideration be given to establishing a centre for confidence-building and verification of arms limitation within the framework of the CSCE (CD/PV.561).

2. Consideration by the United Nations Disarmament Commission

Despite various efforts by States to bring the question of verification to the forefront of arms limitation and disarmament discussions in the international organisation, it was not until 1985 that consideration of the question of verification was intensified within the framework of the United Nations. That year, at the initiative of Canada, a new resolution entitled "Verification in all its aspects" (40/152 0) was adopted by the General Assembly. While that initial resolution requested the Secretary-General for a report containing the views of member States on various aspects of verification, in addition, the resolutions adopted in the following two years called for the Disarmament Commission to consider the issue of verification in all its aspects.

Disarmament Commission reaffirmed the continued relevance of the basic principles on verification identified in the Final Document of the Tenth Special Session of the General Assembly, Building upon them, the Commission developed and adopted in 1988, the list of 16 principles of verification set out in section II of the present report. In addition, the Commission reached agreement on a text on provisions and techniques of verification, and it also addressed the question of the role of the United Nations and its member states in the field of verification.

In its report to the General Assembly, the Commission recognised among ether things that adequate and effective verification involves the use of a combination of various verification methods, procedures and techniques in such a manner that they reinforce one another and that the choice of the appropriate combination varies with the scope and nature of the arms limitation and disarmament agreement. The Disarmament Commission also emphasised that provisions regarding procedures for consultation and co-operation can greatly assist in resolving problems emerging in the course of the implementation of arms limitation and disarmament agreements, and that they could involve such arrangements as bilateral consultations, the United Nations, and/or the use of organisations set up under the specific agreement in question.

On the question of the role of the United Nations and its member states in the field of verification, the Disarmament Commission welcomed the view expressed by the Secretary-General in his 1987 report on the work of the Organisation that the United Nations can make a significant contribution in the field of verification. Some of the proposals made under this topic, which though discussed were not agreed upon, included the establishment of a verification database within the United Nations; the development of a United Nations capacity to provide advice to negotiators respecting verification matters; research into the process, structures, procedures and techniques of verification as well as the role of the United Nations; and the establishment of an integrated multilateral verification system within the United Nations.

3. Consideration by the General Assembly at its Fifteenth Special Session

Four proposals specifically relating to the role of the United Nations in the field of verification were formally submitted to the General Assembly at its fifteenth special session, the third special session devoted to disarmament, held in 1988.

Following up their initiative contained in the Stockholm Declaration of January 1988, the countries represented in the Six-Nation Initiative - Argentina, Greece, India, Mexico, Sweden and the United Republic of Tanzania in a joint working paper (A/S-l5/AC.1/1), called for the special session to endorse the principle of an integrated multilateral verification system within the United Nations as an integral part of a strengthened multilateral framework required to ensure peace and security during the process of disarmament as well as in a nuclear weapon free world. The sponsors further proposed that the special session should request the Secretary-General to prepare, with the help of qualified experts, an outline of such a system.

Canada and the Netherlands submitted a paper on verification and the United Nations, focusing on the constructive role which the United Nations could play in multilateral verification by functioning as an information clearing house and providing assistance and expertise in the area of verification (A/S-15/25). The main focus of this advisory and service function of the United Nations would be, according to the sponsors, to provide assistance to national negotiators and executors of arms limitation agreements. To that end, Canada and the Netherlands proposed an in-depth United Nations study which, they hoped, would advance international understanding of verification within the United Nations framework, and help to develop an appropriate role for the Organisation in this field.

A proposal introduced by France (A/S-15/34) addressed the question of the role of the United Nations in contractual verification, investigation procedures and collection of space data. In connection with contractual verification, France proposed the establishment of a group of experts which, among other things, would study the relationship between verification and security, prepare an inventory of verification methods, techniques and procedures and reflect on the future role of the United Nations in the field of verification. In making this proposal, France indicated its readiness to combine it with that made by Canada and the Netherlands. Concrete proposals were also made regarding investigation procedures and collection of space data, including the establishment, within the United Nations, of an agency for the processing and interpretation of space images.

Bulgaria, Czechoslovakia and the Soviet Union submitted a working paper calling for the consideration of the establishment, under the auspices of the United Nations, of a mechanism for wide-ranging international verification of compliance with agreements aimed at reducing international tension and limiting armaments, and for monitoring the military situation in regions of conflict (A/S-15/AC.1/15). Some of the measures which the sponsors suggested for implementation as part of such a mechanism incorporated the establishment of a United Nations data base on disarmament and verification problems, as originally proposed by Finland; of an international space monitoring agency based on the concept put forward by France; and of machinery for the international verification of nuclear tests as suggested by the countries represented in the Six-Nation Initiative.

As agreement on these and other proposals was not reached during the special session, further action on the question of verification was left for the forty-third session of the General Assembly in 1988. Two separate draft resolutions on the subject were introduced in the First Committee of the General Assembly. The first draft, entitled "Verification in all its aspects" was initiated by Canada, France and the Netherlands. In recognising that multilateral aspects of verification of arms limitation and disarmament agreements deserved further in-depth consideration, the draft requested the Secretary-General to undertake a study which would address the question of the role of the United Nations in this particular area and make recommendations to that end. A second draft, sponsored by the countries represented in the Six-Nation Initiative, addressed the subject of verification within the United Nations. By that draft, the General Assembly would endorse the principle of a multilateral verification system as proposed by the countries represented in the Six-Nation Initiative at the third special session of the General Assembly devoted to disarmament. It would also request the Secretary-General to undertake a study on the role of the United Nations in the field of verification of arms limitation and disarmament agreements, including preparations for an outline of a multilateral verification system within the Organisation. The General Assembly subsequently adopted a composite resolution, 43/81 B by which, *inter alia,* the Assembly requested the Secretary-General to conduct the present study.

C. Verification Provisions Under Existing Agreements

A number of arms limitation and disarmament agreements, as well as some disarmaments-related agreements, include provisions referring to the United Nations or the Secretary-General, to specialised agencies, or to the International Court of Justice. In most cases, those provisions relate to a monitoring or co-operative role, as through certain types of exchange of information, and to the settlement of disputes regarding the interpretation or application of a given treaty, but not necessarily to the actual rendering of compliance judgements. Furthermore, it should be noted that, although such provisions do exist, they have for the most part not been activated. In the particular case of the Treaty on the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco), the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and the South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga), one feature that is common to them is the application of IAEA safeguards, among other measures, to the implementation of the provisions therein.

1. Relevant Provisions Regarding the United Nations and the International Court of Justice

The table below provides a summary of the verification provisions and compliance procedures of various agreements and indicates the instances in which a role is envisaged for the United Nations, including in connection with review conferences. It will be noted that the latter role, although based on treaty provisions, has normally been established through General Assembly resolutions regarding the relevant review conferences.

2. Exchange of Information in Connection with the Biological Weapons Convention

As can be seen in the table, although the Biological Weapons Convention does provide for certain measures aimed at addressing the issue of compliance, there are no specific provisions for verification arrangements. Already in 1980, at the First Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, concern was expressed by skates parties as to the need for strengthening the Convention.

One such concern was reflected in the decision made on that occasion by the states parties in connection with article IV of the Convention. By that article, each state party agrees to take any necessary measures, in accordance with its constitutional process, to prohibit and prevent any acts or actions which would contravene the Convention. In this connection, the First Review Conference invited States parties which had found it necessary to enact specific legislation or take other regulatory measures relevant to article IV to make available the appropriate texts to the United Nations Department for Disarmament Affairs (then Centre for Disarmament), for the purposes of consultation.

With regard to article V, which provides for consultations and co-operation among States parties in solving problems relating to the objective or the application of the provisions of the Convention, the Conference noted the concerns and differing views expressed on the adequacy of the article and the need for the issue to be further considered at an appropriate time. At the Second Review Conference of the Convention, in 1986, that concern was voiced even more strongly and, as a result, a number of decisions aimed at strengthening the authority of the Convention were made by the States parties. Within the framework of article V, States parties were called upon: to exchange data on research centres and laboratories involved in permitted biological activities directly related to the Convention; to exchange information on all outbreaks of infectious diseases and similar occurrences; to promote contacts between scientists engaged in biological research directly related to the Convention, as well as to encourage publication of the results of such research.

The Conference further decided to convene an ad hoc meeting of scientific and technical experts from States parties to finalize the modalities for the exchange of information and data as agreed upon in the Final Declaration of the Conference. By its resolution 41/58 A of 3 December 1986, the General Assembly gave the Secretary-General the mandate to assist in the implementation of the relevant parts of the Declaration. Four exchanges of information have taken place to date, one before the ad hop meeting and three after the experts had adopted an appropriate guestionnaire to facilitate such exchanges. In 1987, 16 States parties provided information and data to the Department for Disarmament Affairs which, in turn, circulated it among the parties to the Convention. In 1988, 22 States parties participated in the exercise already using the guestionnaire; in 1989, 19 States parties participated; and, as at July 1990, 23 States parties had replied to the Secretary-General's latest note verbale on the issue.

3. The Safeguards Systems of the International Atomic Energy Agency

The objectives of the International Atomic Energy Agency (IAEA), according to article II of its Statute, are to seek "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world"—and "to ensure, go far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose". Article III authorises the Agency, *inter alia,* "to establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities, and information made available ... are not used in such a way as to further any military purpose". The article also specifies the circumstances in which IAEA safeguards may be applied: where the Agency itself is the source or channel of assistance; where the parties to a bilateral or multilateral arrangement request Agency safeguards to be applied; and where a State unilaterally submits itself to Agency safeguards.

The Statute itself does not require IAEA members to submit to safeguards but it establishes a framework for the conclusion of safeguards agreements between the Agency and member states. The legal obligations to submit to Agency safeguards under such agreements are to be found in other legal instruments: bilateral agreements between nuclear suppliers and recipients and multilateral treaties of global or regional scope. The

IAEA has, through the years, acquired additional responsibilities as a function of its role in connection with arms limitation agreements. Three agreements require the use of IAEA safeguards from their States parties - the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the Treaty for the Prohibition of Nuclear Weapons in Latin America (Tlatelolco Treaty) and the South Pacific Nuclear Free Zone Treaty (Rarotonga Treaty). The actual application of safeguards under obligations undertaken in bilateral agreements and multilateral treaties is conducted on the basis of safeguards agreements negotiated between the Agency and the safeguarded States.

All Agency safeguards agreements are similar in the sense that implementation of the agreements provides evidence, as a confidence-building measure, that the country which has voluntarily "invited" the application of these safeguards is abiding by its obligations. Other similar or common features are that all Agency safeguards agreements contain undertakings by the Agency to:

(a) Avoid hampering a State's economic and technological developments;

(b) Avoid undue interference in a State's peaceful nuclear activities;

(c) Carry out its functions in a manner consistent with prudent management practices;

(d) Protect commercial and industrial secrets and other confidential information by restricting its dissemination, according to practices agreed upon by both the State and the Agency.

The technical objective of safeguards agreements under the NPT system is "the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other explosive devices or for purposes unknown, and deterrence of such diversion by risk of early detection" (para. 28, INFCIRC/153 corrected). Parties to the NPT have expressed their conviction that IAEA safeguards provide assurance that States are complying with their undertaking and assist States in demonstrating this a fundamental element of the treaty, are regarded by parties to the Treaty as healping to strengthen their collective security.

Safeguards agreements concluded under the NPT safeguards system require the State to establish and maintain a national system of accounting for and control of nuclear materials within its territory, jurisdiction or control. It is the responsibility of the State to ensure that plant operators comply with the requirements of the safeguards agreement.

Safeguards practices are designed to verify - that is, to establish the truth of - statements regarding the amounts, presence and use of nuclear material or other items subject to safeguards as recorded by facility operators and as reported by the State to IAEA. The safeguards system, in carrying out this process of material accountancy, uses the following basic concepts to verify information supplied by a State:

(a) Audit of records and comparison of the State's reports to the Agency with the records kept by the State;

(b) Verification of the inventory and flow of source and special fissionable material by the use of instruments and other techniques at certain strategic points;

(c) Periodic closing of material balances by the taking of physical inventories and their verification;

(d) Containment and surveillance as important complementary measures to materials accounting.

The NPT safeguards system includes three types of inspections. Routine inspections are made to verify the information contained in the reports submitted by the State; ad hoc inspections are made to verify information submitted by States on the design of new nuclear facilities; and special inspections are carried out when unusual circumstances occur, or when there is a need to supplement information collected by routine inspections. To make inspections more effective, IAEA is increasingly using safeguards instruments for non-destructive analysis, and containment and surveillance devices. These devices survey and record movements of nuclear material in plants between Inspections - e.g., by automatic cameras that run for several months and take pictures at short intervals and by similarly programmed TV cameras and recorders. IAEA also makes use of tamper-resistant seals to seal off stores of nuclear material between inspections or to seal the cores of the reactors themselves.

As at 31 December 1988, there were a total of 920 installations in 57 States Under safeguards or containing safeguarded material. IAEA safeguards activities, in 1988, resulted in 2,128 inspections. Some 15,500 seals applied to nuclear material or Agency safeguards equipment were detached and subsequently verified at the Agency's headquarters. About 1,170 plutonium and uranium samples were analysed, with some 3,040 analytical results being reported. To accomplish this, the total safeguards budget of the IAEA amounted to $US 51 million in 1988 (at 1989 price levels) and was almost $US 53 million in 1989. These figures include the salaries and costs of almost 200 inspectors together with research, development, information handling and supporting staff of another 280 individuals at the Agency's headquarters and the specialised safeguards instruments used by the inspectors in the field.

IAEA has stated that if all civil nuclear activities in all nuclear weapon States were brought under IAEA safeguards, a very substantial increase in the IAEA budget would be necessary. Estimates by the Government of Sweden presented in September 1989 at the second session of the Preparatory Committee for the Fourth Review Conference of the NPT suggest that, in such a case, the Agency's safeguards budget would have to be doubled.

In operating its safeguards system, the IAEA has acquired valuable experience in ensuring the non-diversion of nuclear material from peaceful purposes as well as in handling inspection procedures. This experience has been drawn upon in designing verification regimes for various agreements and could be of considerable value in devising future verification regimes.

D. Other Activities Related to Existing Agreements

1. Secretary-General's Investigative Role in Connection with the Alleged Use of Chemical Weapons

Although the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare (Geneva Protocol) contains no specific provisions regarding verification arrangements, allegations of use of chemical warfare have been made from time to time within the context of the United Nations. It was not until 1980, however, that the General Assembly, following yet another series of allegations, adopted a resolution (35/144 C) in which, for the first time, it called upon the Secretary-General to carry out an investigation of such allegations with the assistance of qualified medical and technical experts.

In the years that followed, up to 1984, the General Assembly adopted additional resolutions on the subject renewing the Secretary-General's mandate, as well as requesting him for further reports. By then, the reports had evolved also to include lists, provided by Governments, of experts and laboratories upon which the Secretary-General might wish to draw, and several criteria to guide him in investigating the alleged use of chemical weapons. Some of those criteria included procedures in deciding whether or not to initiate an investigation and specific guidance for the conduct of an investigation, including procedures for on-site and near-site investigations, standards concerning the collection and handling of samples, and choice of laboratories and procedures for the preparation, transmission and analysis of samples.

Allegations of continued use of chemical weapons and concern by the General Assembly over the threat posed to international peace and security by the risk of the use of chemical weapons as long as such weapons remain and are spread led the General Assembly, by its resolution 42/37 C, to renew, in 1987, its request for the Secretary-General to carry out investigations in response to reports by any Member State of the possible use of chemical and bacteriological (biological) or toxin weapons. In addition, the General Assembly requested the Secretary- General, with the assistance of qualified experts, to develop farther technical guidelines and procedures available to him for the timely and efficient investigation of such reports of the possible use of chemical and bacteriological (biological) or toxin weapons; to compile and maintain lists, provided by member states, of qualified experts and laboratories to be drawn upon for the effective discharge of the Secretary-General's investigatory role; to appoint experts to undertake investigation of the reported activities; to make the necessary arrangements, where appropriate, for experts to collect and examine evidence and to undertake such testing as might be required; and to seek, in any such investigation, assistance as appropriate from member states and the relevant international organisations. The work of the group of experts thereby established by the Secretary-General would last two years.

In the mean time, Governments participating in a Conference of States parties to the 1925 Geneva Protocol and Other Interested States on the Prohibition of Chemical Weapons, held in Paris, in January 1989, confirmed their full support for the role of the United Nations, in accordance with its Charter, with respect to the prohibition of chemical weapons. In particular, the participating States reaffirmed "their full support for the Secretary-General in carrying out his responsibilities for investigations in the event of alleged violations of the Geneva Protocol". The participants further expressed their wish for the early completion of the work aimed at strengthening the efficiency of the Secretary-General's investigatory role.

The Secretary-General submitted to the General Assembly at its forty-fourth session, in 1989, the report of the group of experts established in accordance with Assembly resolution 42/37 C. That report (see A/44/561, annex), which also contained nine technical appendices, was unanimously adopted by the experts. The Assembly took note of that report in its resolution 44/115 B of 15 December 1989.

The experts decided from the outset that central to the task of preparing the guidelines and procedures for the timely and efficient investigation of the alleged use of chemical and bacteriological (biological) or toxin weapons (CBT weapons) was the question of how to ensure the required timeliness in the acquisition of relevant information. In this connection, identifying and defining the conditions that would warrant on-site investigations, as well as obtaining the strongest possible commitment by affected member states to permit such investigations emerged as the two correlates to the question of timeliness.

The Group therefore endorsed the concepts where by, first of all, an investigation should be made at the site where CBT weapons were allegedly used whenever it was warranted by evaluation of the. information provided by a member state, and secondly, any Member State should authorize such an investigation in its territory when the Secretary-General so requested. The Group recognised, however, that it was up to the Secretary-General and the relevant member states to agree to the guidelines and procedures. It was thus preferable to formulate them in each case as recommendations only.

Among the recommendations made by the Group were the appointment by the Secretary-General of expert consultants to advise and assist him in a consultative capacity whenever necessary and at his request, the establishment of core teams of qualified experts possessing a distribution of the required specialties so as to facilitate training, exchange of information, as well as the timely selection of the experts for a particular investigation; and the carrying out of inter-laboratory calibration in order to evaluate the validity and accuracy of the analytical methods employed by the laboratories designated by member states.

It should be further pointed out that, parallel to the efforts carried out in response to requests by the General Assembly to establish appropriate procedures, fact-finding missions regarding the alleged use of chemical weapons were also carried out by the Secretary-General in response to requests fay individual member states and/or the Security Council from 1984 to 1988. Relevant Security Council resolutions within that period include 582 (1986) of 24 February 1986; 612 (1989) of 9 May 1988; and 620 (1988) of 26 August 1988. The latter is of particular relevance in that it further encouraged the Secretary-General to carry out promptly investigations in response to allegations brought to his attention by any member state concerning the possible use of chemical and bacteriological (biological) or toxin weapons that might constitute a violation of the 1925 Geneva Protocol or other relevant rules of customary international law, in order to ascertain the facts of the matter, and report the results. By that resolution, the Security Council also decided to consider, immediately, taking into account the investigations of the Secretary-General, appropriate and effective measures in accordance with the Charter of the United Nations, should there be any future use of chemical weapons in violation of international law, whenever and by whomever committed.

E. Other Existing Activities

1. Standardised Instrument for International Reporting of Military Expenditures

If the reduction of military budgets on a mutually agreed basis is to be used as a valid approach in the process of disarmament, certain factors would be of great value, particularly openness of information about military spending and the comparability of budgets. The use of a standardised system for the reporting of military expenditures is one of the instruments considered helpful in this connection.

Within the framework of the United Nations, the development of a standardised instrument for international reporting of military expenditures can be traced back to the twenty-eighth session of the General Assembly, in 1973, when the question of reduction of military budgets was considered for the first time under a separate agenda item. Pursuant to resolution 3093 B (XXVIII) of 7 December 1973, the Secretary-General, with the assistance of a group of experts, prepared a report (A/9770/Rev.l of 1974) which noted, inter alia, that a prerequisite for negotiating the reduction of military expenditures was agreement on the scope and content of such expenditures. The questions of developing a standardised system for defining and reporting military expenditures and of verifying compliance with agreements to reduce such expenditures were also discussed.

The development of the standardised system for the reporting of military expenditures has therefore been a part of a broad effort by the United Nations to develop a set of specific measures for the purpose of facilitating the reduction of military expenditures. At the same time, as has been stated in several General Assembly resolutions on the subject, the use of the standardised reporting instrument could also be considered as a means of increasing confidence. To that end, wide participation by member states has been recommended by the General

Assembly as essential for the achievement of the most useful results possible.

Other General Assembly resolutions and reports of the Secretary-General on the subject, prepared with the assistance of experts, followed in subsequent years. Two reports were of particular relevance in this connection. The first was the report submitted by the Secretary-General to the thirty-first session of the General Assembly (A/31/222/Rev. 1 of 1976), which included a definition of the scope and content of military expenditures and a reporting matrix as an instrument for the standardised reporting. The second report, submitted to the General Assembly in 1980 (A/35/479) contained, in addition to an *ad hoc* panel's report on a practical test of the proposed instrument, the replies of 17 member states, 14 of which had participated in the testing. Based on the report, one of the recommendations made by the General Assembly in resolution 35/142 B of 12 December 1980 was that all member states should make use of the reporting instrument and report annually their military expenditures to the Secretary-General for subsequent reporting to the Assembly.

In 1981, the first such report of the Secretary-General contained 16 national reports of military expenditures through use of the reporting instrument (A/36/353 and Corr.2, and Add.l and 2). Since then, annual reports of the Secretary- General have been submitted to the General Assembly. At the forty-fourth session of the General Assembly, in 1989, 22 member states reported their military expenditures by using the matrix (A/44/422 and Add.l). In addition, several other reports of the Secretary-General on the question of refining the standardised reporting instrument have been submitted to the General Assembly.

Further to the efforts carried out in conjunction with the standardised instrument for international reporting of military expenditures, in 1979, the General Assembly requested the Disarmament Commission to examine and identify effective ways and means for the conclusion of agreements to freeze, reduce or otherwise restrain, in a balanced manner, military expenditures (Assembly resolution 34/83 F of 11 December 1979). Subsequently, until 1989, the Disarmament Commission endeavoured to agree on a set of principles that should govern further actions of States in freezing and reducing military budgets. The General Assembly took note of the draft principles annexed to resolution 44/114 A of 15 December 1989, and decided to bring them to the attention of member states and of the Conference on Disarmament as useful guidelines for further action in this field.

2. *Ad Hoc Group of Scientific Experts to Consider International Co-operative Measures to Detect and to Identify Seismic Events*

An *Ad Hoc* Group of Scientific Experts open to all member States of the Conference on Disarmament, as well as non-member States upon request, was established by the Conference of the Committee on Disarmament (CCD) in 1976. The mandate of the Group was to consider international co-operative measures to detect and identify seismic events. However, the Group was not to assess the adequacy of such a system for verifying a comprehensive test ban. As part of its terms of reference, the *Ad Hoc* Group has been called upon to work on: further development of the scientific and technical aspects of a global seismic data exchange system; elaboration of instructions for experimental tests of such a system; and co-operation in the review and the analysis of national investigations by States participating in the Group.

The first report of the *Ad Hoc* Group was submitted, in 1978 (CCD/558) and described how seismological science could be used in a co-operative international effort to develop a global seismic data exchange system. The report envisaged a network of more than 50 high-quality seismograph stations distributed world wide and operated according to agreed procedures to produce seismic data in standard form on two levels: level I with the routine reporting, with minimum delay, of basic parameters of detected seismic signals; and level II with detailed records of waveforms provided in response to requests for additional information. Level I data would be regularly exchanged using the Global Telecommunications System (GTS) of the World Meteorological Organisation (WMO), and such data would be routinely processed at special international data centres (IDCs) for the use of participant States. The much more voluminous level II data would be exchanged only for those seismic events determined by participants to be of particular interest, and no processing of such data at IDCs was foreseen at that time.

Over the next several years, the Ad Hoc Group systematically defined the elements of such an international co-operative data exchange system, and elaborated in detail its basic scientific and technical aspects. This work, which was aided by practical co-operative tests of selected parts of the proposed system, was documented in the Group's second and third reports (CD/43 in 1979 and CD/448 in 1984) and culminated with the *Ad Hoc* Group's first large-scale technical test GSETT - carried out in 1984, involving the exchange of level I data only; this test was subsequently evaluated and reported on in the Group's fourth report

(CD/720 in 1986). Seventy-five seismograph stations in 37 countries took part in the test providing a vast amount of experience, previously unavailable, on many aspects of practical operation of a global seismic data exchange system.

Drawing upon the evaluation of the 1984 technical test and recognising the possibilities offered by rapid development in seismic equipment, computer processing and communications technology, the *Ad Hoc* Group agreed in 1986 to dire its future work towards design of modern international system. In particular, there was a consensus that those technological advances would make it feasible for complete seismic waveform, i.e., level II data to be regularly exchanged and processed at IDCs. In their fifth report to the Conference on Disarmament (CD/90 in 1989), the scientific experts described initial concepts for the design of a modern international seismic data exchange system that would have the task expeditiously to provide comprehensive information on seismic events, collected of a global basis and processed according to agreed procedures. Although some State-have a different position on a comprehensive nuclear test ban, it is widely considered that a modern international seismic data exchange system could contribute to verification of compliance by its parties with a possible future nuclear-test-ban treaty.

According to the *Ad Hoc* Group, the proposed new seismic data exchange system would be based on the expeditious exchange of waveform (level II) and parameter data (level I) and the processing of such data at IDCs, It would have four major components:

(a) A global network of high-quality seismograph stations, including seismic arrays, each conforming to specified technical standards and operated according to internationally agreed rules;

(b) Government-authorised national data centres (NDCs) responsible for providing agreed seismic data from national stations to IDCs;

(c) International data centres to collect and analyse seismic waveform and parameter data, to distribute the results of these analyses and to make the data readily accessible to all participants. Current plans are to establish a minimum of four IDCs to be located at Canberra, Australia; Stockholm, Sweden; Moscow, Union of Soviet Socialist Republics and Washington D.C., United States of America;

(d) Telecommunications channels for the expeditious exchange of data between NDCs and IDCs, as well as among IDCs.

Furthermore, the *Ad Hoc* Group proposed to conduct a large-scale experiment to collect performance data and experience necessary so that, at the conclusion of the experiment, the *Ad Hoc* Group can assess the results and thus will have a firm technical basis on which to complete the elaboration of the concepts of a modern global data exchange system. The first and second phases of this large-scale experiment, which is called the Group of Scientific Experts' Second Technical Test (GSETT-2), have been carried out. In the light of experience gained so far, and in order to enable additional countries (21 countries participated in phase 2) to make the necessary preparations, the Group is now planning to carry out the full-scale test (phase 3) in two parts. The first part will be comprised of preparatory testing during the second half of 1990 and the main phase will be conducted during the first half of 1991 (CD/981 in 1990).

3. Other United Nations Activities That Might be of Potent Interest for the United Nations Role in Verification

Although not arms limitation and disarmament agreement verification tools per se, the peace -keeping operations of the United Nations have, over the years, acquired an extensive experience in certain aspects of monitoring. United Nations peace-keeping forces have no enforcement power: they require the co-operation of the parties concerned to fulfil their tasks. They also need the continuing support of States contributing troops and the support of the Security Council is essential. In a very real sense, therefore, such operations are multilateral co-operative measures. Since 1948, when the first United Nations peace-keeping operation took place, there have been 18 such operations, including some 500,000 and military personnel.

Deployed in areas where there has been conflict, United Nations peace-keeping forces endeavour to prevent the recurrence of fighting, to contribute to the maintenance and restoration of law and order and a return to normal conditions. By their physical presence in an area. United Nations peace-keeping forces are able to monitor the day-to-day movements and events of human activity. By so doing they are often in a position to exert a steadying influence on an unstable situation and thereby encourage a return of public confidence.

On other occasions, by the establishment of observation posts, patrols and inspactions, the United Nations forces and observers have been used to monitor the disengagement and separation of opposing troops. The peace-keeping operations and the observation missions have provided experience which is relevant to a future role of the United Nations in the field of verification. This experience relates, Inter alia., to the number of personnel required, their training and equipment, and the organisation of international co-operation in this area.

F. Relevant Activities of the Department for Disarmament Affairs and the United Nations Institute for Disarmament Research

1. Department for Disarmament Affairs

The role of the Department for Disarmament Affairs derives from the general functions of the Secretary-General as defined in the Charter of the United Nations and developed over the years through resolutions and decisions of the General Assembly and other legislative organs of the United Nations on disarmament matters. As the organisational unit of the Secretariat responsible for disarmament questions, the Department for Disarmament Affairs is called upon, among other tasks, to provide secretarial, administrative and substantive support services to the General Assembly subsidiary bodies dealing with disarmament, to such negotiating bodies as the Geneva Conference on Disarmament and its subsidiary bodies, as well as review conferences of existing multilateral arms limitation and disarmament agreements. For instance, the Department provides assistance to negotiations on a convention banning the development, production, stockpiling and use of chemical weapons, and on their destruction, within the framework of the Conference on Disarmament's *Ad Hoc* Committee on Chemical Weapons, which includes working group on verification, and the *Ad Hoc* Group of Scientific Experts on Seismic Events also established by the Conference, The work of the United Nations Disarmament commission has also been supported by the services of the Department, an aspect of which was the work of the commission on the question of verification already mentioned above.

Another function carried out by the Department for Disarmament Affairs has been the servicing of export group assisting the Secretary-General in undertaking disarmament studies such as the present one. A number of United Nations studies have been carried out arising from mandates by the General Assembly on the issue of arms limitation and disarmament. The studies, carried out by the Secretary-General with the assistance of governmental experts, have been instrumental in exploring and identifying areas of common ground between States which might then lead to progress in appropriate negotiations. Several of these studies have addressed, in the context of broader arms limitation and disarmament issues, aspects relevant to verification in one form or another, for example, the study on a "Comprehensive nuclear test ban" (A/35/257); the "Comprehensive study on nuclear weapons" (A/35/392, annex); the "Study prepared by the Group of Governmental Experts on regional disarmament" (A/35/416, annex); the "Comprehensive study of the Group of Governmental Experts on confidence-building measures" (A/36/474, annex); the "Study on the implications of establishing an international satellite monitoring agency" (A/AC.206/14); the "Study on All Aspects of the Conventional Arms Race and on Disarmament relating to Conventional Weapons and Armed Forces" (A/39/348, annex); the "Study on concepts of security" (A/40/553, annex); and the 1990 "Comprehensive study on nuclear weapons" (A/45/373, annex) The present study is the first such endeavour to focus mainly on the issue of multilateral verification of disarmament agreements.

Another concern of the Department for Disarmament Affairs has been to create informal opportunities for an open and frank discussion of disarmament issues by governmental officials, members of the academic and scientific communities and the public at large, as represented by non-governmental organisations. The purpose of those meetings has been to provide diplomats with a forum, other than the existing multilateral disarmament bodies, for constructive debate, as well as to create an environment conducive to the cross-fertilisation of ideas. In the particular case of the question of verification, the following meetings organised by the Department for Disarmament Affairs have been of particular relevance: Regional Conference for the World Disarmament Campaign (Beijing, China, March 1987); United Nations Forum on Chemical Weapons (Geneva, Switzerland, February 1988); United Nations Meeting of Experts on Verification (Dagomys, USSR, April 1988); United Nations Conference on Disarmament Issues (Kyoto, Japan, April 1989); Regional Conference for the World Disarmament Campaign (Dagomys, USSR, June 1989). In addition, the Department co-operated in the organisation of the "Pugwash Symposium on Scientific and Technical Aspects of Development of New Weapons, Verification Issues, and Global Security" held at United Nations Headquarters, in May 1988.

2. *Research Activities in the Field of Verification Carried Out by the United Nations Institute for Disarmament Research*

The issue of verification has been in the research programme of UNIDIR for several years. The number of projects and publications in this area has increased recently in view of the growing attention given to these problems by the international community, as well as the new developments in the relevant negotiation and recent agreements. The programme of work of UNIDIR in the field of verification research has concentrated on three areas: verification procedures contained in agreements and treaties currently in force; national positions and attitudes in negotiations concerning verification; and technical and technological problems of verification.

Within these three areas of concern, monographs have been prepared on a legal approach to verification; verification questions relating to the 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 related subject of confidence-building measures; and the verification issue in United Nations; disarmament negotiations. The latter addresses the different negotiations carried out under the auspices of the United Nations or with its co-operation and analyses the positions adopted by different countries during the period of elaboration of the main multilateral agreements, as well as current negotiations. The subject of verification was also one of the themes addressed at conferences organised by UNIDIR in Baku, USSR (2 to 4 June 1987) and Geneva, Switzerland (23 and 25 January 1989).

Currently, UNIDIR is preparing, with the assistance of a group of consultant experts, a report on the verification of current agreements on arms limitation and disarmament—ways, means and practices. This report will present a systematic classification of methods and practices of verification, as well as an analytical study of the procedures envisaged by each treaty or agreement and their implementation. a second stage of this project will follow with a view to addressing different verification proposals made in connection with ongoing arms limitation and disarmament negotiations. In addition, two projects are under way which will provide a better understanding of individual national positions in the field of verification and their evolution. In the area of verification technology, projects on verification by airborne means, verification of conventional arms limitation and the role of new technologies in the field of verification are also being prepared.

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MULTILATERAL VERIFICATION: OPPORTUNITIES AND CONSTRAINTS

The recently completed *Study on the Role of the United Nations in the Field of Verification* undertaken by a Group of Experts has focused much-needed attention on the prospects for, and problems of, multilateral verification in the coming years. In discussing the subject, one should be aware of the different types of verification enterprises which could be entered into multilaterally. On the one hand, the task could be entrusted to a specific agency authorised to verify a given arms limitation and disarmament agreement—as is the case with the International Atomic Energy Agency and the Treaty on the Non-Proliferation of Nuclear Weapons. On the other hand, a general, "all-purpose" multilateral verification agency could be established to verify a wide variety of existing agreements and provide a ready infrastructure as new agreements are reached. Within these varying approaches to multilateral verification, there are, of course, many conceivable options for a United Nations role; indeed, the differences of opinion on this score played a prominent role in the Group's deliberations.

The study itself came at a dramatic moment in history. While much of the public's attention in the Northern Hemisphere is currently focused upon the dramatic thaw between the Super-Powers and the sweeping changes taking place in Europe, the renaissance of multilateralism is an equally impressive portent of things to come. Though it has obviously benefited from the warming of super-Power relations, this renaissance is primarily the result of a growing realisation that certain interrelated problems facing the world community (such as the environment and under-development) can only be addressed on a global scale.

It was into this changing atmosphere that the Verification Study was launched in February 1988. The Study was carried out in pursuance of a resolution adopted by the General Assembly at its forty-third session, in 1988. In it the General Assembly called upon the Secretary-General to "undertake, with the assistance of a group of qualified governmental experts, an in-depth study of the role of the United Nations in the field of verification" that would:

a. Identify and review existing activities of the United Nations in the field of verification of arms limitation and disarmament;

b. Assess the need for improvements in existing activities as well as explore and identify possible additional activities, taking into account organisational, technical, operational, legal and financial aspects;

"c. Provide specific recommendations for future action by the United Nations in this context."

It should be noted that those who were the strongest proponents of the study did not share a uniform approach to it. For Canada, France and the Netherlands, which played a leading role in the resolution that gave rise to the study, it represented an opportunity to address the woefully inadequate store of knowledge about multilateral verification. Canada had long been interested in this field of research, establishing within its Department of External Affairs a Verification Research Programme dedicated exclusively to these issues. As part of its mandate, this programme had devoted considerable resources to the study of problems related to multilateral verification. It had thus been Canadian policy throughout the 1980s to foster research into various aspects of verification, and the proposed study was regarded as an example of this policy.

Others, most notably several nations associated with what was once known as the Six Nation Initiative, saw the study as an opportunity to push for the creation of a United Nations verification body. Proponents of this view reasoned that such an agency would provide expert training in verification techniques for the nations not now engaged in verification or familiar with the techniques involved. They also believed that a standing agency would provide a degree of impetus to conclude treaties on arms limitation and disarmament and might well remove any grounds for arguing that such treaties would not be verifiable. For these and other reasons, these nations also proposed a study, but one oriented towards specific recommendations about activities which could be undertaken by the United Nations.

Still others were not pleased at the idea of any study. Though most of them would eventually vote for the resolution establishing it, they feared that the study would become an exercise in the advocacy of a standing, all-encompassing verification agency. Such a development, they argued, would run counter to the view that verification was a treaty-specific exercise, and that the combination of techniques and capabilities employed under each individual agreement must be the product of negotiation and agreement by those States that would be parties to the agreement.

Though Canada shared these concerns, and firmly subscribed to the view that verification arrangements should be treaty-specific, it still believed that a study need not prejudge the answers to these questions. Moreover, in attempting to fill the huge gap in knowledge on the subject, the study could well provide new approaches. The idea that everyone would bring to the study a politically neutral agenda, with nothing more than an objective desire to explore the issues, was, perhaps, too optimistic.

At the first of the Group's four sessions, in February of 1989, it became obvious that the debate over whether to recommend the establishment of a standing United Nations verification body would be the most difficult issue to resolve. Before tackling this question head-on, however, the Group decided to explore the generic verification issues. With the help of a consultant, Michael Krepon, the Group drafted and re-drafted several descriptive chapters dealing with the specifics of verification.

Most readers of the report will naturally be tempted to begin with a glance at the conclusions. They would be making a grave mistake, however, if they were to ignore the chapters which precede the conclusions. In many respects, these first chapters may well prove to have been the Group's greatest achievement. Long after the dust has settled on the political questions whether this or that recommendation should be acted upon and how, the existence of an agreed descriptive survey of this complex issue will provide a firm basis for constructive discussion and, perhaps, for new initiatives.

The extent to which such an agreed survey of terms and concepts was lacking is reflected in the difficulty which the Group experienced in settling upon a working definition of the term "verification"; indeed it was unable to reach agreement on this fundamental definition until well into the final session. The problem, of course, is that verification is at once easily understood in the broad sense, but difficult to pin down conceptually as one moves from the general to the specific. While few would argue with the definition in the *Concise Oxford Dictionary: "...* the process or an instance of establishing the truth or validity of something", the term as applied to arms limitation and disarmament agreements requires more elaboration if it is to be useful.

A good many definitions of verification, as applied to the arms limitation and disarmament process, have been put forward over the years. As a general rule, these definitions have all emphasised at least two characteristics: first, that verification is a process, rather than a static concept; and second, that this process involves some degree of political judgement as to whether or not an obligation is being fulfilled. This political judgement is usually based largely upon information collected about the weapons in question, but the fundamental biases and political concerns of the party doing the verifying are never entirely absent. Hence the Group's agreed definition:

> Verification is a process which establishes whether the States parties are complying with their obligations under an agreement. The process includes: the collection of information relevant to obligations under arms limitation and disarmament agreements; the analysis of the information; and reaching a judgement as to whether the specific terms of an agreement are being met. The context in which verification takes place is that of the sovereign right of States to conclude and their obligation to implement arms limitation and disarmament agreements. Verification is conducted by the parties to an agreement, or by an organisation at their request. Not surprisingly, given the difficulties which the Group experienced in coming to this definition, the remainder of the descriptive/analytical chapters could also not be agreed upon until the final session. To a large extent the Group's difficulties with definitions and descriptions of generic concepts emanated from its differences over the types of recommendations which should be included in the final chapter.

One can imagine two major focuses of the recommendations made in the study. One type of recommendation could have been oriented largely towards using the offices of the United Nations as an equalizer of opportunities between rich and poor nations in the field of verification. Activities undertaken in this field would aim to provide nationals of less developed countries with practical assistance and advice on the wide range of complex technologies and methodologies which have been employed in the field of verification to date. The second type of recommendation could have been mainly devoted to having the United Nations actually conduct verification activities. Such recommendations would require the acquisition by the United Nations of sophisticated and expensive equipment, and the training of a multinational staff to operate and maintain these devices. It should be noted that the second type of recommendation would necessarily have started the United Nations on the path to a standing multilateral verification agency. The first type of recommendation, on the other hand, would lead to a situation of potential benefit not only to those who favour such an agency, but also to those who favour a treaty-specific approach to the creation of multilateral verification organisations.

The Study Group carefully examined all of the potential recommendations that could have been made. In the first area, it concluded that there was a serious need for a central repository of information on verification. All too often, researchers and officials in various countries (primarily those which have not dealt first-hand with verification) have difficulty in acquiring either technical or methodological studies which are widely available in other parts of the world. It was agreed that the existence of a central data bank on verification issues, featuring a computerised index and an on-line information retrieval system, would do much to ease the difficulties experienced in many parts of the world by those interested in verification.

Following on from the idea of a data bank, the Group considered the prospects for, and possible benefits of, using the United Nations to promote exchanges between experts and officials. The Group agreed that such exchanges would be of value to both the diplomats and the experts. Experts could help diplomats to define solutions to problems faced at the negotiating table, while the diplomats could assist the experts in focusing their work on those areas most in need of intensive research.

These two recommendations of the Group imply that the United Nations would take an active role in facilitating the dissemination of knowledge and the spread of expertise. The United Nations, however, would not necessarily become involved in actual verification activities *per se.* Such activities were discussed at length by the Group. In the discussion two themes emerged: the first revolved around the technologies which the United Nations would have to acquire, while the second concerned the proper administrative structure for a potentially operational United Nations involvement in verification. The Group did not, in the end, recommend United Nations involvement in those areas, for the time being. The discussions were quite detailed, however, and are fully reflected in the report.

In the case of the technologies, it was widely recognised that United Nations access to sophisticated overhead imaging would be especially important if the United Nations were to have the ability to move into a variety of areas on short notice and perform essential verification tasks. There are, at present, two types of overhead imaging systems available: aircraft and satellites. In both cases, considerable expense would be involved in the acquisition of the necessary hardware, information processing and imagery analysis equipment, not to mention the employment and training of operators. Moreover, there was some question as to whether the capabilities of available commercial satellite imaging systems were sufficient for a wide range of verification-related activities.

The expense and organisational upheavals associated with the acquisition by the United Nations of such complex systems would probably lead to the creation of some sort of United Nations monitoring organisation. The numbers of staff required to maintain and operate the equipment and to analyse its output would vary, depending upon the agreed requirements of whatever organisation might be established. At a minimum, however, a certain cadre of trained officials and technicians would have to be kept on the strength permanently. Herein lay the seeds of the greatest problem which many Group members had with the idea of establishing a permanent verification agency: In the absence of anything to verify, what would these people do? The fundamental question here relates to the subject of treaty-specificity and the premise that an agency should not be created unless it had agreed, specific treaty-based tasks.

It might therefore appear at first glance that the Group recommended that the United Nations undertake activities exclusively along the line of disseminating information, while being unable to agree on any actual, hands-on verification initiatives; in short, that the United Nations assist those studying verification, but that it should not verify anything itself. Upon closer examination, however, the third of the Group's recommendations constitutes an attempt to bridge the gap between the two types of activity.

As the report points out,

> "... the experience gained from the Secretary-General's fact-finding activities could be helpful in connection with certain arms limitation and disarmament agreements that lack explicit verification provisions."

By advocating that the Secretary-General's capabilities in this area be "broadened", or that the means by which existing capabilities are carried out be "expanded", the Group recognised that the United Nations Secretariat already plays an important role in contributing to the verification of certain types of arms limitation and disarmament agreements. Of course, as the Group noted, the Secretary-General should only engage in these activities when given a specific mandate to do so and nothing should interfere with his flexibility in this regard. The Group recommended a specific example of an agreement which could benefit from the expansion of the Secretary-General's fact-finding mandate, should the adherents to the treaty agree.

Thus, the report is not devoid of consensus recommendations calling for an expansion of the role of the United Nations in actually verifying arms limitation and disarmament agreements. Moreover, the enthusiastic and thorough implementation of the consensus recommendations could well lead to the creation of circumstances in which the United Nations could develop, over time, the ability to adopt a more active role in verifying agreements. One could imagine, for example, that a series of practical workshops in various technical aspects of verification would, eventually, bring into being a cadre of appropriately trained technicians from several countries. Such workshops could be conducted under the auspices of the Group's second recommendation. Should a United Nations verification body be established in response to the terms of a specific future arms limitation and disarmament agreement which requested that the United Nations assist in its verification, those trained individuals could fill its ranks quickly. One must bear in mind, however, that, as the Group itself concluded:

> "The development of a United Nations verification organisation must be seen as an evolutionary process."

On the whole, the Group's recommendations represent the most ambitious agenda for United Nations action that could achieve consensus at this time. The recommendations provide a clear outline for immediate action, on the part both of the United Nations Secretariat and of the individual member states. Indeed, it should be stressed that the speedy implementation of these recommendations will require of individual Members concrete actions in support of the Secretariat. The compilation and indexation of materials for the verification data bank, for example, would be achieved quite readily if those member states possessing data banks or computer indexes were to make these available to the Secretariat. Canada, among others, has already pledged such co-operation.

Conclusion

In these times of rapid shifts in the uses of military power, as some threats wane while new ones arise, there is a need for continued efforts in arms limitation and for adapting negotiation and verification processes to ever changing circumstances. There is also an urgent need for a greater concentration of the world's resources on environmental and developmental issues. Fortunately, encouraging trends are emerging. Arms control and even disarmament treaties are being signed by the major military powers. This process can only be expected to intensify as their military spending is reduced from the high levels of the post-war period.

As many nations look to arms limitation and disarmament treaties with their former adversaries to play an increasing role in their security policies, there will be a growing need to ensure that these treaties are being observed. One must recognize that, until recently, some treaties on arms limitation and disarmament made only cosmetic cuts in military forces, or merely capped existing levels of armaments, or even sanctioned certain types of increases. In such an environment it was sometimes perceived that compliance was of less importance to national security, given the tremendous redundancy of weapons which such agreements left available, than it was to the creation of an environment of political trust between the signatories.

Today, with some military forces decreasing, in absolute and relative terms, countries are developing new attitudes towards verification. Where both sides had previously used exaggerated verification demands as pretexts for stalling negotiations, they now have to reckon with the other side's saying "Yes". On-site inspection, for example, had been an absolute non-starter in verification negotiations for many years. It was thus easy simply to call for blanket on-site inspection provisions in the full knowledge that the other side would reject them. Today, in the wake of the Stockholm Document of 1986 and the 1988 Treaty between the United States and the Soviet Union on the Elimination of Their Intermediate-Range and Shorter-Range Missiles—the INF Treaty—both sides must rigorously weigh the costs and benefits of granting full on-site inspections to the other side, before calling for such rights themselves. As what was once the stuff of propaganda becomes the substance of actual arms limitation and disarmament treaties, new attitudes are emerging. It may well be that a less costly, multilateral approach will find increasing favour over time.

Moreover, the potential usefulness of verification techniques and methods developed in the arms limitation and disarmament area are not limited to these types of agreements. One can imagine, for example, a future treaty to reduce transboundary emissions of various pollutants requiring some sort of verification regime. Indeed, all sorts of international agreements aimed at tackling various environmental problems may require co-operatively run monitoring regimes.

In other areas, as States come to rely more on cooperative actions for their security needs, there will be a growing demand for disengagement observer forces. Though not verification as such, the techniques involved are similar. One could cite many other examples, all of them stressing the importance of verification techniques as a tool for reducing tensions and allowing negotiations to proceed. In this sense, the report of the Group of Experts makes a significant contribution. It recognises the growing importance of multilateral verification and outlines an immediate and practical role for the United Nations to play in the field.

In summary, three major considerations emerge from the report. First, the successful implementation of the Group's recommendations depends on the will of the member states to take the necessary actions. Success will also largely be a function of the extent to which the multilateral process of arms limitation and disarmament takes fully and realistically into account the services the United Nations could provide.

Secondly, member states must display a willingness to apply the lessons being learned in those areas of the world where tensions are being successfully reduced to regions in which the threat of conflict remains high. The recent advances in arms limitation and disarmament have thus far, unfortunately, been limited almost exclusively to the East/West context. Indeed, as we write, the prospects for regional conflicts are growing in other areas of the world, rather than decreasing. If multilateral verification techniques are to be useful in more than agreements between super-Powers and their alliances, arms limitation and disarmament measures must be applied to regional tensions everywhere.

Thirdly, multilateral verification techniques should be examined in contexts beyond those of arms limitation and disarmament agreements. As member states come to recognize, for example, that their security, indeed their survival, depends as much on a healthy environment as on the absence of war, they will want to negotiate international agreements for the protection of the natural environment and resources. Compliance with such agreements will likely require verification provisions similar to those found in treaties on arms limitation and disarmament. The support which the Study gives to various forms of generic research into verification could thus play a vital role in multilateral co-operation in areas beyond arms limitation and disarmament if the will and imagination exist to use the knowledge gained in non-traditional ways.

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IMPROVEMENTS IN EXISTING ACTIVITIES AND POSSIBLE ADDITIONAL ACTIVITIES WITH RESPECT TO VERIFICATION

A. Introduction

Verification of arms limitation and disarmament agreements is viewed today in a different, more positive light by the international community. The trends towards greater transparency and openness are already having a positive effect on international relations, including their military dimension. A more constructive attitude towards the United Nations by many member states is also evident. These changes are giving further practical significance to the statement, contained in the Final Document of the Tenth Special Session of the General Assembly, that the United Nations has a central role and primary responsibility in the sphere of disarmament. The United Nations may wish to address the multilateral aspects of effective verification measures with increasing attention, particularly as multilateral negotiations become more important. The present study should be seen in this context. The right to verify compliance with existing agreements lies with the States parties or such, organisation as may be designated by them. The States parties may also seek assistance and services from the international community and from United Nations organs. Of course, the United Nations cannot and does not seek to impose itself on current negotiations or on established procedures for implementing existing agreements.

B. Assessing the Need

A point of departure for assessing the need of United Nations involvement in the verification of arms limitation and disarmament agreements should be the fact that it is universally recognised that such agreements should be adequately and effectively verified and that all States have equal rights to participate in the process of international verification of agreements to which they are parties. Verification of compliance with the obligations imposed by an arms limitation and disarmament agreement is an activity that may, *inter alia,* be conducted by an organisation at the request and with the explicit consent of the parties. These are among the 16 principles, adopted by the Disarmament Commission and set out in section II above. The fact that the Disarmament Commission was requested to perform the task of establishing such principles is in itself a recognition of the need to engage the United Nations in this matter.

A number of issues on the international disarmament agenda have or will have a global application. As no other international organisation with comparable status and universal coverage exists in this field, it is appropriate to explore possible contributions that the United Nations might make to the universal and non-discriminatory application of available means of verification. Access to the technical means of verification is very uneven between the States members of the international community. Economic resources and expertise are also very unevenly distributed. It may be possible that in the future some functions and techniques in the verification of different arms limitation and disarmament agreements will overlap. In this context, the United Nations might also make its contribution to the exploration by States parties of rational use of resources in this domain.

The increased importance of multilateral negotiations has several implications that can enhance the role of the United Nations. First, the question of disarmament concerns the peace and security of all States and consequently, as stated in the Final Document of the Tenth Special Session of the General Assembly, all States have the right to participate on an equal footing in those multilateral disarmament negotiations which have a direct bearing on their national security. Secondly, an increasing number of States will wish to have information relevant to ongoing negotiations. Thirdly, States parties will also need expertise in order to play an effective role in the implementation of agreements. An international organisation like the United Nations could offer help to all states, in particular to those which do not have the necessary verification capabilities. The United Nations can usefully build on the foundation it has established in serving member states with the collection of data and the dissemination of information concerning arms limitation and disarmament. The present negotiations of new agreements on a variety of weapon systems would require sophisticated verification provisions as well as the growing co-operation of States in their implementation. In these circumstances, there is an even greater requirement for expertise and information that can help States parties to play a useful role, both in the negotiation and implementation of new agreements.

On occasion, concerns over non-compliance have undermined confidence in the effectiveness of a number of existing agreements. Some bilateral agreements have clear provisions and institutional arrangements to address concerns over non-compliance. These begin with the establishment and communication of facts. Other multilateral agreements, such as the 1925 Geneva Protocol, do not. Given convincing evidence of the recent use of chemical weapons, the pressing need to reaffirm agreed prohibitions against such use, and the widely acknowledged utility of the Secretary-General's fact-finding role in this regard, it would be useful to consider ways in which the United Nations role can be enhanced, and whether similar activities by the Secretary-General could be helpful in other areas of arms limitation and disarmament.

All these factors make it natural to look for multilateral ways and means of co-ordinating resources in order to use them more rationally and to compensate for asymmetries in capabilities of States in this field. This may also be an important factor in promoting universal adherence to future agreements. No organisation other than the United Nations has a better potential to cater to such needs. Whether they could or should be performed within the existing framework, or whether a special body should be established within the United Nations system, will be dependent on the extension of the functions entrusted to the United Nations.

C. Examination of Possibilities

The following list of possibilities for enhancing the United Nations role in verification collates specific ideas that have been advanced under generic headings. It is not exhaustive; new proposals continue to be advanced. What follows is a descriptive survey of proposals where organisational,' technical, operational, legal and financial aspects can be readily assessed, and where short- medium-, and long-term implications can be considered carefully. Government studies cited in this report are used to illustrate this list of possibilities; the Group does not necessarily endorse these studies.

Cost estimates for these proposals will vary as they depend on the tasks at hand, the specific configuration of the equipment employed and the manner of its use. The estimates given below, as made available to the Group, are therefore only illustrative of the magnitudes of sums involved.

1. United Nations Capability for Data Collection

(a) Background and Description

Verification arrangements for existing accords are built upon data collected by national technical means (NTM), whether unilaterally or in co-operation with others, and by other co-operative arrangements. Increasingly, the access to and availability of data, by data exchanges and other means, have become essential building-blocks for arms limitation and disarmament agreements and for confidence-and security-building measures between States parties. Several types of data might also be beneficial for States that are not parties to existing agreements, and these may be derived from:

(a) Information on the generic verification process (e.g. verification research, methods and bibliographies): as this information is related to research into the development of better methods and approaches, its collection may be directly relevant and beneficial to all States;

(b) Information related to verification procedures and actual compliance with existing arms limitation and disarmament agreements: this information provided or released by some States parties could be relevant as well to States not parties as they consider future participation in the agreements. In order to collect information relating to compliance with a specific agreement the United Nations may require a specific mandate.

Greater openness, through the unilateral provision of data, data exchanges and other means, can also help establish conditions so that nations will become inclined to reduce the burdens imposed by the purchase of weapon systems and rely increasingly on alternative arrangements that provide for common security. To this end, information on military budgets, as well as notification and declaration of military activities, may be openly published by some States or provided directly to the United Nations. Expanded data exchanges can help provide the much needed basis for confidence- and security-building measures and for the negotiation of future arms limitation and disarmament agreements.

In particular, the United Nations could be entrusted with collecting information on military matters pertaining *to* areas common to all

States and with distributing such information to member states, thus contributing to openness and transparency in such areas. Information of this kind could be of value for States both in their efforts to verify the implementation of current arms limitation agreements applicable to such areas, and generally for their assessment of the status of these areas.

(b) Organisational Implications

In several ways the elements of a United Nations data collection service for verification are already coming into place. Data relevant to the Biological Weapons Convention are provided to the United Nations on an annual basis; some member states have begun to provide the United Nations with data regarding national military expenditures, a process that can be "usefully expanded and elaborated upon; a roster of chemical weapons (CW) investigative experts and laboratories is on hand in the Office of the Secretary-General, a practice that could also be expanded to other areas; a primary database on chemical weapons, in connection with the draft convention being negotiated, is being established by the Department for Disarmament Affairs at Geneva; in addition, some States are already contributing national data relevant to the draft CW convention; seismic data are being compiled on a world-wide basis by experts in the field; individual member states and non-governmental organisations have also compiled comprehensive bibliographies of verification literature and collected material from centres of verification expertise.

The United Nations might gather and organize existing information in a structured formal way, make a more concerted and co-ordinated effort to compile, store and disseminate useful data relating to verification, and assign these functions to a specific department or office where appropriate. The elaborate accounting system of the IAEA and its records on facilities covered under the safeguards system provides an example of how such a system, handling specific information in the context of a specific agreement, can help build mutual confidence and security and contribute to verification of arms limitation and disarmament accords.

Initially, a United Nations data collection service could begin on a small scale, collecting, compiling, and disseminating material on verification provisions and confidence- and security-building measures. In the absence of a new organisation within the United Nations, a clearinghouse function involving basic data could be carried out by an existing United Nations body such as the Department for Disarmament Affairs. Particular effort could be directed at the collection of useful published data additional to that required under existing accords (such as disaggregated data on national military expenditures).

Pending the establishment of an effective verification and complaints mechanism for the Biological Weapons Convention, the United Nations data collection service could be provided with additional information by States parties to that agreement on certain facilities or activities within their borders that could raise questions concerning compliance. Annual declarations provided to the United Nations on high containment biological research facilities and detailed information regarding the outbreak of diseases, as agreed upon at the Second Review Conferance of the Biological Weapons Convention in 1986, could provide the foundation for additional data exchanges in this field. The expertise of the world Health Organosation (WHO) and the Food and agriculture Organisation of the United Nations (FAO) might be helpful in this regard. Member states could also provide complete bibliographies of verification-related material published in their countries, as well as copies of such material, where possible. Additional information could be provided by international organisations and agencies with verification responsibilities. Rosters could list the international experts who could respond to verification questions. As there is currently no central repository of verification materials establishing such a capability and facilitating the provision of such services could be helpful not just for Governments, but also for United Nations officials and researchers in the field.

A central repository of published information in the verification field under United Nations auspices could help promote relevant expertise and better understanding of national concerns. It could also clarify areas requiring further investigation. The degree to which such a service would facilitate research would vary, depending upon the research materials available in the United Nations and the extent to which individual States would draw upon it. As collections of data grow over the medium- and long-term, the service could help narrow gaps in knowledge between member states, providing up-to-date information on current research findings.

A distinction should be made between library-oriented activities and an operational exchange of data relevant to confidence-building and treaty verification. Such an exchange may include collecting, compiling and redistributing data obtained, for example, from seismological and radiological measurements and from overhead imagery obtained from satellites and aircraft.

(c) Technical, Legal and Operational Implications

The technical difficulties associated with the establishment of a United Nations data collection service do not appear to be great. Computerised data banks would be required, as well as the time and effort associated with inputting and updating all of the data. Legal constraints could arise. If such data collection involved the transmission of data relating to existing accords, the consent of States parties would be required. Operational complications could be minimised by tasking an existing body within the United Nations with the responsibilities of establishing a data collection service. There should be co-ordination in order to minimize costs and duplication should be avoided by appropriate use of data-transmission services between the United Nations organs involved. An operational data exchange is an extensive function, involving large amounts of data, which requires access to experts as well as dedicated computers.

(d) Financial Implications

Financial obligations that would arise from the establishment of such a United Nations service would depend on the size and functions agreed upon by member states, and therefore cannot at present be estimated. A United Nations data service would entail additional computer capability and added personnel to carry out assigned tasks. Its size and functions could grow over time with new sources of data stemming from voluntary and agreed procedures, subject to financial constraints.

One example of a collection, compilation and dissemination function within the United Nations is the Energy Statistics Unit of the Department of International Economic and Social Affairs of the United Nations Secretariat. This unit is responsible for collecting, compiling and disseminating statistics on energy and related subjects. With two Professional and five General Service staff, it has a regular annual budget of $US 270,000.

2. Promotion of Exchanges between Experts and Diplomats

(a) Background and Description

The increased complexity of verification techniques means that negotiators have more to learn from one another. The increased complexity of these negotiations means that negotiators also have more to learn from experts, whether from Governments, industry, or non-governmental specialists, such as seismologists. Exchanges between technical experts and diplomatic officials can therefore be quite beneficial, within and across bilateral and multilateral negotiating contexts. They may also be beneficial for both groups: experts can help diplomats address negotiating problems, and diplomats can help experts focus on problems in need of solutions. Ideas, technical approaches, and procedures developed in one negotiation may also have applicability in another.

The usefulness of such exchanges can be expanded to inform States not parties to ongoing negotiations. Their participation in informal exchanges on verification might prove helpful in several ways. They might, for example, gain new insights as to how their security concerns can be alleviated through co-operative verification measures under consideration in diplomatic exchanges to which they are not parties. They might also gain sufficient confidence in verification concepts so as to join in multilateral negotiations or existing accords.

Exchanges between technical experts and negotiators have been carried out in the context of ongoing negotiations in the Conference on Disarmament on a complete ban on chemical weapons and discussions on a nuclear-test ban and on prevention of an arms race in outer space. Separately, with the co-operation of various Governments, there have been seminars and symposia held on verification issues, organised by the Department for Disarmament Affairs and by UNIDIR, as well as United Nations studies on arms limitation and disarmament. Participants in these exchanges have found them to be helpful: technical experts gain a better understanding of negotiating perspectives, and diplomats acquire a "hands on" appreciation of sometimes technically complex negotiating issues.

(b) Organisational Implications

An expansion of exchange programmes between technical experts and diplomats could help to facilitate verification research, promote international co-operation in the development of verification technology and stimulate progress in ongoing negotiations. It could also help build consensus as to appropriate monitoring methods for difficult verification problems. Such exchanges could be carried out, as at present, within the framework of current negotiations or under United Nations auspices. If carried out under United Nations auspices, exchanges could help build expertise among participants that might be useful over the long-run in the formulation and implementation of verification provisions. This assistance, however, would be provided on a responsive basis, and with the consent of parties involved in the negotiations.

The most appropriate activities of the United Nations in fostering exchanges, at least initially, might be to encourage a cross-fertilisation of ideas and the inclusion of States that are not parties to ongoing negotiations. Countries in which advanced verification research is under way might be encouraged to host exchanges under United Nations auspices. Presentations during these exchanges might then be published in United Nations publications and logged into a United Nations data bank, to serve as a resource for officials and researchers in the field.

(c) Technical, Legal and Operational Implications

Given its existing activities, the promotion of exchanges between technical experts and diplomats need not pose short-term technical, legal, and operational difficulties for the United Nations.

(d) Financial Implications

Over the long-term, exchanges between technical experts and diplomats under the auspices of the United Nations could expand to the point where additional staff may be required to carry them out, imposing new financial obligations on the United Nations. Financial obligations arising from such exchanges could be alleviated by host country donations and by earmarked financial contributions by member states.

3. Possible Expansion of the Secretary-General's Fact-Finding Activities

(a) Background and Description

Another possibility for enhancing the role of the United Nations in verification relates to the Secretary-General's fact-finding activities. As explained in detail in section IV above, the Secretary-General currently has a mandate to investigate the alleged use of chemical weapons and bacteriological methods of warfare. For this purpose, he may draw from a roster of qualified medical and technical experts and use the services of laboratories to analyse evidence collected.

Fact-finding capabilities may be enhanced either by broadening the scope of the Secretary-General's mandate, or by expanding the means by which the current mandate can be carried out. For example, the Secretary-General's mandate could be extended to cover existing and new agreements on a case-by-case basis, with the consent of States parties. For example, the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, might be a case in point. In order to enhance greater confidence in the Biological Weapons Convention, ways might be studied of building upon the relevant provisions of the Final Declaration of the Second Review Conference of the Convention adopted in 1986.

Fact-finding capabilities could also be enhanced by expanding the roster of qualified experts and by providing them with improved technical and analytical capabilities. Near-term improvements in fact-finding capabilities might include expanded rosters of technical experts for the 1925 Geneva Protocol and provision of improved portable CW monitoring equipment. In all such cases, expansion of the Secretary-General's fact-finding responsibilities would be at the behest of member states, with the clear purpose of strengthening accords already approved by them. Future agreements, such as the CW Convention, will of course have to be taken into account.

In the medium term. member states might consider expanding fact-finding operations as data exchanges grow or as new agreements warrant. Improved monitoring capabilities, such as portable equipment especially suited for fact-finding missions, could be provided as they are developed by member States. When appropriate, aircraft operating under United Nations auspices could be dedicated to fact-finding missions to ensure timely arrival, or transportation could be provided by member states. When appropriate, satellite imagery, or that obtained by aircraft, provided with the assistance of member states or from commercial sources, could also be used in support of fact-finding operations.

Over the long term. United Nations fact-finding operations could utilize the supporting services of the United Nations in the field of verification or an international verification system. Further considerations of medium- and long-term improvements, such as the use of aircraft, satellites, and the establishment of an international verification system, are discussed below.

(b) Organisational Implications

Near-term improvements in the Secretary-General's fact finding capabilities raise a variety of organisational issues. An expansion of the Secretary-General's means to carry out the existing mandate in connection with fact-finding missions may require greater co-ordination within the United Nations and between the Secretary-General and member states.

Proper care must be taken to ensure that, whatever organisational arrangements would be agreed, they should not hinder the Secretary-General's flexibility to conduct fact-finding missions in a manner most appropriate to the circumstances at hand.

As fact-finding tasks might differ substantially from one agreement to the next, separate rosters of experts would be required. Questions concerning the nationalities of individual experts and the composition of expert teams might be raised, suggesting the need for further agreed procedures governing fact-finding missions. In the future, fact-finding operations in connection with armaments and for peace-keeping operations might employ similar procedures, suggesting the need for close coordination and oversight.

If an expansion of the means to conduct fact-finding missions under the Secretary-General's current mandate, or an expansion of that mandate to new arms limitation and disarmament agreements, does not require new institutional arrangements within the United Nations, organisational implications can be minimised.

(c) Technical, Legal and Operational Implications

Contributions by member states that provide additional technical capabilities to fact-finding teams under the Secretary-General's current mandate are encouraged, as they have no adverse implications. In expanding the Secretary-General's fact-finding mandate it would be appropriate to take into account a number of considerations. An expansion of the mandate to new arms limitation and disarmament agreements would have to be at the behest of States parties and must take place with their expressed consent. It would not substitute for, nor interfere with, direct consultations between States that might be beneficial to address concerns over compliance. The mandate for any new fact-finding activities by the Secretary-General must be created first, and the development of any capability and infrastructure to carry out such activities must be contingent upon having an agreed mandate. New fact-finding mandates should not interfere with existing treaty procedures respecting verification. Any investigation should be carried out in the least intrusive manner possible.

Additional difficulties arising from an expanded fact-finding role by the Secretary-General relate to whether such efforts will be useful in confirming violations of existing accords. No inspection team can go to a place when the host nation does not approve. The United Nations would not be able to render this service unless it was given both the mandate and the capability to perform fact-finding missions.

Expanded fact-finding operations could be organised in such a way as to facilitate the resolution of compliance concerns when the facts in question are subject to differing interpretations or when such interpretations may be keyed to political orientations instead of facts.

(d) Financial Implications

The financial obligations that might arise from an expanded fact finding role by the Secretary-General could vary greatly. Rosters of experts and qualified laboratories could be expanded at low cost, while providing experts with improved man-portable equipment could entail modest costs. Improved analytical capabilities within national laboratories presumably would be borne by the States parties. Financial obligations arising from such improved capabilities to carry out the Secretary-General's existing mandate could be alleviated by host country donations and by earmarked financial contributions by member states.

Dedicated aircraft to transport fact-finding missions would entail costs for procurement, manning, maintenance, and operation, especially as back-up aircraft and crews might be required. Cost estimates vary greatly, depending upon the tasks at hand, the parameters of aircraft use and the basis for calculating costs. Therefore, the costs presented are for illustrative purposes only.

For example, over a five-year period, the direct and fixed operating costs for a fleet of five Gulfstream IV aircraft might average approximately $US 31 million per year. Comparable costs for a fleet of five Boeing 757-200 aircraft might-average $US 89 million per year. The capital costs for a fleet of five Dehavill and Dash 8-300 aircraft, modified to carry radar, infrared and optical sensors, is estimated to be approximately $US 84 million. Annual recurring costs for aircraft maintenance, operation, and personnel are estimated to be approximately $US 6 million. A fleet of five EMB 120 Brasilia aircraft would cost approximately $US 38 million. The purchase price of a fleet of five AN-30 aircraft equipped to carry optical mapping cameras is approximately $US 8 million. The purchase of a fleet of five AN-72p aircraft, available in 1992, equipped to carry optical mapping and panoramic cameras, would cost approximately $US 52 million. Costs could be defrayed if other tasks were assigned to these aircraft, such as for peace-keeping operations.

Costs could be minimised if member states donated aircraft for future United Nations verification efforts, or assumed the costs of transportation for specific fact-finding missions. Costs may also be reduced by leasing aircraft and surveillance equipment. Annual leasing costs for two Canadian aircraft and associated sensors are estimated to be approximately $US 8 million. Estimated annual leasing costs for a fleet of five Gulfstream IV aircraft are approximately $US 27 million. Estimated leasing costs per EMB-120 Brasilia aircraft are $US 1 million approximately per year. The costs entailed in providing satellite support for fact-finding missions are discussed below. The costs of such operations must be weighed against their presumed benefits. Increased costs for fact-finding by the Secretary-General would have to be borne through increased payments by member states, through donations in kind, or through greater cost efficiencies or reductions in existing services.

4. Possible Uses of Aircraft for Verification Purposes

(a) Background and Description

As described in section III above, aircraft have several important features that lend themselves to verification purposes. Aircraft can be extremely flexible verification platforms that can be deployed relatively quickly to carry out surveillance over any specified area, subject to the consent of States overflown. Aircraft may also succeed in gathering data at night and under cloudy conditions, whereas satellites usually are not equipped to do so.

Aircraft overflights may also be particularly useful for monitoring confidence- and security-building measures. Aircraft overflights can be a means to build mutual trust and transparency between States, making threatening military preparations harder to conceal, allowing them to negotiate more far-reaching arms limitation and disarmament agreements in the future.

(b) Organisational Implications

The use of aircraft by the United Nations would raise organisational issues regarding agreed procedures and equipment. Aircraft could also be employed in different ways by the United Nations. As a result, management decisions would be required as to how aircraft, associated personnel and equipment would relate to existing and new activities, and whether the control of such operations should be centralised.

(c) Technical, Legal and Operational Implications

Aircraft overflights for verification or monitoring purposes, whether for verification of compliance or for greater transparency between States, would require the consent of all parties concerned, including States parties to an arms limitation and disarmament agreement. Suitable procedures and equipment would also have to be agreed upon.

The sensors carried on board aircraft for verification purposes can be optimised for different tasks. For example, if the aircraft is appropriately equipped, cameras and/or radars can be employed, depending on weather conditions. Several different sensors can be carried aboard at the same time, depending on the size of the aircraft and the weight of the sensors. The choice of sensors is, of course, primarily a function of the tasks at hand.

Aircraft overflights for verification and monitoring purposes have several limitations. Such aircraft can be vulnerable to local conditions or situations of potential danger, necessitating clear rules for these operations. Range limitations may be of concern, and for large areas to be covered, multiple aircraft would be needed. Operational costs may also be raised by the need for back-up aircraft, crews and maintenance personnel. The composition of flight crews must be satisfactorily resolved. Agreed procedures between flight crews and hosts must be established in advance that are not subject to different interpretations by States parties, although some flexibility will be required to deal with unusual circumstances that may arise during overflights. Consultative arrangements will be needed and corrective measures must be taken when agreed procedures are not adhered to.

Aircraft overflights provide opportunities for many States to become more fully involved in the verification process. Many States have thorough training programmes in this regard. Some States have also gained experience in the observation of military exercises by implementing the Stockholm Document. As differences in interpretation of data collected on aircraft overflights might arise, a combination of different methods of verification might be used in order to reduce the possibility of contention.

(d) Financial Implications

Estimated costs for aircraft operations are described in paragraph 211 above.

Financial costs for agreed aircraft overflights could be curtailed by the use of existing aircraft and sensors, some of which may be surplus to current military requirements or may be leased commercially or purchased without any major changes. member states may be inclined to make these assets available to multilateral efforts to facilitate arms limitation and disarmament. However, even if initial outlays for equipment are minimised, operating costs can be substantial over time.

5. Possible uses of Satellites

(a) Background and Description

Optical Imaging Satellites

For almost 30 years, only the United States and the Soviet Union have operated moderate-to-high resolution Earth observation satellites. The images emanating from these satellites have served as a tool for various monitoring purposes, including verification of bilateral arms limitation and disarmament agreements.

As more States develop the capability to build and launch imaging satellites, new possibilities are created for "Multi-national technical means". In this regard, the French Government proposed in 1978 an international satellite monitoring agency (ISMA), with a view to advancing disarmament efforts and strengthening international confidence and security.

As initially proposed, ISMA was to be responsible for collecting, processing and disseminating information secured by means of Earth observation satellites. France proposed that the Agency's mandate include fact-finding and verification of compliance with existing agreements, if States parties were inclined to use its services. ISMA would have required a centre for processing data, ground stations, and satellites. This proposal was the subject of an in-depth technical, legal, and financial assessment in a United Nations study (A/AC. 206/14), as requested by the General Assembly. Ideas have also been advanced for a regional satellite monitoring agency.

In 1988, the Soviet Union proposed the establishment of an international space monitoring agency that would provide the international community with information relating to compliance with multilateral agreements in the field of disarmament and the reduction of international tension, and would also monitor the military situation in areas of conflict. This proposal, included inter alia, the idea of joint research and development of such satellites by member states. It was stated that Soviet launch vehicles and launching-sites could be provided and the flight-control complex and ground data-reception stations belonging to the USSR could provide controlling services.

In 1988, the French Government proposed that, as a first step, an agency for the processing of satellite images (APSI) be created. This agency would collect, process, and disseminate data obtained by means of existing civilian satellites, and train photo-interpreters in the technical processing of raw data. APSI could be employed in the service of disarmament agreements, crisis management, or natural disasters. The products of the agency would be made available to its members. France and the Soviet Union have offered to provide or sell imagery from their observation satellites to such an international body.

Additional analysis of imaging satellite operations for multilateral agreements has been provided by the Canadian and Swedish Governments. Canada has studied the PAXSAT concept focusing on two applications for multilateral agreements; verification of space objects from space, and space-to-ground verification. Sweden has carried out and published detailed studies of the technical and financial aspects of developing, building, launching and operating a verification satellite. This satellite, "Tellus", is conceived for space to ground monitoring applications.

Radar Satellites

The utility of optical satellite with sensors only in the visible light spectrum is limited to daylight hours and areas of the globe that are relatively free of cloud cover when the satellites pass overhead. Radar satellites, while they have limited capabilities for use in the search mode over land, are not constrained in this way. They can complement optical imaging satellites and other monitoring tools in certain ways.

An illustrative example is the study carried out by the Canadian Government on the feasibility of developing a regional monitoring satellite system applicable to conventional arms limitation and disarmament in Europe (PAXSAT B), based on Western technology commercially available in the next 10 years. According to the study, this system would consist of two synthetic aperture radar satellites with 5-metre resolution orbiting at an altitude of approximately 800 kilometres, plus one spare satellite, ground data-receiving stations and image-processing equipment. The study states that, in addition, two optical sensing satellites, plus one spare satellite and ground-based equipment would complete the system.

Telecommunications Satellites

Telecommunications satellites provide reliable and rapid communication links between States, a capability that might prove of importance in various arms limitation and disarmament efforts and in confidence- and security-building measures that help establish the conditions for new disarmament agreements.

The United States and the Soviet Union have long relied on satellite communications to provide secure information to each other at the head-of-government level via the Direct Communication Link, or "Hot-Line". These communication links were broadened and strengthened in 1987 with the establishment of Nuclear Risk Reduction Centres to lessen the possibility of direct confrontations through misinterpretation, miscalculation, or accident. The communication link of the Nuclear Risk Reduction Centres is also used to transmit notifications under the INF Treaty and the Ballistic Missile Launch Notification Agreement.

As new accords are negotiated requiring large data exchanges, the role of telecommunications satellites in arms limitation and disarmament agreements will become more important. Such data exchanges will be a feature of international co-operative measures to detect and identify seismic events and of the implementation of a chemical weapons convention. In addition, a growing number of States may wish to take advantage of satellite communications for multilateral activities of military conflict risk reduction, including within the framework of the United Nations.

The Swedish Government has proposed the establishment of the COMSENS Data Exchange Satellite System to establish an independent channel of communication for the exchange of verification data. The operational system would include two satellites in a near-polar orbit with on-board processors and memory units, linked to international and national data centres. The satellite could be employed for any agreement requiring significant data transfers from observers and sensors in the field. The Swedish proposal is based on a study that underlines that seismic monitoring of a possible future test ban would require significant data transmissions. It further emphasises that such a communication system would enhance the possibilities of establishing the authenticity of transmitting stations and of the data provided. It would also make it possible to track and identify military and other units equipped with electronic identification devices. The expertise of the International Telecommunications Union might be helpful in efforts for using telecommunication satellites.

(b) Organisational Implications

As stated in the report of the Secretary-General on ISMA, "The Implications of Establishing an International Satellites Monitoring

Agency" (A/AC.206/14, para. 303), no provisions on general international law entail a prohibition for an international organisation to carry out monitoring activities from space. However, a specific mandate would be necessary to charge an international organisation, such as the United Nations, with the responsibility of verifying arms limitation and disarmament treaties from space. Such a mandate would presuppose the consent of States parties to these treaties. On the other hand, the use of existing satellites by the United Nations to perform such tasks in relation to non-treaty specific activities would require only a decision by the appropriate organs of the United Nations.

Whenever satellites or their imagery are utilised by a multi-national institution, organisational questions will be raised because of the multi-purpose nature of satellite operations. With appropriate resolution, timely receipt of imagery and professional photo-interpretation capabilities, satellites can be useful for monitoring peace-keeping operations, disengagement agreements, crisis diplomacy, confidence- and security-building measures, and arms limitation and disarmament accords. Satellites can also be used in conjuction with electronically "tagged" equipment of relevance in this context. These activities are the concern of different parts of the United Nations system. Management decisions would therefore be required as to how new monitoring capabilities and personnel would relate to ongoing activities. Given the sensitivity of imagery analysis in a multi-national context, such activities would require close supervision by the Secretary-General.

(c) Technical, Legal and Operational Implications

There are no insurmountable technical barriers to the development, construction and launch of imaging, radar, and telecommunications satellites; the barriers are mainly political and financial. In the short-term, imaging and radar satellites developed for multi-national verification purposes might have insufficient resolution to assist in verification of compliance with some provisions of arms limitation and disarmament agreements. Over time, however, the development of high resolution satellites appears feasible.

The effectiveness of a verification and monitoring system based on the use of observation satellites placed at the service of the United Nations would depend, inter alia- upon the tasks assigned to those satellites, their number, the extent of delay in obtaining imagery, the timeliness with which interested countries would have access to it and their photo-interpretation capacity. It is possible to envisage an initial configuration rather modest in its goals and gradual improvements to be developed in the long term. It might be practicable to start with a small number of satellites, which could subsequently be increased.

If the United Nations were to make use of imagery from observation satellites for such tasks as carrying out fact-finding missions on the ground, or implementing arms limitation or disarmament agreements, a cadre of trained photo-interpreters would be needed. In this regard, consideration could be given to the training that might be provided on a voluntary basis by member states, or by the Organisation, to ensure regional balance among the qualified cadre of photo-interpreters.

Beyond the technical processing of raw data, in this context, imagery analysis and judgements as to compliance or non-compliance would be the responsibilities of States parties to the agreement in question, unless the States parties provide such a mandate to the Secretary-General or to an international or regional satellite [monitoring agency.

(d) Financial Implications

The likely costs would depend greatly on the specific configuration of satellite equipment and all associated facilities and support. The estimates given below, as made available to the Group, are therefore illustrative.

Swedish experts estimate the costs to establish the Tellus system at approximately $US 400 million (2,500 million Swedish kronor (SKr)), including development, and launch of one imaging satellite and limited ground facilities. The yearly operating costs per satellite are estimated at $US 15 million (SKr 80 million). Four launches could take place over a 10-year period, assuming a four-year life span for each satellite and an overlap between satellites of between one and two years. The 10-year costs for such a system including satellite development and launch, as well as operating costs, are approximately $US 1.7 billion (SKr 9,960 million).

A 1990 Canadian review of satellite costs suggests a capital cost of $US 246 million for one synthetic aperture radar imaging satellite, and $US 246 million for one optical imaging satellite. Launching costs for both satellites were estimated to be approximately $US 230 million; two satellites receiving stations would cost $US 11 million. Two image production systems are stimated to cost approximately $US 8 million. Telemetry, tracking and control stations for the satellite system would require an additional $US 33 million, for a total cost of approximately $US 774 million. Soviet launch services, if obtained on a commercial basis, are estimated to range in cost from approximately $US 28 million to $US 58 million, depending on, *inter alia,* the type of launch vehicle used, the concrete characteristics of the loading, associated facilities and orbital characteristics. The average life-cycle costs of a radar satellite system, as estimated by the anadian Government, are approximately $US 500 million per year. This figure represents the purchase and operation of two synthetic aperture radar satellites, plus one spare and associated ground quipment. A further $US 500 million per year would be required for the two optical satellites, plus one spare and ground-based equipment. These figures do not include the cost of training photo-interpreters or other personnel costs associated with radar satellite operations.

The total cost of developing and manufacturing the COMSENS system of two telecommunications satellites, including the ground control station, was earlier estimated at approximately $US 50 million by the Swedish Government. A more recent cost estimate (January 1990) puts this cost at approximately $US 40 million (SKr 250 million). This includes the launch of the two satellites and the establishment of their ground control station. The yearly cost for the operation and maintenance of the system, essentially its ground control station, is estimated at approximately $US 1 million (SKr 6 million). The satellite is designed for a lifetime of about eight years. The additional cost for one satellite (excluding launch) is estimated at $US 8 million (SKr 50 million). The launch cost for one satellite, depending on arrangements, is estimated to be $US 5 million to $10 million (SKr 30 million to SKr 60 million). One issue for consideration is the alternative cost of leasing data communications channels from international or national satellite networks.

If member states are unable to provide additional contributions for satellites, donations in kind would be a means of avoiding the most significant outlays associated with satellite operations by an international body. In the absence of such a body. member states operating observation satellites could undertake to provide their services, including possible access to their imagery.

6. Possible Creation of an International Verification System

(a) Background and Description

The incentive to create an integrated multilateral verification system within the United Nations framework rests in the unique characteristics of the United Nations. The Organisation has the capacity to provide impartial observers and experts; it has already done so, for example, in support of regional peace-keeping efforts and to strengthen the 1925 Geneva Protocol. A number of proposals have been made, as already described in section IV above, to create some type of international verification system. Many of these proposals mention the need to utilize available multi-purpose verification techniques.

An international verification system might also be tasked by States with facilitating conflict resolution efforts, early warning with regard to emerging crises, or identifying confidence- and security-building measures in regions of the globe that do not now have these arrangements in place. In such cases, the work of an international verification system can lay the basis for new arms limitation and disarmament agreements. Where such arrangements already exist, an international verification system could add new monitoring capabilities or help to establish far-reaching transparency measures.

(b) Organisational Implications

Some of the ideas raised could constitute services provided by an international verification system within the framework of the United Nations. Services could include, but not be limited to, gathering and distributing data, facilitating research, providing expertise and advice, when requested and when able. Such services could begin in the near-term at a modest level, such as by the collection of data. In due course, more complex and costly organisational responsibilities could be considered, such as operating aircraft overflights and establishing an international or regional satellite monitoring agency utilising optical, radar and telecommunications satellites.

An evolutionary approach might be used to establish an international verification system within the United Nations if a decision was taken on the issue. Such a verification system could start with quite modest equipment and subsequently it could consider more advanced techniques including imagery from aircraft and satellites as well as use of optical, radar and telecommunication satellites. Such an international verification system might also develop institutionally in an evolutionary manner starting with modest international centres and subsequently, when the United Nations has been assigned sufficient verification tasks to justify it, consideration might be given to establishing an appropriating agency within the United Nations system.

(c) Technical, Legal and Operational Implications

The United Nations provides an institutional framework as well as the infrastructure to build on existing activities. The Organisation has particular potential to be able to provide an integrated multilateral approach to verification of arms limitation and disarmament agreements. The legal authority of the United Nations to play a role in the verification of specific arms limitation and disarmament agreements - whether through an international verification system or more limited arrangements - is dependent upon States parties granting the United Nations such authority.

When there are common elements in several agreements in regard to methods, procedures, techniques and approaches to verification and compliance, an integrated approach may also provide certain advantages. It is also conceivable that an international verification system would encompass separate verification units for different arms limitation and disarmament agreements. In either case, the integrated mechanism would have to work in tandem with the different organs and parties to the separate agreements. By means of such a mechanism, an organisational structure would be in place, when new agreements would be concluded, thus facilitating the beginning of verification operations in a timely fashion. The verification experience accumulated in the international verification system would also be useful. Costs could be reduced as overhead and administrative costs would be shared.

Some difficulties may arise while contemplating an integrated approach. For example, not all arms limitation and disarmament agreements are negotiated at the same time as confidence-building measures. In principle, not entirely the same set of States may be parties to all agreements. Each specific agreement can, in principle, create a specific mechanism to address the attendant compliance questions. An international verification system that attempts to provide central guidance or authority to diverse undertakings involving different States parties may not always facilitate and encourage further progress toward disarmament. A mandate for an international verification system will need to be carefully formulated in order to meet the concern of States parties about participation by non-parties who do not share the obligations of the agreement in question.

A successful integrated verification system could do much to promote confidence and trust between States, thereby facilitating the achievement of further arras limitation and disarmament measures.

(d) Financial Implications

The costs associated with the creation of an international verification system would depend entirely upon the wide-ranging nature of its possible functions. At present the few responsibilities in the area of verification of arms limitation and disarmament that have been assigned to the United Nations have been on an *ad hoc* basis and no substantial financial support has been devoted to them. For instance, only a very small proportion of the resources of the Department for Disarmament Affairs is related to verification issues; the Department's total budget for all its activities is slightly more than $US 5 million per year (some 0.6 per cent of the total annual regular budget of the United Nations). As an illustration of the costs that could be involved in the creation of an international verification system, the current costs of the IAEA safeguards arrangements (see section IV above) amount to almost $US 53 million per year. For the United Nations to acquire the level and amount of verification expertise that would be necessary would involve the commitment of significant financial resources.

TOWARDS AN INTERNATIONAL VERIFICATION SYSTEM

A more peaceful international system should have, as one its main pillars, arms limition and disarmament agreements that include verification measures in which all states can have confidence. It is now universally accepted that adequate and affective verification is an element of arms limitation and disarmament agreements.

Verification is a process for establishing whether the States parties are complying with an agreement. The process includes data collection, data analysis, and reaching a judgement on the basis of that information about whether or not obligations under an agreement are being met.

The context in which verification takes place is that of the sovereign right of States to conclude arms limitation and disarmament agreements and their obligation to implement them. Verification is conducted by the parties to an agreement, or by an organisation at their request.

Having identified and reviewed existing activities of the United Nations in the field of verification of arms limitation and disarmament, the mandate of the Group of Experts required it to assess the need for improvements in existing activities as well as to explore and identify possible additional activities, taking into account organisational, technical, operational, legal and financial aspects. The Group's consideration of this part of its mandate is reflected in section V above, which presents a survey of possibilities for enhancing the United Nations role in verification by collating specific ideas under generic headings. The survey is illustrative and not exhaustive. New proposals can be expected in the light of current developments.

Taking into account the essential role of verification in arms limitation and disarmament, the Group concluded that the United Nations will need to address the multilateral aspects of verification with increasing attention, particularly with the growing importance of multilateral negotiations.

Significant changes in East/West relations have developed in recent years that have enhanced security. The improving situation has established conditions for successful arms limitation and disarmament measures that were once considered remote. A continuation of these trends and further positive developments in other areas of the world cannot but increase confidence and security between States and may lead to more far-reaching steps by the United Nations in the field of verification of arms limitation and disarmament agreements.

In considering the role of the United Nations in the field of verification, and in recognition of the complexity of political, organisational, technical, operational, legal and financial aspects involved, the Group agreed that further actions should be considered in the terms of short, medium and longer timescales. The Group recognizes, however, that the dynamic development of the world situation, possible rapid progress of arms limitation and disarmament negotiations, and the growing importance of finding multilateral solutions, may well overtake any current projections and introduce new schedules and approaches for United Nations involvement in verification.

In a world in which mistrust and suspicion have all too frequently dominant, and progress in arms limitation and disarmament has often been hindered by the absence of mutual confidence between States, the recent and more intense consideration by consideration by the General Assembly of the question of verification is a welcome development. In this regard, the endorsement by the General Assembly in 1988 of the 16 principles of verification was a noteworthy achievement (seel Assembly resolution 43/81 B of 7 December 1988). The Group believes that this involvement of the United Nations draws upon one of the great strengths of the Organisation, namely, its virtually universal membership, and reflects its responsibilities set out in the Charter of the United Nations in the field of international security and disarmament.

Just as all States have the duty to contribute to efforts in the field of disarmament and the right to participate in disarmament negotiations, so too is the successful implementation of arms limitation and disarmament agreements in the interest of all States. Verification is, indeed, an essential element in the process of achieving and implementing arms limitation and disarmament agreements. Therefore, the Group sets out below a number of conclusions and recommendations for further action.

A. Data Collection Capability

The Group of Experts agrees that, in the short term, in anticipating further advances in the field of treaty-specific verification, the United Nations can play a useful role in making research and data relating to co-operative arrangements and verification available to wider audiences. A United Nations data collection capability could assist governmental experts and negotiators on verification provisions and confidence- and security-building measures. This impartial and non-discriminatory capability would facilitate their work and help to lay the foundation for their eventual involvement in future negotiations or existing multilateral agreements. Such United Nations services should not entail significant new expenditures or the creation of new bodies. Voluntary contributions, on an objective and non-discriminatory basis, can be made by member states; these could include bibliographies and existing published materials by member states, including the provision of rosters of experts and organisations to whom questions could be addressed and with whom verification research projects could be discussed.

The Group recommends that the United Nations, through the Department for Disarmament Affairs, develop a consolidated data bank of published materials and data provided on a voluntary basis by member states on all aspects of verification and compliance. The data bank might include, inter alia; the history of negotiations and treaty compliance; procedures for verification and monitoring; information on techniques and instrumentation for verification and monitoring; lists of contacts and experts on verification and addresses of institutions, organisations, companies and individuals which can provide expertise, technologies, advice on aspects of verification, bibliographic information and data - including data connected with the Biological Weapons Convention and the future chemical weapons convention.

The Group also recommends that the United Nations should make the-data easily accessible to all member states, by regularly publishing the lists and additions in the data bank. For instance, the *United Nations Disarmament Yearbook* could cover, by way of dedicated chapters, the range of data, in particular new developments, held in the data bank. Special reports, with a wide circulation, could be prepared as a result of data collected by the United Nations. Particular emphasis might be given to the use of computers for data storage and retrieval, on-line data access, devices for mass data storage and interfacing with relevant data bases to which member states provide access.

The Group recommends that the United Nations should take an active part in facilitating the operational international exchange of data contributing to treaty verification upon request of States parties and to confidence-building.

In this context, the Group discussed whether such an exchange could include the collection, compilation and distribution of data obtained by a variety of means such as may be appropriate to the requirements of a future treaty or treaties. Included among the issues discussed were seismological and radiological measurements, overhead imagery obtained from satellites and aircraft, and the proposed agency for the processing of satellite images (APSI). It is not for the Group to pass definitive judgement on these issues, as decisions on them should be left to the appropriate multilateral forums.

B. Exchanges between Experts and Diplomats

The Group of Experts also agrees that, in the short term, in anticipation of further advances in the field of treaty-specific verification and new agreements increasing confidence and transparency between States, the United Nations can play a constructive role in promoting exchanges between experts and diplomats to help the latter to address negotiating problems, and to help experts focus on needed solutions. Such exchanges can contribute to the creation of general overall awareness of verification issues, enabling States to have a fuller appreciation of the role of verification in alleviating their security concerns. The States may thus also reach a better appreciation of difficult verification problems and of the appropriate monitoring methods for their solution. The exchanges could also promote international co-operation in the development of verification procedures and technology. Responsibility for carrying out a wider exchange programme could be assumed by the Department for Disarmament Affairs. In this regard, the Department could seek co-operation with national institutions as well as international non-governmental organisations and scientific research institutes such as the Pugwash Conferences on Science and World Affairs and the Stockholm International Peace Research Institute (SIPRI).

The Group of Experts recommends that the United Nations, through the Department for Disarmament Affairs and, when appropriate, in co-operation with UNIDIR, promote workshops, seminars and training programmes on verification and compliance. In addition, it would be useful for the United Nations Disarmament Fellowship, Training and Advisory Services Programme to give increased attention to the subject of verification and compliance.

The Group further recommends that the United Nations explore ways to provide expert advice to States, at their request, to establish and implement verification structures, thereby increasing their effective participation in agreements.

The Group proposes further that the United Nations, through UNIDIR, increase its support to ongoing multilateral negotiations by undertaking specific research on verification topics, responsive to the needs of those negotiations. UNIDIR could, for example, undertake research tasks that address specified problems encountered during the negotiations. UNIDIR could also continue to commission research into new verification technologies, methods and procedures as well as legal aspects of verification and compliance.

C. The Role of the Secretary-General in Fact-Finding and Other Activities

The Group of Experts believes that the experience gained from the Secretary-General's fact-finding activities could be helpful in connection with certain arms limitation and disarmament agreements that lack explicit verification provisions. It is the Group's view that, in the short-term, the Secretary-General's capabilities may be further strengthened and broadened, provided he is granted a mandate to do so. Such enhancement could be achieved either by broadening the scope of the Secretary-General's capabilities or by expanding the means through which the existing mandate is carried out. For example, the Secretary-General's fact-finding mandate could be extended to cover the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects. Proper care must be taken to ensure that whatever organisational arrangements are agreed upon, they should not hinder the Secretary-General's flexibility to conduct fact-finding missions in a manner most appropriate to the circumstances at hand. The determination of what actions the Secretary-General may undertake to strengthen his fact-finding capabilities will be dependent upon the mandate he is given and must be made on a case-by-case basis.

In addition, the complementary role played by bilateral and multilateral limitation and disarmament efforts can be further strengthened through the United Nations. To this end, the Group recommends that States parties to future multilateral arms limitation and disarmament agreements should consider depositing those instruments with the Secretary-General of the United Nations, as is the case, for instance, of the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (see General Assembly resolution 31/72, annex, of 10 December 1976) and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (see General Assembly resolution 34/68, annex, of 5 December 1979). In this connection, States parties should also consider providing to the Secretary-General and the General Assembly periodic reports regarding the implementation of those agreements for subsequent dissemination to all member states. As has been the case in several multilateral agreements, review conferences could also be organised with the assistance of the United Nations.

D. Use of Aircraft for Verification Purposes

The Group of Experts further considered the possible use of aircraft by the United Nations as a verification tool. Such United Nations use of aircraft would of course require the consent and support of States parties to the agreements concerned. Where existing agreements lack thorough verification procedures, aircraft could be used in conjunction with pact-finding missions on the ground. Where established verification procedures already exist, the use of aircraft by the United Nations would require careful co-ordination. The use of aircraft for verification purposes by the United Nations would have significant organisational and financial implications which would require appropriate governmental approval and support. The question of processing the data acquired through the use of aircraft must also be properly addressed. Costs might be reduced if member states were prepared to donate the use of specialised aircraft for verification purposes on a temporary basis as required. The Group did not pass definitive judgement on this issue.

E. Use of Satellites

Noting that the use of satellites has played a key role in verifying arms limitation and disarmament agreements and is likely to have continued relevance for the future, the Group of Experts considered the development and launching of a United Nations satellite network for arms limitation and disarmament verification. Such a network would involve not merely providing the necessary satellite hardware but also major investments in acquiring relevant expertise and an image analysis capability. These undertakings would have very great organisational and financial implications. Because of the lead-time required to design, develop and build such a network, the use of its own satellites by the United Nations for arms limitation and disarmament verification appears unlikely, at least in the short-term, unless donations in kind are made by member states. However, a first step in that direction could be the decision to organize, within the existing architecture, a "clearing house" for data gathered from existing satellites, where training would also be offered in the field of basic photo-interpretation. The Group did not pass definitive judgement on this issue.

F. Towards an International Verification System

The Group of Experts considered the issue of an international verification system. The same basic reasons which have led to a multilateral approach to certain arms limitation and disarmament questions also raise the issue of a multilateral framework to ensure the verification of resulting disarmament agreements. Many nations do not have the means to perform the full range of tasks nor do they have access to the necessary expertise.

The Group of Experts considered that the development of a *U*nited Nations verification system will depend in large measure on further changes in the political environment and on the verification requirements emerging from continued advances in arms limitation and disarmament agreements. Moreover, the development of appropriate multi-purpose verification techniques would greatly facilitate this process. The development of a United Nations verification organisation must be seen as an evolutionary process. There are several possible ways in which an international verification system could come into existence, one of which might be as an "umbrella" verification organisation resulting from the co-ordination or merging of two or more future verification systems. The Group did not pass definitive judgement on this issue; however, it recognises that the subject will continue to be considered in the light of future developments.

The present international situation provides the right environment to engender a dynamic multilateralism. Indeed, the present situation and the complexity of the problems faced by the international community suggest the need to develop a system which can cope with the problems of security and disarmament in a multilateral framework. The United Nations is unique in its global scope, its membership and its Charter. The role played by the United Nations in the recent past in addressing crisis situations is a sign that it is likely to be called upon in the coming years to deal with a number of such situations. With the prospect of greater attention being given to achieving multilateral agreements on arms limitation and disarmament, an enhanced United Nations capability to assist in verification, with the consent of all States parties to such agreements, could be a significant contribution to international security and co-operation.

OPEN SKIES

Introduction

The rapid evolution of events, particularly in Europe, has created a new climate within which the future of the arms limitation and disarmament process is likely to be fashioned. The ability and the means of verifying compliance, a significant element of that process, cannot help but be affected by these dramatic events. Nowhere is this more evident than in the evolution of the Open Skies concept. Initially proposed by President Eisenhower in 1955, and revisited by President Bush in 1989, Open Skies is now reaching the final negotiating stage.

The Eisenhower proposal was indeed, for its day, revolutionary in concept—so much so that it seemed that it was rejected at the outset because of the penchant on the part of the USSR for secrecy. In those days, verification was characterised by the USSR as "legalised espionage". Today, of course, that cloak of secrecy has long since been penetrated by satellite sensing.

Perhaps the most noteworthy aspect of the Open Skies proposal when it was put forward by President Bush was its almost immediate acceptance, in principle, by the Soviet Union. The Bush proposal expanded upon Eisenhower's earlier suggestion in terms of concept, geographical area and membership, throwing open for virtually unrestricted aerial surveillance all of the territories of North America, Europe and the Soviet Union. The significance of the proposal, which is not tied to any particular disarmament treaty scenario, lies far more in its confidence-building potential than in the capabilities of the verification systems to be employed.

Eisenhower Proposal

President Eisenhower's proposal, apparently like that of President Bush some 34 years later, was the product of the White House apparatus rather than of the wider Administration. A panel of experts, convened by Nelson Rockefeller, then Special Assistant to the President, undertook to generate some innovative ideas which might be considered by the United States for use at the 1955 Geneva Conference of Heads of Government. To some degree, the Open Skies proposal was seen as a means of testing the seriousness of the Soviet Union on disarmament. The idea of mutual aerial inspection seemed to be a good test for determining the willingness on the part of the USSR to accept intrusive inspection. Speaking in Geneva on 21 July 1955, partly from notes and partly "off the cuff", President Eisenhower outlined the core of the Open Skies proposal in a number of steps. He said:

> "These steps would include: to give 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 pictures you choose and take them to your own country to study, you to provide exactly the same facilities for us...."
>
> As Mr. Eisenhower later recorded in his memoirs, the Soviet side assessed the proposal to be "nothing more than a bald espionage plot against the USSR". It was clear that the Soviet Union's suspicions, which are well documented in the annals of United Nations arms limitation and disarmament negotiations, precluded the use of intrusive methods of verification. The Open Skies concept continued a tortuous round of negotiations through the late 1950s, but to no avail. The shooting down of a United States reconnaissance aircraft over the Soviet Union on 1 May 1960 and the advent of an effective space-based reconnaissance capability on both sides hastened its demise. In the latter event, the ability to gain information without the use of intrusive means satisfied the national security requirements of the super-Powers. It also made overhead reconnaissance the exclusive purview of the space Powers for the following quarter of a century.

The Interim Period

For more than 30 years relatively little attention was focused on the use of aircraft in a strategic sense as a method for overhead reconnaissance for arms control purposes. In September 1986, this general pattern began to change with the signing of the Document of the Stockholm Conference on Confidence and Security-building Measures and Disarmament in Europe. Termed the Stockholm Document, the agreement provided for a system of monitoring and observation of military activities in Europe using a combination of aerial and ground inspection measures.

Although not seen initially as a breakthrough in terms of airborne surveillance for disarmament verification purposes, the agreement by the 35 members of the Stockholm negotiations (particularly by the USSR) to the following four provisions of the Stockholm Document (paragraphs 89-92) in retrospect proved to be a significant turning-point:

> (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 inspecting and receiving States. Aircraft win be chosen which provide the inspection team a 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 are 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.

Between the termination of the Stockholm Conference in September 1986 and the opening of the Vienna negotiations on conventional arms reductions in March 1989, the Soviet Union drastically revised its approach to disarmament verification. On 9 March 1989, Foreign Minister Shevardnadze, in his address to the official opening conference of the Open Skies negotiations, summarised the Soviet approach by stating that there was no verification method the USSR would not accept, given reciprocity.

Bush Proposal

At Texas Agricultural and Mechanical (A&M) University, on 12 May 1989, President Bush spoke of President Eisenhower's suggestion as a test of Soviet readiness to open its society. He suggested exploring the proposal once again "but on a broader, more intrusive and radical basis".

The new Open Skies proposal which was elaborated subsequently by President Bush in Brussels, and which was endorsed in the communique of the North Atlantic Treaty Organisation (NATO) of 30 May 1989, constitutes a dramatic variant of the initial Eisenhower ideas. If agreed to, it would have the effect of opening the territory of North America, Europe and the Soviet Union to virtually unrestricted aerial surveillance. The theme of this initiative would be "openness" and "transparency" rather than "inspection" *per se.* The overflights would intentionally not be related to any specific disarmament treaty (such as the Treaty on Conventional Armed Forces in Europe (CFE) and the Treaty on the Reduction and Limitation of Strategic Offensive Arms (START)). The major benefit of the regime would likely derive more from the confidence-building dimension than from any treaty-related verification benefits which might be forthcoming.

The basic principle would be that participating nations would open their skies to regular unarmed, non-combat type aerial surveillance flights. While Soviet participation would be essential, the ultimate objective would be a regime founded on an agreement among the countries which chose to participate. The initial intention was that these countries would be from both NATO and the Warsaw Treaty Organisation (WTO), but there is growing recognition that all European nations will eventually be able to participate in the regime.

Negotiations

Throughout the summer and autumn of 1989, representatives of the States members of NATO and the WTO met separately to develop common positions on the structure of an eventual Open Skies regime. Although at least one negotiator characterised Open Skies at the outset as being "doomed to succeed", it became apparent that tough negotiations would be required. On the one side, it was becoming increasingly apparent that, although meant as a confidence-building mechanism, Open Skies flights could be useful in checking on treaty-limited equipment (TLE) which might be moved outside of the Atlantic-to-the-Urals (ATTU) area as a result of the CFE Treaty. A welcome, but complicating, factor was the increasingly independent positions developed by members of the Warsaw Pact as its decision-making mechanism evolved. Only recently have the requirements arising from newly emerging States within the ATTU area been addressed.

On 24 September 1989, in order to kick-start the negotiation, Prime Minister Mulroney announced that Canada had offered to host the first stage of an international conference to develop the Open Skies regime, with the second stage to be held in Budapest, Hungary, in the spring of 1990, at which it was hoped the treaty would be completed and signed.

The Open Skies Conference was duly opened in Ottawa by the Prime Minister of Canada on 12 February 1990. Foreign ministers of the 23 NATO and WTO member States attended the ministerial part of the Conference. The Budapest phase of the Open Skies Conference began on 23 April 1990 and concluded on 12 May, though without any final agreement. A third round was held in Vienna in the spring of 1991, likewise without success. As a result, the negotiations were suspended until some possibility for compromise could be identified.

Generally, throughout the initial three sets of negotiations NATO favoured a regime that would be open to the greatest extent possible, without any limitation other than that required for flight safety. Issues on which NATO countries held firm involved keeping overflight restrictions to an absolute minimum, allowing sophisticated "all-weather" sensors, and raising the number of overflight quotas to a significant level. The WTO position reflected a different conceptual approach to Open Skies. The Soviet Union, in particular, insisted upon a common fleet of aircraft, with a universally available pool of data resulting from each overflight. The Soviet position (not shared by all WTO States) on permitted sensors attempted to reduce the remote-sensing capability of Open Skies aircraft below that considered by NATO countries to be sufficient to allow 24-hour/all-weather coverage. It similarly restricted both the number and the duration of annual overflights of Soviet territory to a bare minimum.

The dissolution of the Warsaw Pact as a cohesive decision-making entity, and the continuing evolution in the Soviet Union's approach to permitted sensors and aircraft ownership, led to a decision to resume negotiations in Vienna in the autumn of 1991.

Within the first hour of the re-commencement of the Open Skies talks in Vienna on 5 November 1991, it seemed clear to all concerned that the new goal of a completed negotiation before the start of the Helsinki CSCE follow-up meeting in March 1992 was realistic and attainable.

After a year-end break, negotiators returned to Vienna on 13 January 1992 for what was intended to be a final push. The goal of achieving the Helsinki time-frame, though difficult, was still attainable. The dissolution of the Soviet Union, of course, raises a myriad of questions, and creates both opportunities and uncertainties. On the positive side, the emergence of Russia meant that there was now a clear successor State negotiating for the bulk of what was once the USSR, a fact which remained the key to any meaningful agreement. Remarkably, a proposal first put forward at the height of the cold war now appears about to become a reality.

Trial Overflights

What has been unique and innovative in terms of the most recent Open Skies experience is that while negotiations have continued intermittently, practical experience has been gained through the exercising of tentative procedures under field conditions.

In collaboration with the Hungarian Government late in 1989, Canada agreed to conduct a trial Open Skies overflight of Hungary. The objective of the trial was to gain practical experience about the administrative and operational procedures expected to be necessary for an Open Skies regime. The exercise was arranged on a reciprocal basis, with Hungary having the option to conduct its own trial overflight over Canadian territory.

On 4 January 1990, a Canadian Forces C-130 "Hercules" aircraft arrived in Hungary to conduct the overflight. While *en route,* the Canadian aircraft transited Czechoslovak airspace. Flight clearances were provided for the transit at short notice by Czechoslovak authorities. The overflight itself took place on the morning of 6 January 1990. Since the trial flight was intended to test procedures, it was felt that the aim could be accomplished *without prejudice* to the issues that were still under discussion by interested nations.

While every effort was made to ensure that this overflight reflected as closely as possible the air traffic control procedures that might be agreed to in an Open Skies treaty, it was recognised that the greatest lessons would be derived from the flight if extra time were taken at each stage of the process to evaluate each activity immediately. Thus, the periods devoted to notification, flight planning time, and the total time elapsed between initial notification and the actual overflight were slightly longer than the corresponding periods that might be agreed to in the eventual treaty. Perhaps the most important difference between this first trial overflight and an actual Open Skies overflight was the fact that the Canadian aircraft carried no on-board sensors, apart of course from standard navigation systems. No optical devices were operated during the overflight in a way that would provide images from outside the aircraft. The aircraft was therefore incapable of accumulating any data on Hungarian activities.

In January 1992, Hungary took up the option of conducting a trial overflight in Canada using aircraft and sensors under a more technically oriented programme. Building upon the results of the initial overflight of Hungary, the programme for the second trial overflight was designed to include the use of sophisticated sensors.

The aim of the second trial overflight, which included a sensor-equipped aircraft to simulate a designated overflight as well as an additional orientation/familiarisation flight for observers, was to help the negotiations by demonstrating some of the sensor capabilities and limitations, and by simulating the exchange of flight-recorded data. The first flight, using a CC115 "Buffalo" aircraft, provided a unique opportunity to test some operational procedures still under negotiation in Vienna. On the following day, the sensor-equipped aircraft used both synthetic aperture radar (SAR) and optical camera sensing as envisioned in the negotiations. The trial overflights were preceded by a two-day programme of briefings, technical discussions and demonstrations that helped set the stage. This programme provided the opportunity for representatives from both countries to exchange views and further develop their mutual understanding on the technical requirements of Open Skies missions. Subjects discussed and briefed were:

(a) Synthetic aperture radar (SAR);

(b) Aerial photography;

(c) Mission planning; and

(d) Sensor development and aircraft modification engineering.

The orientation/familiarisation flight followed the same routing as the sensor flight of the next day and allowed for visual observation and recognition of the sensor targets. A total of 14 observers from the two countries participated. This flight also tested the notification and clearance procedures for restricted areas. The aircraft overflew Canadian Forces Air Base Trenton, Canadian Forces Army Base Petawawa, two commercial nuclear power plants and a major industrial automobile manufacturing facility in Oshawa.

The second flight was carried out using a sensor-equipped Convair 580 aircraft operated by the Canada Centre for Remote Sensing. Sensors included:

(a) CCRS Synthetic Aperture Radar (C-band with a 6-metre resolution);

(b) Fixed optical camera (RC10 with a 152-millimetre focal length lens);

(c) Low Light Level TV (RCA TC 1030/H); and

(d) Standard colour video camera.

The aircraft carried 5 CCRS crew members consisting of 2 pilots, 1 mission manager and 2 sensor specialists. Flight representatives included 1 cockpit/navigation observer from Hungary, and 2 Hungarian and 1 Canadian sensor specialists as observers.

Among the initial conclusions reached as a result of the trial flights are the following:

Resolution:

The resolution presently being proposed in the negotiations limits the effectiveness of the regime. In particular:

(a) 30 centimetre resolution proposed for optical and electro-optical sensors limits aircraft ability to fly under cloud cover; and

"(b) 3 metre resolution on SAR imagery produces a limited amount of information which may be insufficient to justify the high costs involved."

Navigation:

"Combination of different types of navigation equipment fitted in the aircraft ensures optimal results. The treaty should allow use of any navigation equipment necessary for exact navigation and processing of sensor data...."

Cost Effectiveness:

"The relatively high costs of aircraft and sensors make cooperation highly desirable. Joint flights, leasing of equipment, and reduction of costs by sharing information on a commercial basis are all important ways of making the regime more cost-efficient. The treaty should provide a flexible framework allowing all possible ways of cooperation."

CFE Aerial/Open Skies Harmonisation

As the make-up of the various sets of negotiations continues to evolve, harmonisation of a number of aspects will become increasingly more relevant. Under the terms of the CFE Treaty signed in Paris on 19 November 1990, States parties have committed themselves to accept an agreed number of aerial inspections for the verification of residual levels of treaty-limited equipment. Although considerable discussion relating to aerial inspections took place during the period of CFE Treaty negotiations, no consensus was reached concerning the use of aerial imagery for verifying compliance. From the outset, it was clear that imagery acquired for CFE verification purposes would have to be of sufficient resolution to permit recognition of the differences between, for example, a tank and an armoured combat vehicle (ACV). As a result, resolution and scale requirements for CFE aerial inspection purposes could be easily computed.

In contrast to the CFE Treaty, Open Skies, in its initial concept, focused on "openness" and "transparency" rather than "inspection" and "verification". It was apparent therefore that the level of resolution necessary for Open Skies could be less than that required for CFE verification purposes. Open Skies, seen in the context of "confidence-building", was related more to the monitoring function than to the more comprehensive process of verification. Beyond the ATTU, the value of Open Skies relates to its unique capability to monitor TLE not subject to verification by on-site inspection under the CFE Treaty. The technical requirements of an Open Skies system were not seen, however, to be as demanding as those for CFE Treaty purposes. While a system designed to meet CFE aerial inspection purposes would inherently be able to meet the less restrictive Open Skies requirements, the reverse would not necessarily be true.

Now that a successful Open Skies agreement seems assured prior to the CSCE follow-up meeting in Helsinki, and recognising the explicit commitment to aerial inspections in the CFE Treaty, the need to harmonize these two concepts and capabilities, in terms of the ATTU, is apparent. It seems likely, therefore, that technical meetings, after the Helsinki meeting in 1992, focusing on concept harmonisation and practical application will be essential.

Conclusion

The Open Skies concept has been transformed from its Cold-War origins into a mechanism for coping with the multi-faceted arms limitation and disarmament problems of modern Europe. While it will serve significantly as a confidence-building measure in terms of pan-European security, it will also help strengthen the purposes of the CFE

Treaty and could serve as a useful option in terms of reducing regional tension. From the standpoint of the Euro-Atlantic community, it is the only measure encompassing the territory from "Vancouver to Vladivostok". From the global perspective, it could serve as a model which might, perhaps, be adapted in time to meet concerns in other regions.

A BILATERAL ACCORD THAT HELPED RESUME THE OPEN SKIES CONFERENCE: THE HUNGARIAN-ROMANIAN OPEN SKIES AGREEMENT

History and Political Background

The Open Skies initiative was launched more than three and a half decades ago by United States President Dwight Elsenhower. According to his proposal made in 1955, the United States and the Soviet Union would have voluntarily opened their airspace on a reciprocal basis, permitting overflight of their territory. In May 1989, President George Bush revived the Open Skies concept. He proposed the opening of negotiations between the North Atlantic Treaty Organisation (NATO) and the Warsaw Pact with a view to establishing an overflight regime covering the whole territory of all member States, including the United States and Canada. Negotiations towards this end are continuing. On 11 May 1991, Hungary and Romania became the first States ever successfully to negotiate and sign a bilateral Open Skies agreement.

The dramatic changes that had taken place in Europe since the revival of the proposal in May 1989 made this agreement possible and timely. The collapse of the Warsaw Pact also brought about the end of the old European security structure based on an approximate balance of the military forces of the two alliances. Great instability became the most dramatic negative side-effect of the profound political changes in Central and Eastern Europe. Earlier arms control agreements have lost much of their relevance in the light of today's political realities. Participants in the various arms control forums have not moved boldly in the current state of flux. The limitations set in the treaty on Conventional Armed Forces in Europe (CFE) are aimed at redressing the East-West balance but are not very relevant to the new sources of military instability which emerged with the disappearance of the East-West divide.

In this new political and military situation the States of Central and Eastern Europe have a choice: either to re-nationalize their defence policies and return to the pre-war emphasis on military force, which would further destabilize their region, or to start building a new, cooperative security structure. Bilateral confidence- and security-building measures, such as the Hungarian-Romanian Open Skies regime, could play an important role in this new cooperative security structure of Europe.

Hungary has been a devoted and active supporter of the Open Skies concept since President Bush revived it in 1989. At that time an Open Skies regime seemed to be a new and effective way to ease tension and build confidence between the two military blocs. Together with Canada, Hungary volunteered to host the Open Skies Conference. The first round of the Conference took place from 12 to 28 February 1990 in Ottawa, the second round from 20 April to 10 May 1990 in Budapest. At that time the positions of NATO and the Soviet Union were too far apart to be bridged by almost six weeks of intensive negotiations.

Soon after the second round of the Open Skies Conference, Romania proposed to Hungary the initiation of negotiations for a bilateral Open Skies agreement. Hungary did not at that time accept the Romanian offer. As designated host of the third round of the Open Skies Conference, it made every effort possible to help bring about the continuation of the multilateral negotiations. Hungary was well aware that a multilateral regime would have several obvious advantages; among others, it could serve as a verification regime for existing and future arms control agreements.

Only in January 1991 did Hungary give a positive answer to the repeated Romanian proposal. By that time it became clear that most participating States were not going to give their consent to the continuation of the Conference unless the Soviet Union indicated clearly that it would remove the stumbling-blocks from the road to the successful conclusion of the negotiations. The decision to begin bilateral Open Skies negotiations did not mean that Hungary had abandoned the idea of a multilateral regime. In 1989, the Hungarian delegation to the negotiations on confidence- and security-building measures in Vienna introduced the concept of “amplified confidence-building measures” in the relations of neighbouring countries. A bilateral Open Skies regime functioning in parallel with a multilateral regime was seen as a good example of the realisation of this concept. Furthermore, both countries believed that the creation of a bilateral regime could demonstrate the viability and utility of Open Skies and help convince other participants to continue the Conference.

The signing of an Open Skies agreement between Hungary and Romania had a special political significance. The two countries have, regrettably, a history of strained relations. For three and a half decades their membership in the Warsaw Pact prevented Hungary from properly addressing the problems which the sizeable Hungarian minority living in the territory of Romania were facing. After the disbanding of the Warsaw Pact their situation became a source of tension and open debate between the two countries. The willingness to establish a regime which would ensure a high degree of openness and transparency in their military activities and serve as an effective tool of confidence- building shows the determination of Hungary and Romania to solve their problems exclusively by negotiations—either bilateral or within the framework of relevant institutions such as the Council of Europe or within the Conference on Security and Co-operation in Europe (CSCE) process.

Negotiation of the Agreement

The Romanian delegation arrived in Budapest in mid-February 1991. The first round of the negotiations was very intensive and fruitful. The fact that both delegations presented draft agreements based on the draft treaty text of the second round of the Open Skies Conference facilitated matters. The main body of the agreement was worked out in three days. The second round of the negotiations, held at Bucharest in mid-March, was equally intensive and effective. In two and a half days the delegations agreed on all eight annexes to the Agreement.

The Hungarian and Romanian negotiators agreed from the very beginning that the regime to be created should be simple yet effective and should match the technical and financial resources of the two countries. The provisions of the Agreement are, therefore, flexible and take into account to a great extent the requirement of cost-effectiveness.

According to the quota annex, the two countries have a right to carry out four flights a year in each other's airspace. This flight quota is quite substantial if one takes into account the fact that the bilateral regime will continue functioning after the multilateral Open Skies agreement enters into force. An observation flight is restricted by the following, whichever applies first: a maximum duration of three hours or a maximum distance of 1,200 kilometres. This was calculated on the average speed (400 kilometres/hour) and range (2,000 kilometres) of the designated observation aircraft. A Hungarian observation aircraft using the closer point of entry (Timisoara) can carry out an observation flight in Romanian airspace and return to Budapest without refuelling. However, if it uses the further point of entry (Bucharest), refuelling is needed.

Both countries intend to use their existing aircraft for the purpose of Open Skies observation flights: Romania will use the Soviet-made medium-size, two-engine turboprop AN-30 (which is a specialised version of the AN-24 transporter, modified for aerial photography), while Hungary will use either the two-engine turboprop AN-26 transporter or the Czechoslovak-made two-engine turboprop L-410, a small multi-purpose plane. The observing party can use its own aircraft or an aircraft of the observed party. The right of choice belongs to the observing party. As both countries have only a few aircraft suitable for Open Skies purposes, the observing party shall submit a request seven days in advance if it intends to use an aircraft of the observed party. The sensor annex contains only the two sensors Hungary and Romania have at present: aerial cameras and video cameras. This annex can, however, be updated if the parties want to introduce further sensor categories. In view of the possibility of upgrading the sensors, the parties have undertaken the obligation to use similar sensors of comparable capability and to facilitate access to such sensors for use by the other party. The ground resolution of the sensors is not limited. This flexibility allows the pilot of the observation aircraft to fly as low as flight safety requirements permit. Low-level flights might be necessary in cloudy weather, when the only way to take photographs is to fly under the cloud cover.

Request for an overflight shall be submitted 24 hours in advance and shall be accepted promptly, unless *force majeure* prevents the party to be overflown from receiving the observation aircraft. The Agreement guarantees that overflights will be as unrestricted as possible. Hazardous airspace must be publicly announced in the aeronautical information publication. If the observed party requests overflight of hazardous airspace, such as airspace over nuclear-power stations, chemical plants or exercise grounds where a firing exercise is going on, the observed party may specify the minimum safe altitude, may propose an alternate flight route as near to the hazardous airspace as safety requirements permit, or may propose a change in the time when the aircraft is to arrive in the hazardous airspace.

The observed party has the right to inspect the aircraft and its sensors. According to the Agreement, this pre-flight inspection may last no longer than eight daylight hours and shall terminate no later than three hours prior to the actual commencement of the observation flight. This time-frame was agreed with the intention of ensuring that the observation aircraft would have to spend no more than two days on the territory of the observed party. If the aircraft arrives in the observed country in the morning, the inspection is to be finished by night, the observation flight is to take place the next morning, and the processing of observation materials is to be completed in the afternoon of the second day.

Information-sharing is ensured by the use of double cameras. The two rolls of film are developed by a joint team of the two parties at the end of the observation flight in an established ground facility of the observed party. One negative is taken home by the observing party while the other remains with the party which has been overflown. If no double camera is available, the negative is copied and the copy is taken home by the party which carried out the observation flight. The same applies to video cameras.

The Agreement establishes a Hungarian-Romanian Open Skies Consultative Commission. The Commission's task is to solve any dispute which may arise in the course of the implementation of the Agreement. The Commission is also responsible for updating the following annexes: on sensors, on flight quotas and on entry and exit points. In the hypothetical case that a party discovers, as a result of an overflight, disturbing or unusual military activity on the territory of the other party, the issue may also be raised in the Commission.

The Demonstration Flight

Hungary and Romania carried out a demonstration flight on 29 June 1991. Representatives of all countries participating in the Open Skies Conference were invited to take part as observers in the trial flight. The purpose of the flight was manifold: to demonstrate to other participants of the Open Skies Conference the viability and utility of Open Skies, to take advantage of the confidence-building potential of bilateral overflights even before the Agreement entered into force, and to test in practice the solutions to various technical problems which were worked out in the course of the negotiations.

Before the Agreement was signed, France had offered technical assistance to both countries. France provided Hungary and Romania with double cameras and automated film-developing machines. A French team of technicians was sent to Budapest and Bucharest to install the cameras and the apparatus and to train local personnel in their use.

The Romanian AN-30 aircraft arrived at Tokol military airport outside Budapest on 28 June. Hungarian officials accompanied by Romanian escorts inspected the aircraft to make certain there were no hidden sensors on board the aircraft. The inspection team divided itself into three sub-teams: one subteam inspected the fuselage, the second group the avionics, the third group the sensor, a French-made OMERA-33 aerial camera. The team was able to check the aircraft thoroughly in less than three hours because of the fact that the Hungarian air force had used this type of aircraft for decades. After completion of the inspection the aircraft took off for a short flight to calibrate and check the sensor. When the inspection and the test-flight were over, the Romanian crew filed a flight plan and the Hungarian officials approved it. Before the aircraft took off the next morning, Hungarian officials briefed the Romanian crew on expected weather conditions and flight safety and navigation regulations.

The Romanian AN-30 aircraft took off at 8 a.m. on 29 June. The observers followed the observation aircraft on board an AN-24 transporter flown by the Hungarian air force. Following the flight plan, the observation aircraft flew over various militarily significant objects: a civilian airport, a military college with heavy armament openly displayed for this occasion, an abandoned Soviet military airport and an exercise ground. After a short technical landing on Romanian soil, the demonstration flight was continued over Romania. There the observation plane flew over a military airfield, a training ground, an ammunition depot and a railroad junction.

Weather over Hungary was fair, with a cloud base at 2,000 to 3,000 metres. The plane therefore flew at an altitude of 1,500 metres. Photographs taken from this altitude had a ground resolution of 10 to 15 centimetres. The weather over Romania was poor: it rained and the cloud base at some places was at 400 metres. The aircraft therefore had to fly as low as 200 to 250 metres. The crew of the observation aircraft decided to take the risk of low-level flight because of the desire on the part of both countries to have a successful demonstration. Photographs taken at this altitude had a ground resolution of 2 to 3 centimetres. Navigation proved to be a much more serious problem than either side had expected. The obsolete navigation equipment of the aircraft, the absence of detailed charts of the sites to be overflown and the lack of an electronic pointing device for the camera were to blame for the problems. The observation aircraft had to fly over some sites twice or even three or four times to take a good photograph.

These repeated passes would have been impossible during a "real" observation flight, as the agreement prohibits loitering over the same site.

After completion of the observation flight, the aircraft landed at Otopeny airport in Bucharest. A joint team of Hungarian and Romanian technicians developed the films (for reasons of easy development, only black and white film was used). They were able to produce a few prints as well. The quality of some of the pictures was not satisfactory because of the adverse weather conditions and a slight malfunctioning of the focusing mechanism of the camera. Observers were briefed on the results of the demonstration flight in Budapest.

Conclusions

The most important conclusion drawn from the bilateral flight was that two countries with modest technical and financial resources can create and operate a relatively effective Open Skies regime. Both the Hungarian and the Romanian air forces have to perform regular training flights, and some of these flights will be used for Open Skies purposes. In this way the costs of observation flights can be kept to a minimum.

Simple and not very expensive sensors—such as aerial cameras—can be used under various meteorological conditions, provided that the terms of the agreement are flexible enough. At the same time, participation in a multilateral Open Skies regime offers several technical advantages compared to a bilateral regime. Larger, technically more developed countries could provide smaller countries with aircraft equipped with sophisticated sensors with an all-weather, day-and-night capability. In this way, smaller countries could carry out observation flights at night or under adverse weather conditions as well. This would increase the technical efficiency and political utility of the regime.

The demonstration flight proved fully the excellent confidence-building potential of Open Skies. The preparation and carrying out of an observation flight requires a high degree of cooperation and real teamwork on the part of the officials involved. This in itself is a confidence-building exercise. Short-notice overflights are tangible proof, not only for the military of Hungary and Romania but also for the average person, of the considerable degree of confidence between the two countries. The confidence strengthened by these flights can contribute to the solution of bilateral problems.

The signing of the bilateral Agreement and the carrying out of the demonstration flight facilitated efforts to bring about the continuation of the Open Skies Conference. Technical experience gained during the demonstration flight was used extensively by the Hungarian delegation in preparation for the third round of the Open Skies Conference. The Hungarian-Romanian bilateral regime, functioning in parallel with the future multilateral Open Skies regime, served as an example when delegations in Vienna, where the third round of the Open Skies Conference began in November 1991, discussed the possibility of an additional number of overflights between neighbouring countries. Within the framework of a multilateral Open Skies regime, countries have the right—for obvious political and financial reasons—to perform and the obligation to receive only a limited number of overflights. Neighbouring countries may need to overfly each other's territory more often—especially in cases of tension. A multilateral regime is much more useful if it allows neighbours to overfly each other's territory whenever there is tension in their bilateral relations or perceived unusual military activity on the territory of one party.

Open Skies overflights—even more than onsite inspections within the framework of arms control agreements—can help Central and Eastern European countries to accustom themselves to voluntary cooperation in matters of military security. Unlike Western countries, these States have very limited experience in free and democratic cooperation. The acceptance of regular, short-notice overflights of any of their military installations may make it easier for them to accept a helping hand from the community of CSCE nations in case of tension or crisis.

Last but not least, bilateral and multilateral Open Skies regimes in Europe and North America can serve as an example for other continents. Regions of tension—such as the Middle East and the Korean peninsula—also could take advantage of this new and highly effective confidence-building tool.

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OUTER SPACE AND DISARMAMENT

Initial Efforts to Ban Weapons of Mass Destruction in Outer Space

Early efforts to prevent the spread of the arms race to outer space were made in the Sub-Committee of the Disarmament Commission and the General Assembly in the late 1950s. On 29 August 1957, in the Sub-Committee of the Disarmament Commission, Canada, France, the United Kingdom and the United States submitted proposals for partial disarmament measures, including one by which a technical committee would be established to study the features of an inspection system designed to assure that the launching of objects through outer space would be exclusively for peaceful and scientific purposes. This proposal became one of the provisions of General Assembly resolution 1148 (XII), adopted by the General Assembly on 14 November 1957. A draft resolution by Yugoslavia, proposing among other things that agreement should be sought in the Sub-Committee of the Disarmament Commission on measures to ensure that ballistic missiles and other outer-space devices be used only for peaceful and scientific purposes, was not pressed to a vote.

At the thirteenth session of the General Assembly, two sub-items were put on the agenda, under the item "Question of the peaceful use of outer space"[1]. One sub-item, proposed by the, Soviet Union, was entitled 'The banning of the use of cosmic space for military purposes, the elimination of foreign military bases on the territories of other countries and international cooperation in the study of cosmic space". The other, "Programme for international cooperation in the field of outer space", was proposed by the United States. The debate on these two aspects of the item ultimately led to the adoption of resolution 1348 (XIII), by which the General Assembly established an *Ad Hoc* Committee on the Peaceful Uses of Outer Space. The Committee was requested to report to the Assembly at its subsequent session on a number of questions related to the peaceful uses of outer space, including "the future organisational arrangements to facilitate cooperation in this field within the framework of the United Nations."

Establishment of the Committee on the Peaceful Uses of Outer Space

The report of the *Ad Hoc* Committee[2] was considered by the General Assembly at its fourteenth session. As a result of the debate on this item, the General Assembly, recognising the common interest of mankind in furthering the peaceful use of outer space and the great importance of international cooperation in this field, adopted resolution 1472 (XIV) of 12 December 1959 by which a Committee on the Peaceful Uses of Outer Space was permanently established. While other organs at the United Nations would continue to perform the tasks of facilitating progress on disarmament, the new Committee was requested, *inter alia,* to "review, as appropriate, the area of international cooperation, and study practical and feasible means for giving effect to programmes in the peaceful uses of outer space which could appropriately be undertaken under United Nations auspices."

At its sixteenth session, in 1961, the General Assembly, believing that the United Nations should provide a focal point for international cooperation in the peaceful exploration and use of outer space, formulated some principles for the guidance of States in the exploration and use of outer space, which were embodied in resolution 1721 A (XVI). The principles, which were commended to States for their guidance, were the following: "(a) international law, including the Charter of the United Nations, applies to outer space and celestial bodies; (b) outer space and celestial bodies are free for exploration and use by all States in conformity with international law and are not subject to national appropriation". These principles were subsequently expanded in General Assembly resolution 62 (XVIII).

Meanwhile, at the Ten-Nation Committee on Disarmament, the five Western powers proposed, in their plan of 16 March 60, consideration of a ban on the placing of weapons of mass destruction in outer space. The programme for general and complete disarmament proposed by the United states on 27 June 1960 also called for a ban on placing in orbit vehicles carrying weapons of mass destruction.

Eighteen-Nation Committee on Disarmament and 1962 and 1963

In 1962, Canada, supported by Italy and Mexico, pressed for priority for the question of the peaceful uses of outer space. Both the Soviet

Union and the United States plans for general and complete disarmament, it was noted, included a ban on the placing of weapons of mass destruction in orbit, and these countries proposed that such a measure be implemented independently of general and complete disarmament. No definite action was taken on these suggestions during 1962, but at the General Assembly's seventeenth session, that year, the United States declared its readiness to enter into such an agreement.

During 1963, the issue again arose in the ENDC when, on 21 June, Mexico submitted a working paper[3] containing the outline of a draft treaty on the prohibition of the orbiting or stationing in outer space of nuclear weapons and other weapons of mass destruction. The draft treaty also prohibited tests in outer space of all weapons of mass destruction or any other warlike devices. In introducing the document, Mexico stressed the *sui generis* character of the problem which made its solution distinct from other disarmament measures.

Consideration by the General Assembly 1963

At the beginning of the General Assembly's eighteenth session, on 19 September 1963, the Soviet Foreign Minister, Mr. A. Gromyko, declared that his Government deemed it necessary that steps be taken to prevent the spread of the armaments race to outer space and to that end suggested that an agreement be reached between the Soviet Union and the United States to ban the placing in orbit of objects equipped with nuclear weapons or other weapons of mass destruction. It was assumed that an exchange of views on this subject would be continued between the two Governments on a bilateral basis. President Kennedy of the United States, in his statement of 20 September to the General Assembly, welcomed the Soviet response to the suggestion for an arrangement to keep weapons of mass destruction out of outer space, and proposed that negotiators work out the details to attain this goal.

Resolution Banning Weapons of Mass Destruction in Outer Space

Following private talks and agreement between the United States and the Soviet Union, Mexico submitted a joint draft resolution, on behalf of the seventeen participating members of the ENDC, to ban nuclear and other weapons of mass destruction from outer space.

The United States, welcoming the cooperation of the Soviet Union, observed that the draft resolution, which was another decisive step towards disarmament, should be relatively easy to implement, since it merely called upon Governments to refrain from extending the arms race into space and did not require the cessation of any activities known to be already under way. It recalled and reaffirmed previous United States statements of intention in this regard. If events as yet unforeseen suggested the need to review the matter, the United States would acquaint the United Nations with such events.

The Soviet Union viewed the draft resolution as representing another important step towards establishing confidence among States and urged the Committee to support it.

After a brief discussion, the General Assembly, on 17 October 1963, approved the seventeen-Power draft by acclamation as resolution 1884 (XVIII). It reads as follows:

The General Assembly,

Recalling its resolution 1721 A (XVI) of 20 December 1961, in which it expressed the belief that the exploration and use of outer space should be only for the betterment of mankind,

Determined to take steps to prevent the spread of the arms race to outer space,

1. *Welcomes* the expressions by the Union of Soviet Socialist Republics and the United States of America of their intention not to station in outer space any objects carrying nuclear weapons or other kinds of weapons of mass destruction;

2. *Solemnly calls upon* all States:

(a) To refrain from placing in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, installing such weapons on celestial bodies, or stationing such weapons in outer space in any other manner;

(b) To refrain from causing, encouraging or in any way participating in the conduct of the foregoing activities.

The Secretary-General, addressing the Assembly because of the significance of the occasion, stated that the adoption of the resolution implied acceptance by the United Nations of the political and moral responsibility for its implementation.

Outer Space Treaty of 1967

Thereafter, the matter was considered in the Committee on the Peaceful Uses of Outer Space and by the General Assembly. After the Soviet Union and the United States had reached agreement on a "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies", the General Assembly commended the Treaty in resolution 2222 (XXI), unanimously adopted on 14 December 1966 (*for text of the Treaty, see appendix VII*).

In its preamble, the Treaty, among other things, referred to resolution 1884 (XVIII) and recognized the common interest of mankind in the use of outer space for peaceful purposes. The principal disarmament provisions of the Treaty were: (1) an undertaking by States Parties not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner 'article IV (2) a prohibition of all 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 manoeuvres, but excepting the use of military personnel in scientific research or for other peaceful purposes, as well as the use of equipment necessary for peaceful exploration (article IV); and (3) a provision that all stations, installations, equipment and space vehicles on the moon and other celestial bodies would be open to representatives of States Parties "on a basis of reciprocity" (article XII).

In expressing to the General Assembly, after the adoption of resolution 2222 (XXI), his satisfaction with the progress made, the Secretary-General said: Space disarmament is but one segment of the broader, overshadowing problem of world peace and disarmament, with which the world has wrestled for so long with a growing awareness of the need, but without sustained success. Eventually, nations must surely realize that their genuine interests lie in peaceful rather than in military activities, and that their activities in space should thus be peace-oriented. The treaty was opened for signature on 27 January 1967 and entered into force on 10 October 1967.

REFERENCES

1. *Official Records of the General Assembly, Thirteenth Session, Annexes,* agenda item.
2. Document A/4141.
3. *Official Records of the Disarmament Commission, Supplement for January to December 1963,* document DC/208, annex 1, ENDC/98.

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INTERNATIONAL SECURITY AND OUTER SPACE

Prevention of an arms race in space was one of the central issues in Reykjavik. What is our view of this issue? Science and technology open up the possibility of the development of new types of space-based weapons, no less dangerous than nuclear ones, based on other physical principles. Such weapons are lasers, railguns, ultra-high frequency (UHF) and very high frequency (VHF) weapons, and others, whose lethality cannot be even theoretically assessed at present. It is upon these weapons that the United States relies for the implementation of SDI.

The plans to militarize space that are being drawn up in Washington put the security of peoples at risk and precipitate a critical situation in international relations. Should efforts to prevent the implementation of those plans fail, the arms race will enter a qualitatively new stage: uncontrollable processes will arise in the field of armaments and the risk of an outbreak of nuclear war will sharply increase. Is it not high time that policy-makers stop, ponder and ward off the decisions which would push the world towards a nuclear catastrophe?

The Reagan Administration has been attempting for four years to persuade other States, including its NATO allies, that SDI is beneficial and even necessary to mankind. Very sophisticated arguments are invented in favour of SDI. However, in all countries there is a profound awareness of the immense danger inherent in the "Star Wars" programme.

Taking advantage of people's fear of nuclear weapons, Washington claims that SDI will, free the world of them. The concept of a phased transition from nuclear offensive systems to non-nuclear defensive systems was especially devised for that purpose. Its authors argue that at present the deployment of strategic nuclear arms should be continued; moreover, a space-based anti-ballistic missile (ABM) system or, in other words, space strike weapons must be developed. Not before all that has been completed, possibly many decades later, will it be possible to reduce or eliminate nuclear weapons.

According to that theory, the elimination of nuclear arms would first require a manifold increase in the stockpiles of those arms. By that perverse logic, the path to nuclear disarmament would lie only through a buildup in offensive weapons and the militarisation of space, and besides, it would take many decades. There would seem to be no other way.

What is the purpose of this exercise? It is done in order to distract the attention of the public from the need for urgent and effective measures to reduce nuclear arsenals. Washington turns the task of completely eliminating nuclear arms upside down, reinterpreting it in such a manner as to clear the way for a further buildup of nuclear weapons. Actually, that is the current practice in the United States. It is stepping up the development of six new types of first-strike strategic systems: two types of intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBMs), two types of heavy bombers, and long-range cruise missiles of all basing modes. It is also developing other new nuclear weapons systems and nuclear weapons for those first-strike systems: manoeuvrable weapons to destroy air-defences, weapons for deep penetration of the Earth to hit silos, underground command and control posts and weapons for nuclear-pumped lasers.

That is why the United States is opposed to the Soviet proposal for a comprehensive nuclear-test ban and is reluctant to agree to a 50 per cent reduction in nuclear arms and strict compliance with the ABM Treaty, including a ban on testing ABM components in space. In fact, its position will not result in delivering the world from nuclear weapons, but rather in a further buildup in the United States nuclear potential.

Washington has yet another idea—to place SDI outside the negotiations, to break the inherent relationship between space and reductions in strategic offensive arms. At the Geneva negotiations, the United States is seeking to get the Soviet Union to agree to the testing and deployment of space-based ABM components concurrent with a 50 per cent reduction in the two sides' ballistic missile forces. What is the objective the United States is seeking to achieve?

The United States would like, with the Soviet Union's consent and for an agreed period of seven years, to develop and test everything that would be required for deploying a large-scale ABM system with space-based elements, while continuing *pro forma* to comply with the ABM Treaty. When that work is over and the feasibility of the concept of SDI has been established, the United States would start deploying a space-based ABM system and would scrap the ABM Treaty. But under Washington's plan, the two sides during that period would have to proceed to radically reduce the number of their ballistic missiles to the level of 4,800 warheads, as stipulated in the United States 50 per cent option. SDI would thus have to provide a shield against a mere 4,800 warheads, which would facilitate the development of a space-based ABM defence and increase confidence in its reliability.

The strategic offence-defence relationship is a key issue, and the prospect for an agreement is dependent upon it. There was a time, back in 1972, when agreements were signed which emphasized that relationship. Now the Reagan Administration proposes a reduction in our strategic offensive arms, for instance, by 50 per cent, and in Reykjavik the President even proposed a 100 per cent reduction in land- and sea-based ballistic missiles. But the United States side now denies that relationship and talks about reducing strategic offensive arms while at the same time deploying a territorial ABM defence system, including a space-based battle echelon within that system. There is no need to explain that it is impossible to radically reduce strategic offensive arms while simultaneously deploying a territorial ABM defence.

Secretary of Defense Caspar Weinberger argues in favour of an early deployment of the first echelon of a territorial ABM defence. I, for one, believe that as soon as the first battle systems capable of shooting down satellites and ballistic missile warheads are developed in space, any hope of reducing or even limiting strategic offensive arms will be dashed.

We are concerned that Washington is playing games with the ABM Treaty. For 15 years the Soviet Union and the United States, including under President Reagan, have adhered to an identical interpretation of the Treaty. Now the United States side is about to renounce it and has argued in favour of a possible "broad" interpretation of the Treaty. In actual fact, this boils down to an attempt to adapt the Treaty to the SDI concept, to find loopholes for legalizing testing and deployment of SDI components in space, and to open the way for the Pentagon to place arms in outer space. Of course, the United States decision to renounce the ABM Treaty or not does not depend on the Soviet Union, but if the Treaty is broadly interpreted, it will be nullified. Naturally, the Soviet Union is not going to help the United States do away with the treaty, and one should not expect any concessions from the Soviet Union in this respect. Suffice it to say that without the ABM Treaty there will be no agreements on strategic offensive arms.

It is clear from their technical characteristics that the space arms being developed now are offensive arms. First, they can be used to deliver surprise strikes against the other side's most critical satellites in order to blind them and catch them unaware, thereby, totally disrupting or impairing their capability to respond to a nuclear attack. Secondly, space arms have a long range of 4,000-5,000 kilometres. But, can arms with a 4,000-5,000 kilometre range qualify as defensive? They are universal weapons capable of destroying targets in outer space and from outer space on Earth.

The SDI programme is designed to obtain a first-strike capability and achieve military superiority over the USSR and other countries in order to blackmail them and impose on them the United States will. In other words, in purely military terms, SDI undermines the current strategic equilibrium. This military programme must be stopped, except for laboratory research and testing.

What are the dangers of SDI? It will undermine the existing agreements on curbing the arms race and on strengthening security (the 1972 ABM Treaty, the 1963 Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and under Water, the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, and others).

From the military point of view, the implementation of the "Star Wars" programme will definitely annihilate Soviet-American agreements in the field of maintaining strategic stability. Today that stability is known to be based on mutual deterrence, on the understanding that neither side will be the first to launch a nuclear attack, since retaliation would be inevitable, even under the most unfavourable conditions. The "space shield" conceived by the Reagan Administration, together with the concurrent buildup of strategic offensive weapons, is undermining this stability and setting the following objective: to acquire for the United States a first-strike capability with impunity and deprive the USSR of the possibility to retaliate, i.e., it is designed to disarm the Soviet Union. It means that SDI objectively recognises and envisages the possibility of using nuclear weapons, delivering the first nuclear strike, and winning a nuclear war. This is the real danger of "Star Wars" for all of humanity.

Obviously, the Soviet Union will have to take countermeasures, although we advocate another way—the way of disarmament, which would make SDI superfluous. But we see that the United States is striving for military superiority through SDI. This is a very harmful idea. The Soviet Union will be able to find a response; it will be able to provide for its security. This response will be asymmetrical, not necessarily in outer space and not so expensive. Yet, this will create an extremely dangerous situation in which there will be no trust between the Soviet Union and the United States and everyone will feel insecure.

Mikhail Gorbachev told President Reagan in Reykjavik that if the White House was so committed to SDI, the Soviet Union could agree to continued laboratory research. Last May the Soviet leaders explained to Mr. Shultz in Moscow what laboratory research consistent with the ABM Treaty meant. What is meant is research in laboratories on Earth—in research institutions, at production plants, at test sites and ranges. It might be possible to look for a compromise on the basis of this approach and discuss at an expert level what specific devices would be prohibited in outer space.

There are no arms in outer space at present—neither Soviet nor American—and there should be no arms there; outer space should be peaceful. The 15 April 1987 agreement between the Soviet Union and the United States (signed by Eduard Shevardnadze and George Shultz in Moscow) provides for peaceful co-operation in the following areas of space science: research of the solar system, space astronomy and astrophysics, Earth science, physics of Sun-Earth interaction, space biology and medicine.

This co-operation could be carried out through the mutual exchange of scientific information and delegations, through meetings of scientists and specialists and in other forms, including the exchange of scientific equipment and establishment of mixed working groups in each of the areas involved. With a view to guaranteeing the prohibition of the militarisation of outer space and the prevention of the emplacement of weapons of any kind there, the USSR proposes the establishment of an international verification system and, in particular, an international inspectorate providing for the presence of its representatives at all sites used for launching space objects.

Should outer space be peaceful or not? Today mankind is faced with this question in all its gravity. It was prompted by the Reagan Administration, which initiated the development of a large-scale ABM system and space strike weapons capable of offensive operations. The appearance of weapons in outer space will signify that mankind has reached the point of no return in the arms race. For this reason, the question of whether an arms race can be prevented in outer space assumes the utmost importance. The further evolution of the military and political situation in the world will depend on the way this question is solved.

LIST OF PROJECTS FOR CO-OPERATION IN PEACEFUL USE OF OUTER SPACE

1. Co-ordination of the Phobos, Vesta and Mars-Observer projects and exchange of scientific data based on the results of these projects.
2. Utilisation of the United States long-distance space communication network to track the descending Phobos and Vesta probes and subsequent exchanges of scientific data.
3. Invitation by mutual agreement of co-researchers and/or specialists of an interdisciplinary profile on the Phobos, Vesta and Mars-Observer projects.
4. Joint research to determine the most likely landing sites on Mars.
5. Exchange of scientific data on the exploration of the surface of Venus.
6. Exchange of scientific data on space dust, meteorites and lunar soil.
7. Exchange of scientific data in the field of radio-astronomy.
8. Exchange of scientific data in the field of space Gamma- and X-ray and submillimetre astronomy.
9. Exchange of scientific data and co-ordination of programmes and research related to Gamma-bursts.
10. Co-ordination of observation under the projects for studying solar terrestrial relationships and subsequent exchange of relevant scientific data.
11. Co-ordination of research to study global changes in the natural environment.

12. Co-operation under the programme of bio-satellites of the Cosmos series.
13. Exchange of relevant bio-medical data on Soviet and United States manned space flights.
14. Exchange of data based on the results of studying the changes in metabolism, including the changes in calcium content, caused by conditions of a space flight on the basis of data obtained from space flights and on-ground experiments.
15. Examination of possibilities for joint basic and applied medical and biological experiments, including exobiology, on the ground and in space vehicles of various types.
16. Preparation and publication of the second joint enlarged study entitled "Fundamentals of space biology and medicine".

A PERSPECTIVE FROM THE UNITED STATES

It is impossible to disagree with the proposition that the prevention of a dangerous arms race in outer space is a matter of the highest priority. Particularly dangerous and reprehensible would be a form of frantic competition between the two principal nuclear and space powers in which either one sought or both sought such a degree of military-technological-strategic superiority as to be tempted some day to consider the circumstances favourable for a first strike. This would be highly destabilizing, especially if one side was confident of its superiority in strategic defence capabilities and the other in strategic offence capabilities.

Arms control analysts have long assumed that the bilateral strategic relationship between the United States and the Soviet Union is in a most stable equilibrium when there exists a rough parity between the two sides. Mathematically exact equality of weapons systems is not necessary; moreover, it is not possible. Each side has a varied arsenal of weapons with differing characteristics suited to its own unique geo-strategic requirements. Parity involves a constant calculus of fluctuating inequalities and compensating asymmetries. In the final analysis, the effort to negotiate an equitable distribution of power for deterrent purposes between the two nations is more a matter of achieving mutual political-psychological satisfaction that parity exists than of computing the mathematical equality of physical assets.

Ever since the mid-1970s, spokesmen on each side have recurringly accused the other Rower of seeking military superiority, while denying that their own Government has such a goal.

Whether this is mere propaganda for popular consumption at home and abroad or whether both sides sincerely believe their charges, it is impossible for me to say. Few strategic analysts, either in the Soviet Union or in the United States, really think that the current "robust" nuclear balance could easily be upset by one side before the other could react appropriately. Each side has frequently made it clear that it is determined, and that it possesses the means, to prevent the other from ever gaining a decisive strategic advantage. Such declarations of intent definitely have a ring of credibility to them. Perhaps—and this is to be hoped—the stage is now being set for more realistic, hard-headed and equitable bargaining than has marked arms control negotiations in the past.

Each side must be willing to grant formal recognition to the fundamental rationality of the other side's strategic decision-making processes and to admit that the technological quest for a first-strike superiority will probably prove futile, whether based primarily on strategic offensive capabilities or on a defensive-offensive mix, so long as the level of offensive weapons is high. No one can predict with confidence. But if that level should become substantially lower, as we hope it will, then it will be highly desirable to arrange a jointly managed transition to some sort of parity in the offensive-defensive mix on both sides, as both parties co-operate to move in tandem or in parallel towards a more defence-dominant regime.

Western arms control analysts have been convinced for a long time that nuclear deterrence, both direct and extended (to the members of the European alliance systems), has proved quite effective in preventing war and in making Governments with nuclear capabilities more cautious than ever when it comes to taking steps that might lead to either a nuclear war or a conventional war with a potential to escalate to the nuclear level. Governments have professed to realize that any deliberate choice for strategic nuclear war (beyond a defensive first use by NATO against aggression) could serve no rationally conceivable political or military purpose, but would be absurd and immoral. We should always keep this fundamental reality in mind when we hear either side accusing the other of harbouring a desire to plan a strategic first strike. With that kind of thinking, all meaningful arms control agreements will continue to lie beyond our reach. The danger of unintentional war remains, however, and both sides should work together to reduce the chances of error, uncertainty and misinterpretation in the handling of our command and control systems. The recent conclusion of an agreement to establish military risk reduction centres reflects growing super-Power concern over this problem. Now to the main topic. SDI is a research programme designed to determine whether strategic defence will be, from a technical and economic standpoint, significantly more feasible as an option in the mid-1990s than it was in the late 1960s and early 1970s.

Architectures of strategic defence are now being studied by both sides, although the Soviet Union has been keenly interested in them longer than the United States. Since 1983, several different technologies have been suggested—weapons which destroy oncoming missiles with kinetic energy (including pellet-projecting satellites and electromagnetic rail guns), a variety of lasers (chemical, X-ray, free electron and excimer, either space-based, pop-up, or ground-based) with mirrors in space to redirect their beams, and particle-beam weapons (along with ultraviolet excimer lasers) for interactive discrimination— to distinguish warheads from other objects and to disrupt the delicate electronic circuitry in the warheads' guidance or detonator systems. In our fascination with exotica, we should not forget terminal defence systems using the interceptor rockets and phased-array radars permissible under the ABM Treaty. The fact that the USSR has been modernizing its system around Moscow is one indication that it perceives the importance of strategic defences. No decisions have yet been taken concerning technological choices by the United States. Some technologies may be considered more or less promising within specified time-frames of 10, 15 or 20 years. But the research is far from completed. It is much too early to begin choosing technologies or to estimate the cost of futuristic strategic defence systems.

On 23 April 1987, a panel of the American Physical Society rendered its opinion that so many breakthroughs will be required in lasers and particle beams for an effective anti-missile system that it will take a decade or more for responsible policy-makers to determine whether the job can actually be done. That panel did not deal with nearer-term kinetic-energy systems. Some advocates of SDI would like to speed up the decision-making process for the development and testing of such systems before the Reagan Administration departs from office, so that a commitment will be set in motion that will later be difficult to reverse, even by a president who does not share the Reagan vision. Naturally, many in Congress are wary of, if not hostile to, such an attempt. Administration officials regard the American Physical Society report as unduly pessimistic. When the scientific and engineering communities divide on these matters of military technology, we softer political scientists seek probable truth in the middle. In my opinion, it will not be possible to shut off completely the faucet of space technology in the next 10 or 20 years. If we act intelligently, we can control the pace and direction. What is not feasible in the 1990s may be by the year 2020.

There has been some confusing debate as to whether the purpose of SDI is ultimately to strengthen deterrence by protecting retaliatory capabilities or to replace deterrence with something totally different—i.e., by substituting an effective shield over the nation and its population. Whatever technological choices the United States makes, its purpose will be to strengthen deterrence. Reagan wants to move away from "mutual assured destruction" to "assured protection and survival" as the best way to prevent any war. This is a very new idea.

If the Soviet Union is absolutely determined to defeat SDI and the vision which underlies it, it may very well be able to do so by adopting the "McNamara solution", based upon the premise that it will always be easier and cheaper to overcome an adversary's defences by saturating them with additional warheads. But that can be extremely difficult. The deployment of only two layers of defence—boost phase and terminal—would enormously compound the uncertainty of calculating the outcome of a first-strike plan and require a vast increase in the number of missiles and fractionation of warheads. To my way of thinking, that would be the very worst conceivable course for the Soviet Union to pursue—worst not only for the United States, but also for the Soviet Union and the entire world, for it would augur no hope whatsoever for the future. It would lead to a futile offence-defence race, the most destabilizing of all outcomes.

If I may give advice, a vastly preferable course for the Soviet Union to adopt as a rejoinder to SDI would be to explore the technological possibilities of coping with it by choosing technologies other than offensive strategic weapons. At least that would shift the competition from the buildup of capabilities for annihilating societies and their achievements towards competition for balancing defence with defence, or with offensive capabilities aimed at defensive mechanisms in space rather than at helpless populations and socio-economic structures on the surface of the Earth.

Both American and Soviet scientists in recent years have suggested a vast array of countermeasures that might be researched, developed, tested and deployed against space-based strategic deterrence. These include: *(a)* launching dummy rockets along with real missiles; *(b)* developing faster-burning fuels in order to reduce to a minute or two the time when missiles in the boost phase would be vulnerable to attack before the warheads separate and go onto their individual trajectories; *(c)* rotating missiles in flight to make them less vulnerable to laser beams or coating them with deflecting substances; *(d)* using chaff, decoys and balloons to confuse the defence; *(e)* attacking space-based defence with direct ascent missiles and/or "space mines"; *(f)* designing offensive warheads to detonate upon contact with defensive devices, thereby producing electromagnetic pulse (EMP) disruption of unshielded circuitry and otherwise distorting electronic reception, communication and fire directives in defensive systems; etc. It must be conceded that any object in orbit (if unprotected) is highly vulnerable to attack, and that any object capable of being launched into space has a potential to attack objects in orbit. (That is one major reason why the United States has contended that the verification problems of an anti-satellite (ASAT) ban are virtually insuperable.)

Some of the countermeasures mentioned may be cheaper to produce than additional offensive warheads in missiles with self-protecting and deceptive capabilities. Some other countermeasures which can be theoretically conjured up may be both difficult and expensive when it comes to actual engineering. This would be especially true if each layer in a multi-tiered defensive system—say, seven layers—were to consist of a different type of defensive weapons technology. Reagan Administration spokesmen have often said that it would make no sense for any country to deploy a strategic defence system unless it could survive possible countermeasures and could also be cost-effective at the margin. That is why the SDI funds research to neutralize counter-measures. If strategic defence will not work, the American Congress will not support it. As you know, both before and after Reykjavik, Congress, especially the House, has sought to apply severe cuts to Administration requests for SDI funds.

I should say a word about the views of the NATO allies from an American perspective. Initially, their reactions to SDI were quite cool for several reasons. They had not been consulted in advance; they feared "decoupling" and a revival of "Fortress America" thinking; they deemed the new initiative poorly timed, coming at the height of their domestic debates over intermediate-range nuclear force (INF) deployment; they were worried that a programme aimed at strategic defence against ICBMs would not address European concerns over medium- and shorter-range missiles; and they had misgivings that SDI would worsen the international political climate and doom the prospects for arms control by undermining the ABM Treaty. French and British strategic planners were dismayed at the thought that a new arms race for space defence would degrade the effectiveness of their own national strategic nuclear deterrent forces.

Western European Governments, however, as distinct from anti-nuclear groups as well as segments of the public and the media, are not terribly fearful that SDI will necessarily be destabilizing and increase the risk of war. They are willing to explore the possibility that strategic defence could enhance deterrence and that certain forms of participation in SDI research could improve Europe's hi-tech capabilities for both defensive purposes (perhaps even more against conventional than nuclear weapons) and commercial uses. Do not forget that all strategic defence technology (apart from the X-ray laser) is non-nuclear. Moreover, Western European defence elites, convinced that the Soviet Union has been vigorously pursuing anti-missile defence technologies for many years, are unwilling to forfeit to the USSR a monopoly right to move ahead in such a strategically important area. The NATO defence ministers (in whose meetings France does not take part) gave more support to the SDI research programme than the NATO foreign ministers of France, Denmark, Greece and Norway. During the last 18 months, the United Kingdom, the Federal Republic of Germany and Italy, as well as Japan (a principal non-NATO ally of the United States), have agreed to participate in various ways in the SDI programme. Other allied Governments (Canada, France and Norway), while refraining from formal memoranda of understanding, allow their private firms to participate. Generally, the allies wish to make sure that their own security interests are taken into account in the R and D phases of space defence and that they will be able to exercise some influence over future United States decisions with regard to development, testing and deployment.

It should be noted that when the United States signed the ABM Treaty, Gerard Smith clearly linked United States adherence to the expectation that the threat of offensive strategic missiles would be reduced in SALT II—something that never happened. Since then we have argued about the construction of the Krasnoyarsk radar, the Soviet ASAT system and Soviet research into and prototype testing of laser and particle-beam weapons at Sary Shagan. More and more of the non-aligned States are lending credence to reports of Soviet efforts. Perhaps both sides are becoming mature enough to admit that they are keenly interested in the possibilities of strategic defence.

I do not have time in this brief presentation to delve into the technical subtleties of the legal debate over the interpretations to be placed upon the ABM Treaty, except to say that neither side worked very hard to clarify what would be permitted in the future and both parties seemed willing to tolerate ambiguity rather than foreclose future ABM developments based on "other physical principles" that science and technology might make available. In my own country, the debate between advocates of the "strict interpretation" and those of the "broader interpretation" turn on the text of the ABM Treaty and Agreed Statement 'D', the negotiating record, the record of the Senate ratification hearings and the record of actual practice. In the debate, the international law of treaties and the constitutional relationship between the President and the Congress have often become confused. We can certainly take up this matter of treaty interpretation in the discussion period.

A case can be made that President Reagan's SDI has aroused within the Soviet Union a greater willingness than heretofore to contemplate substantial cuts in existing levels of offensive strategic weapons. This becomes clear if we recall the history of the SALT II negotiations and especially the negative Soviet reaction to President Carter's proposal in March 1977 for significant reductions. If we compare that to the Soviet negotiating positions since September 1985 at Geneva and Reykjavik, we can see remarkable changes, with both sides oscillating between realistic and unrealistic proposals for nuclear weapons cuts. President Reagan's SDI has ushered in an entirely new phase in the history of arms control. Few would deny that it has introduced a novel element into the picture and led to a "sea change" in our thinking. It may seem to complicate our task now, but it might eventually provide us with the key to resolve our dilemmas. It has already slowed United States offensive programmes by prompting Congress to become increasingly tough toward MX and Midgetman.

I am not certain that there will be a scientific-technological breakthrough which will make strategic, space-based defence economically affordable and militarily effective beyond enhancing the present deterrent, but even that would be valuable. Perhaps the superconductivity revolution which now excites the world of physicists will some day make strategic defence much cheaper, more workable and more abundant than offensive weapons. It is difficult to predict. At present, I am inclined to think that strategic space defence, conceived as a leakproof shield to render ballistic nuclear weapons impotent and obsolete against populations and structures, will not be technically and economically feasible to halt a full-scale strategic attack at the high levels of offensive armaments now existing, for example, 1,000-2,000 missiles carrying 10,000-20,000 or more nuclear warheads. This is always the scenario which figures in media models of "Star Wars". President Reagan may have had that scenario in mind when he launched SDI. But since then, he has frequently indicated that in his view strategic defence should be linked to drastic cuts in offensive nuclear arms. Naturally, the Soviet Union asks why it should cut strategic missiles if the United States intends to acquire strategic defence. The United States seeks a carefully managed transition through joint action from an offence-dominant to a defence-dominant regime, carried out over a long period of time to prevent destabilizing consequences, especially fears of a pre-emptive first strike.

There is reason to think that during the last two years each of the two principal space Powers has been moving towards a more realistic position with regard to exotic defence technologies—their interest in them, their cost, and what kind of agreements might be reached on the ABM Treaty to clarify permissible research, development and testing activities while postponing deployment decisions well into the future. Soviet spokesmen have hinted that they are not inflexible on research, development and testing. The United States at Reykjavik seemed ready to pledge no deployment for at least 10 years. That was linked to proposals for the total elimination of strategic nuclear missiles within 10 years—proposals put forth in what James Schlesinger called an atmosphere of "casual utopianism". Since then, the focus has been on a 50 per cent cut within 5 or 7 years, not on total elimination in 10 years. The United States has moved possible deployment of strategic defence forward to 1994. All of these are items yet to be negotiated.

Almost everyone seems willing to admit that our offensive arsenals are much larger than necessary for mutual deterrence. Even at 50 per cent or 40 per cent or 30 per cent of current levels, space defence against an all-out attack might still not prove highly effective; we cannot yet be sure, but if we were ever to negotiate downward to 20 per cent or lower, strategic defence at much more finite levels of deterrence capabilities would become not only more credible, but also more politically desirable and strategically essential, to provide a guarantee of security in a disarming environment. As the point is approached at which the surprise attack which had been deterred at higher offensive weapons levels might once again become "thinkable", Governments and their peoples will demand defence. It was precisely that fear of reintroducing the incentive for aggression at low armaments levels which made plans for general and complete disarmament in the period 1959-1962 stillborn. If progress is to be made towards substantial nuclear disarmament in the next 20 years—and there are causes for doubt—strategic defence will come to be looked upon as a prerequisite hedge against the possibility of cheating on a disarmament agreement, of breaking out of its constraints and embarking upon a course of rearmament, or against an accidental launch or a small-scale attack by nuclear missiles or a large-scale attack by conventional missiles. Thus whether we like it or not, the growing demand of the peoples of the world for disarmament will fuel the drive for strategic defence as an imperative of national security among many nations.

SATELLITES AND SDI

I would like to go a bit beyond all the slogans, such as "the non-militarisation of space", "the prevention of an arms race in space", and the establishment of "mutually assured security"—which nobody has defined—rather than "mutually assured destruction". These may be fine and necessary words but we need to understand what lies behind them; and I plan to deal briefly with SDI separately at the end.

Military satellites already exist in space. They are playing an increasing role as the "eyes and the ears" of the military. Some of these satellites have a broadly passive role and play a part in peacetime security and the prevention of war. These are the communication satellites, navigation satellites and observation satellites which are used as part of the national technical means for the verification of arms control agreements. Other satellites have their principal role in war-fighting. These are, for instance, active and passive radar satellites, radar reconnaissance satellites, satellites for warning of sudden ICBM attack, and so on.

The communication satellites are in high orbit; most of the reconnaissance satellites are in low Earth orbit. That is, to say they circle the Earth at relatively low altitudes. All satellites are vulnerable to attack and some are more vulnerable than others, particularly those in low Earth orbit. The latter are, as I said, generally the observation and reconnaissance satellites. They are vulnerable, first of all, to attack from weapons on the ground, interceptors, or perhaps high-powered lasers or other directed-energy weapons. The communication satellites in higher, and particularly geostationary, orbits (geostationary means that they stay in the same position relative to the Earth as both Earth and satellite go around), because they are much farther away, are basically not nearly so vulnerable to attack from the ground. Even if you launch things at them, it takes some time for the interceptor to get there, so there is a considerable amount of warning time.

Satellites, all of them, whether they are in low Earth orbit or in high orbit, need to have ground links. It's no good having a satellite in space talking to itself, it has to talk to the ground. Those "down links" and the ground stations that receive them are also vulnerable to attack. Attacks on satellites may be of a *"soft-kill"* nature, that is, they don't actually involve the physical destruction of the satellite, but they involve interference with the way it works: electronic jamming or perhaps laser blinding. (If you flash a very bright light in front of somebody's eyes, they can't see for a few minutes and if you make it strong enough they may never see again. You can do similar sorts of things to satellites with lasers.) These are what we call "soft-kill" weapons. But there are also *"hard-kill"* weapons. You can attack satellites by bringing an interceptor alongside them and making an explosion (a so-called "space mine") or by firing guns or beams of high energy particles at those satellites. These are sometimes called "kinetic-energy weapons", or "hit-to-kill weapons". This very brief explanation describes some of the basic facts behind all these slogans.

Now what are the options for negotiated arms control to prevent possible attacks on satellites? I give very briefly three categories.

Firstly, you could limit ground-launched anti-satellite capabilities. Both the United States and the Soviet Union already have rather rudimentary anti-satellite systems. These are capable of attacking satellites only in low Earth orbit. The Soviet system in particular takes a long time to set up and to make a kill. The systems do exist, but limits could be put on their use, and their further development, particularly by restraints on testing. Limits could be put on other systems. For instance, if you limit the power output of lasers which might be used to damage satellites in low Earth orbit, you can effectively control and limit the capabilities of this type of anti-satellite system. That is sort of agreement that one could have.

The second would be of a more fundamental nature and would prohibit both the launching and deployment of an in-orbit anti-satellite system. That is a system which is launched initially from the ground but remains in space, going round either in low or high Earth orbit until required for use. Such a capability is particularly important because, as I have mentioned, the satellites which are in high orbit geostationary orbit or some orbits which the Soviet Union uses (called "Molniya" orbits) cannot effectively be attacked from the ground. You have to have something already up in space if you are going to be able to attack them in reasonable time. So this prohibition would be on weap ons in space—active weapons, like the railgun that fires pellets, or directed-energy weapons that fire high energy particles. It should be possible to differentiate between what might be genuine peacetime uses for scientific experiment and wartime uses, by putting limits on the power output allowed in space from satellites.

The third category of agreement which might be negotiated and would help with the protection of satellites, would be a "rule-of-the-road" agreement. You may think that there's a lot of space out there and that satellites are not likely to run into each other. But in fact, space is really getting quite crowded. We could for instance negotiate an agreement which would help in peacetime to remove suspicion. For example, if you saw someone else's satellite approaching a vital one of yours, you might begin to wonder if your opponent wanted to destroy your satellite; and that would obviously not contribute to mutual confidence. So some sort of rule-of-the-road agreement would be useful. There are precedents for this on Earth, for instance, the very successful agreement which was negotiated between the United States and the Soviet Union some years ago, and more recently the agreement between the United Kingdom and the Soviet Union, called the Incidents at Sea Agreement. We could have a similar sort of agreement for space.

Now none of these three catagories of arms control agreements for space would be very easy to negotiate. But in my view, it would be possible both to enforce and to verify them. Verification might well be a process which would call for some international agency. I don't propose to say any more about the satellite systems. I hope what I have said may be helpful to us in trying to set out what it is we are really talking about when we use all these slogans about preventing a war in space.

Let me briefly talk about SDI. First of all, I will talk about my Government's attitude to SDI, which is governed by the need—and I quote—"to prevent an arms race in space" (one of the slogans!). But its policy is guided by an agreement which was signed between the British Prime Minister and the United States President at Camp David in December 1984. It was agreed that the West's aim in SDI would not be to seek to achieve superiority; that the deployment of any strategic defence would have to be a matter for negotiation; that SDI should enhance, and not undermine, deterrence; and that East-West negotiations should be aimed at achieving security with reduced levels of force on both sides. Perhaps we may be forgiven in Europe for thinking that the President doesn't always seem to remember the principles of this agreement. Let me just say that while most of my military colleagues believe that research into anti-ballistic missile (ABM) systems needs to go ahead—a view which I share—almost none of them see the likelihood that military requirements alone would justify the development and deployment of a comprehensive SDI system.

I would just like, since I have three more minutes, to make four points of my own.

First, the supporters of SDI describe SDI as being "defensive". Any prudent, sensible military man would be extremely cautious about classifying any active weapons system—one which fires things, whether bullets or electron beams—as either "offensive" or "defensive" That classification depends on how and when you use the system.

Secondly, the basic aim of Mr. Reagan's SDI (and all sorts of other SDIs) appears to be to defend against a "first strike". A first strike is a pre-emptive strategic nuclear disarming strike on your opponent. Gentlemen, such a concept does not exist. I am one of the commanders here that has had the direct responsibility of commanding nuclear forces. Let me just give you, from my experience, an illustration. If, for some reason, which I do not understand, the Soviet Union were to launch a disarming first strike against the United States and it was 100 per cent successful (which is unbelievable in military terms) and it thus took out every single American land-based missile, every air force base before it could launch its aircraft, every United States ballistic missile submarine in harbour (because when they're in harbour they are vulnerable), then there would still be enough missiles at sea in the sub-surface ballistic nuclear (SSBN) force, every moment of every day of every month of every year, to fire one warhead, of between five and ten times the power of the Hiroshima bomb, every 30 seconds throughout more than 24 hours. That's not necessarily how they would be fired indeed it is not how they could be fired, but that is the nuclear power that rests completely invulnerable—and I say that as a professional sailor without any doubt whatsoever—invulnerable beneath the seas I respond to any such "disarming" first strike. So the concept of a "first strike" exists only in the minds of armchair theorists.

Thirdly, we do have a problem in the balance between defence an offence in the strategic field. We have been defending our strategic assets for a long time. We put missiles into the ground in holes. The reason we then reinforce the holes is to protect them. We put missiles in submarines. Why? Because we want to protect them. So there is no reason why we shouldn't look at whether active defence measure should also be part of that equation. This is an area that I believed requires a great deal more study.

And finally, let me just say to you, again as a military man wit some sad experience in war: "Beware of military party tricks." Just because technology allows you to do something, it doesn't become feasible operation of war; Clausewitz said that in war even the simplest things are extremely difficult. The idea that, because you can carry out an experiment or test in which a number of ballistic missile warhead are destroyed, you have satisfactorily demonstrated that you have such an operational capability *in war*—when the system *has* to work the first time to be any use at all—is in total defiance of all my military experience. Perhaps you might ask one or two others about the impact of surprise. You might ask Mr. Sakarov why Soviet Air defences didn't stop a plane from landing in Red Square. You might ask the captain of the *Stark* why though he had the capability to destroy those Exocet missiles which hit his ship, he didn't do so; or the captain of H M S *Sheffield,* a British ship in a very similar situation. And I say this not to criticize Mr. Sakarov of the Soviet Union, the very gallant captain of the Stark or my own compatriot naval officer, the captain of the *Shef field. I* say it because the person who has actually experienced fighting a war knows very clearly that almost never does everything go right the first time.

SPACE AND SECURITY MATTERS, POST-REYKJAVIK

It is quite likely that the Reykjavik meeting would never have taken place had it not been for the question of security uses of space, in particular the expressed United States intent to use space technology to create strategic defences. Indeed, an entire new arms control effort was put in motion by the prospect of such defences. The change of emphasis in strategic affairs from deterrence of war through the threat of nuclear vengeance to deterrence based on non-nuclear defences of the major powers represents the only truly hopeful avenue for the mutual reduction of nuclear arsenals worldwide.

In fact, we are already witnessing a new view of the continued usefulness of massive deployments of nuclear ballistic missiles because of the likelihood that soon they will no longer enjoy a free ride to their targets, but instead will face effective defences. As with any of; the so-called ultimate weapons of the past, the nuclear ballistic missile will lose its attractiveness to *all* States, large and small, when that class of weapon is rendered vulnerable to defences. As long as nations decline to defend themselves against such weapons, there will be an irresistible urge for major powers to acquire more of them and for lesser powers to acquire some of them. It is imperative that the United States and the Soviet Union shift their emphasis away from the threat awesome destruction in order to ensure deterrence. It is essential to us our best technology to render the most destabilizing of nucler arsenals—masses of long-range nuclear ballistic missiles—impotent as instruments of coercion by any Power, large or small. This is in the interest of preventing the spread of such weapons to other Powers a of preventing an increase in the chance that nuclear war would launched by accident or by the actions of fanatics.

I am not known for agreeing with the opinions of Soviet leaders on most issues, but I would like to quote some Soviet views on strategic defences with which I fundamentally agree. General Nikolai Talensky, former editor of the Soviet General Staff journal *Military Thought,* wrote that an anti-missile system is designed solely "for the destruction of enemy rockets and not for hitting any objectives on the enemy's territory" and that defences go into action only "when the act of aggression has been started".

Alexei Kosygin, former Chairman of the USSR Council of Ministers, said at a press conference in London in 1967 that "defensive weapons are not the cause of an arms race" but instead "a factor preventing the death of people". Mr. Kosygin went on to attack the bourgeois reasoning of then-United States Secretary of Defense McNamara, whose opposition to strategic defences was primarily a matter of dollars and cents. Kosygin said: "Some persons reason thus: Which is cheaper, to have offensive weapons that can destroy cities and entire States or to have defensive weapons that can prevent such destruction? Such theoreticians argue also about how much it costs to kill a person—$500,000 or $100,000. An anti-missile system may cost more than an offensive one, but it is intended not for killing people, but for saving human lives."

In 1982, Marshal Ogarkov of the Soviet Union stated in a report to the Politburo: "Strategic defences are not only desirable, they are inevitable." I agree with the view expressed by the Soviet Staff that the doctrine of "mutually assured destruction" (MAD) promoted by the United States side in force structures and in treaties such as the anti-ballistic missile (ABM) Treaty is "bourgeois naivety". It is bourgeois because its main objective is to save money; it is naive because it calls on both the United States and the USSR to forgo forever defending themselves.

Now how does this remarkable convergence of views between the stated position of Soviet spokesmen and myself relate to the question of the uses of space in the future?

If Marshal Ogarkov and I agree that strategic defences are both desirable and inevitable, how can either of us maintain that one kind of defensive technology, that is space technology, must be excluded from consideration? Certainly I know—and I'm sure that Marshal Ogarkov also knows—.that the best defences against nuclear ballistic missile attack would be space-based. Why? Because the best defence is one hat destroys an enemy's missiles early in their flight, before warheads are released or at least while they are close together and vulnerable, Such intercepts can be made only by systems using components based in space.

The United States can, and I believe the Soviet Union can, put into ace non-nuclear defensive systems incapable of harming a hair on anyone's head—Russian, American, or other—but capable of preventing terrible destruction. We could both acquire defensive capabilities which, as General Talensky said, do nothing at all unless nuclear aggression has already started.

This straightforward logic is countered not by counter-logic, but by slogans. One often hears that such defences would "militarize space". People cry: "Let's keep weapons out of space." What nonsense!

Space was militarized long, long ago, in 1945, when the Germans launched over 1,000 V-2 missiles into space with the objective of destroying London. Today the most numerous of space weapons are the thousands of long-range ballistic missiles prepared to travel unimpeded through space to wreak terrible destruction on their targets. True, until launched, these missiles sit in silos on land or at sea, but once launched, they hurl themselves into space to do their awesome work. It makes no more sense to refuse to consider these missiles as space weapons than it does to insist that a battleship is not a naval weapon as long as it remains in port or that a bomber is not an air weapon as long as it is in its hangar on the ground.

Space-borne defences are designed to prevent the entry into space of these terribly destructive weapons and to prevent their use of space for free rides to an opponent's territory. To say that defensive weapons militarize space and intercontinental ballistic missiles (ICBMs) do not is like arguing that interceptor aircraft militarize the air, but the bombers they defend against do not. This defies all human logic.

Another more general slogan used to stop the United States from belatedly seeing to its strategic defences claims that such an action would expand the arms race. Let us look closely at this objection.

First of all, we should examine what causes arms races. There are two factors which must exist to energize an arms race. One is the inexorable advance of technology. No nation is going to allow its armed forces to continue to be equipped with bows and arrows while all other nations are acquiring machine guns. The other factor, political enmity, is controllable. There will never be an arms race between nations if no political or ideological hostility exists.

For instance, there is no arms race between the United States and Japan or the United Kingdom, even though all of us continue to upgrade the effectiveness of our forces with improved technology. Should one of us be determined to seize territory or bring down the Government of the other, there would be an arms race between us. Since we have no such fundamental enmity, we have no arms race.

It is political and ideological hostility that fuels an arms race between the United States and the USSR. So long as this hostility exists, there will be constant competition, including that for strategic military advantage. But this is an area in which the USSR must remove the obstacles, not the United States. In 1920, Lenin himself threw down the ideological gauntlet that keeps the competition alive when he declared American capitalism to be "enemy number one" of the socialist camp. And as late as the winter of 1986, the members of the Twenty-seventh Congress of the Communist Party of the Soviet Union rose as a body and recited in unison their determination to destroy the whole world of capitalism.

Only the leaders of the Soviet Union can remove this fundamental cause of the arms race. The United States has not declared a national goal of destroying the whole world of socialism. The ideological animosity is not of our making. Nor can (or should) the United States attempt to check the expansion of its technology, especially when such technology promises advantages for ourselves and our friends in security and economic progress. Further, we must insist on private enterprise—yes, capitalism—in space, not merely statist enterprises.

We Americans, if we are smart, will go into space along with our Western allies to protect and promote free political systems and free enterprise economic systems. We will do so to provide a strategic defence much more compatible with the basic moral values of our societies than the nuclear vengeance theories of mutual destruction. And we will do so to tap the unlimited sources of material and energy in space for the economic benefit of ourselves and others. The United States must pursue its space efforts in full recognition of the fact that there will almost certainly be more competition than co-operation with the Soviet Union in space.

One might wish it were otherwise, and indeed some Americans believe that the next great United States space effort should be a joint United States-Soviet manned mission to Mars. These enthusiasts disregard the currently insoluble problems of guarding the lives of men in space beyond the Van Alien belt from cosmic rays and solar flares. They seem to be motivated mostly by the hope that co-operation with the Soviet Union in such a venture would change political realities. This is what any good Marxist would call “bourgeois naivety”.

I see competition rather than co-operation in space as a promising way to change political realities for the better. If one looks closely, one can see it already working to change the world’s political scene for the better.

Space programmes, primarily the United States space programme, have driven technology forward at an amazing pace. Since the early 1960s, the demand of our space programme for small, lightweight and efficient computers has caused a tenfold increase every four years in our ability to process data. Our SDI programme has even accelerated this incredible pace.

When I was a major in the early 1960s, I was astonished at the computing power of machines that occupied a room the size of a dance hall. Today I can carry that computing power around in my pocket.

Today, in the United States, Europe, Japan and elsewhere, millions of scientists, technicians, scholars and businessmen have tremendous data-processing power at their fingertips. They are, so to speak, a hundred thousand times smarter than they were 20 years ago. This does not necessarily make them wiser, and the quality of their much speeded-up work is totally dependent upon their access to data—data that is accurate.

Herein lies the leverage of technology driven by space efforts to change political reality. There is an old saying about the new technology of computers—"garbage in, garbage out". That is, the computer's power is useless unless the data it processes is accurate. And this means that any political or economic system which wishes to stay abreast of the new surge in technology must give millions of people access to a broad range of accurate data. Any system based heavily on State control of information or that permits its bureaucracy to provide skewed data must reform itself or slip backwards technologically and economically.

The most profound aspect of the technological revolution which arose with the space era is development in communications. But this development has had the opposite effect of an earlier revolution in communications: radio and television mass communications. Radio and television were developments which assisted the State in controlling its people. Certainly Adolf Hitler used such mass communications with astonishing success, as did Franklin Roosevelt, Winston Churchill and Josef Stalin. But the new revolution in communications has the opposite effect. It assists the citizen in curbing the powers of the State.

This new reality must eventually have powerful effects on all highly centralized political systems—even on my Government, I hope, which has been tending over the years towards massive bureaucracies. We are perhaps seeing a reaction to this reality today in the Soviet policy of *glasnost*—a policy which may account for my being able to say these things to you today.

I believe that the most important joint effort the United States and the Soviet Union could undertake would be to launch a satellite system called *"Glasnost"*. I will gladly accept the Russian name. Why not some *glasnost* in space? Why not place in space the entire United States Library of Congress plus the Soviet Bolshaya Encyclopedia and the works of Marx and Lenin and make it all easily available to anyone on Earth? Surely, here is a way to use space for peaceful purposes and to provide to all mankind the means to determine for themselves what is truth and what is justice.

And in the field of arms control, I would make one other proposal. Let both of us, the United States and the Soviet Union, agree to change our emphasis in strategic armaments from offensive nuclear missiles to defensive, non-nuclear systems. Let us agree to defend our countries and to reduce nuclear arms at the same time. I, for one, though certainly not celebrated as a pacifist, would be happy to see United States negotiators make the following proposition to their Soviet counterparts:

"We are going to defend ourselves against nuclear ballistic missiles with any non-nuclear means available. As these defences reduce the threat to our retaliatory nuclear forces, we will reduce their numbers. For every 10 ballistic missiles we can confidently defend against, we will get rid of 5 or more of our missiles. We want the USSR to do the same." Surely this could be done without any possible reduction in either State's security and could not be rejected on military grounds, unless one party is determined to maintain a first-strike rather than a retaliatory nuclear force.

SPACE—AN ARENA FOR PROSPECTS AND PROBLEMS

Introduction

In October this year, we can celebrate the thirtieth anniversary of space research—the successful launching of the first artificial Earth satellite. During the three decades since Sputnik 1, space technology and the utilisation of space platforms of various kinds have gone through many phases of evolution. We have witnessed astonishing success as well as failures; some of the latter with severe and tragic consequences. The profile of applications and utilisation of space technology covers wide areas, from research to civilian and military support functions of various kinds. These applications depend extensively upon numerous platforms and probes of widely differing variety.

The importance of space research and space technology applications is difficult to evaluate on an absolute scale. It should also be pointed out that many question the wisdom of the enormous investments being made in space and argue that it would have been better to spend this money on Earth to solve some of humanity's difficult problems. On the other hand, one should not underestimate the effects and values which space technology applications have brought about. Such effects range from the significant "push-pull" effect on technology as such (in particular, on micro-electronics) to real application functions. Furthermore, one should not overlook the fact that space offers an important challenge as the "last" frontier for mankind.

Still, within a more restricted context, the various areas of application are of more importance. These applications may be structured in several ways, though it is interesting to note that the great majority of them are related to information—either by observation or by relaying information. The first group consists of a large collection of observation satellites for civilian and military use, while the second group consists of communication and navigation satellites. Application of space technology has therefore become a significant component of the "information society".

This paper will address some aspects of the prospects of space technology, while emphasizing some of the problems related to the use of space. The intention is not, however, to give a detailed analysis of the various application fields or the problem areas. On the contrary, only a few of the more important points will be elaborated upon.

The paper is organized as follows. First, some of the main lines of the evolution of space technology are pointed out. Then the main fields of both civilian and military applications are summarized, with the emphasis on observation satellites. Next follows a discussion of verification problems and the possible use of observation satellites for monitoring purposes in a multinational (regional, international) regime. Finally, some of the problems related to the militarisation/weaponisation of space are addressed, with special emphasis on defining space-related activities.

Space Technology in Transition

The broad pattern of evolution of space technology/space applications can be summarized as follows: development of basic technology, development of infrastructure, development of and applications of satellites/probes for research purposes and development of and applications of satellites for various civilian/military support functions. The driving forces in space development have been many, including the pursuit of political prestige as well as the need to develop new tools for various purposes (observations, communications, etc.).

Space technology has always been a costly undertaking. Nevertheless, what started as a monopoly of a very few industrialized nations has become more and more a technology accessible to many. In general, space technology services are available to and utilized by most nations throughout the world.

Many of the previous uses of space technology could be characterized as test experiments for developing basic technology and testing the feasibility of various schemes. Examples of such experiments are found in Earth observations, using remote sensing and astronomical observations from space-borne telescopes. The transition from pioneering mission to the next operational level in most cases means huge investments ("facility class" missions in NASA terminology)—investments in the order of billions of dollars for each project. This is also one of several indications that space technology has grown beyond the national scale. In the long run, international co-operation will be the only way to solve these problems.

Civilian Uses of Space Technology

The civilian community uses space for several functions:

— Exploration of the celestial environment (astronomy);
— Exploration of the environment in the vicinity of Earth Magnetic fields Earth/solar interrelationship Ionosphere;
— Exploration of the environment on and close to Earth Geodecy Meteorology Land use/vegetation/oceanography;
— Space manufacturing.

Civilian Remote-Sensing Programmes

The best known and most utilized remote sensing programme is the Landsat programme. Five satellites have been launched under it. Landsat 1, 2 and 3 carried sensors with pixel (picture elements) sizes from 80 m-45 m; Landsat 4 and 5 carried sensors with a pixel size of 30 m. The coarse resolution of Landsat 1, 2 and 3 can only be utilized for detection of large (geometric) features like land-forms, lakes, roads, airports, urban characteristics and similar large-scale phenomena. The usefulness of the observational data is, however, partly due to the spectral information given by the multi-spectral scanner. It should be emphasized that in ordinary photo-interpretation (as in direct vision), the scene (environment) is generally interpreted by the use of geometrical features (shape and forms, texture, shadows, occlusions, etc.). The Landsat data (and other remotely sensed data carrying multi-spectral information), on the other hand, are generally analysed using spectral features. This is often efficient for land/water studies, vegetation studies, environmental monitoring, coarse urban studies, etc.

The recent SPOT programme (systeme probatoire d'observation de la Terre) is interesting from several points of view. The geometrical resolution is three times better than the best Landsat sensor (pixel size of 10 m), thus revealing geometrical details far better than previously obtained by civilian satellites. Furthermore, this improvement in geometrical resolution makes it possible to investigate civilian and military activities never before viewed by civilian sensors. Also, military targets and activities of tactical interest can now be investigated.

Military Uses of Space Technology

The military applications of space technology have been developed at approximately the same time by the two super-Powers, the United

States and the Soviet Union. These military functions can be summarized and categorized as follows: *(a)* communications; *(b)* navigation; and *(c)* observations: early warning of ICBM attack, meteorology, reconnaissance, signal intelligence, ocean surveillance, nuclear explosion detection and geodetic satellites.

In many cases, the satellite assets constitute support functions for strategic war-fighting. More and more, space functions are used on tactical levels as well, for the support of tactical forces. There is no doubt that satellite systems and functions play an important role—a role spanning many different levels: national prestige, intelligence functions, support for military C^3I-functions, targeting information, treaty verification, weapon navigation, alert for surprise attacks, crisis management, and control of military manoeuvres.

The military functions provided by space technology, as listed above, are all "non-aggressive" functions. Furthermore, it is generally considered that, on the whole, they are politically stabilizing, in particular with regard to the strategic scenario. It should be emphasized, however, that the majority of the space functions above also act as "force multipliers" in the sense that they enhance the capability of existing weapons (nuclear and/or conventional). It is therefore no surprise that we can now see the development of systems intended to both destroy and protect satellite systems. Consequently, we can also consider military space technology as a significant extension of the arms race.

Since the characteristics of the military satellites, their detailed use and their incorporation into military organisation and weapons systems are classified information, it is difficult to assess the degree of dependence on such systems. It is generally considered that the super-Powers are highly dependent upon their systems for peacetime use (verification, targeting and intelligence). This is probably also the case for the grey zone between war and peace (crisis-monitoring and early warning). During war-fighting, the survivability of the space systems and functions is determined not only by the attacks on the satellites themselves, but also by the attacks on the control and support functions (launching sites and ground stations), as well as by the use of more conventional countermeasures (jamming, false signals, etc.). The question of survival vulnerability and dependence upon space functions will therefore, to a great extent, be related to the particular war scenario in question.

Observations by Satellites

The kind of information which may be acquired by satellite observations may be categorized in several ways. One categorisation, with respect to rapidity of temporal change ("time-scale" or "time constant") of the phenomena or activity, is the following:

— Non-changing data (Time-scale: very large/years)
  Geodetic data
  Topographic data;
— Slowly changing data (Time-scale: day - months)
  Construction
  Industries
  Silos
  Roads
  Airports
  Vegetation;
— Medium speed changing data (Time-scale: hours - day)
  Military units (land, sea)
  Weather;
— Rapidly changing data (Time-scale: part of second - hours)
  Communication, radar
  Weather
  Military units (airborne)
  Missiles, airplanes
  Nuclear explosions.

Sensors for Acquiring Information

In order to acquire the data necessary to obtain information concerning the activities listed above, large numbers of different sensors are used. Many of these have been developed especially for use on satellite platforms. In most cases, the information needed concerns not only the particular radiation characteristics ("signature"), but also the geographic location of the source of the radiation activity. Most sensors are therefore "image-forming", since they record both the electromagnetic radiation (or rather one or several of the properties of this radiation) and the angle of incidence (normally given in terms of geographic co-ordinates on ground-based, on sensor and on satellite parameters). The accuracy of position information depends on both the nature of the signals and the sensors used for detection. A brief categorisation may be made as follows, reflecting a mixture of both signal and sensor types: (a) geographical accuracy in the order of kilometres or more: signal reception, weather, nuclear explosion detection and missile launch; (b) geographical accuracy in the order of hundreds of metres - kilometres:

radar SLAR (side-looking airborne radar) mode, weather and oceanographic parameters; (c) geographical accuracy in the order of tens of metres: electro-optical cameras, photographic cameras and radar SAR (synthetic aperture radar) mode; and (d) geographical accuracy in the order of metres: electro-optical cameras, photographic cameras, radar SAR-mode and laser radar.

Characteristics of Sensors

The primary metrics for assessing the quality of sensors are as follows: *(a)* resolution: ability to distinguish fine details; and *(b)* range: ability to cover a wide range.

These metrics can be applied to three important parameters, or dimensions, for imaging sensors: *(a)* spectral: spectral resolution (narrowness of spectral channels) and spectral range; *(b)* intensity: contrast accuracy and contrast range (dynamic range); and *(c)* geographical: spatial (two-dimensional) resolution and area coverage.

Many of the militarily interesting targets and activities are revealed by the detection of target shape and other geometrical details. Therefore, high geometrical (spatial) resolution is needed. The spatial-resolution power of an imaging sensor is determined by the following parameters: focal length of camera, detector resolution, satellite altitude, size and quality of lenses, wavelength of radiation, and disturbing effects, including atmospheric haze, atmospheric irregularities (turbulences) and platform stability.

The actual resolution of the best cameras in military reconnaissance satellites is subject to stringent classification. It is generally believed that camera and satellite technology permit focal lengths of several metres and this should give resolution cell size, on ground, as small as a few decimetres. For resolution values as good as this, atmospheric conditions start to be important.

It should be pointed out that cameras working in the visual part of the electromagnetic spectrum are needed for detailed investigation of ground activities. Cameras using the longer wavelengths of optics, in the infra-red (IR), do not give the same ground resolution. On the other hand, such cameras are very useful for the detection of hot objects (ICBM-launches), camouflage penetration and underground activities. Also, any sensor system is limited in its performance. The satellite sensors are limited as follows: (a) observation repeatability: satellite orbit and satellite manoeuvrability; *(b)* cloud and other atmospheric conditions: visual and IR (cloud penetration); *(c)* lighting conditions:

visual (daytime), IR (daytime and night-time) and microwaves (day and night, fairly weather independent); *(d)* camouflage; *(e)* non-movable targets; and *(f)* time delay of information/interpretation.

The limitation to non-movable targets (static targets) is important; the present systems are therefore not very useful for tactical war-fighting. There are indications that the United States is developing special mosaic sensors which should make it possible to detect movable targets like aircraft and tactical missiles.

Verification Problems

As indicated earlier, the detailed characteristics and use of military space systems operated by the super-Powers are not available. The same is true for the intelligence organisations making operational use of these and other intelligence data. One of the problem areas where satellite data are used is the monitoring and verification of parts of the SALT agreement.

The SALT Treaties comprise the following agreements: (a) prohibition regarding construction of additional, fixed land-based ICBMs after 1 July 1972; *(b)* prohibition on conversion of land-based light ICBM-launchers into heavy ICBM-launchers; (c) limitation of SLBM (submarine-launched ballistic missiles); *(d)* limitation of the number of re-entry vehicles per launcher; and *(e)* prohibition on interference with national technical means of verification.

The national technical means play a most significant role in the verification process, and it is generally understood that they comprise several technical information collection processes, including satellite observations.

The objective of the Treaties is to:

— Restrict the number of strategic weapons
  Main verification method: satellite observations;
— Restrict qualitative improvements on existing strategic weapons
  Main verification method: non-satellite observations;
— Restrict developments of new missile systems
  Main verification method: satellite and non-satellite observations.

The technical means of verification appears to consist of ground-based systems, sea-based systems, airborne systems and spaceborne systems, while the technical methods are the following ones:

— Radars

Line-of-sight radars

Ground-based

Sea-based

Airborne

OTHR (over-the-horizon radars)

Ground-based;

— I R-sensors

Satellite-borne;

— Photographic sensors

Satellite-borne

Sea-based;

— Interception of communication, radar and telemetry signals

Ground-based

Airborne

Satellite-borne

Sea-based.

These verification methods are efficient because the introduction of new missile systems (and this is true for most weapons systems as such) has to go through several phases, such as research, development, testing, production and deployment, and it is very improbable that a system could go through several or all of these phases without detection.

The information which might be gathered by the sensor systems listed above is as follows:

- — Radars: detection of existence of missile tests, determination of missile trajectory, character of re-entry vehicles, and frequency of test used to infer propagation of system through its various phases from test to deployment;
- — Early warning satellites (IR): existence, location and time of launch;
- — ELINT (electronic intelligence): telemetry data indicating status of test (size, pay load and fuel consumption);
- — Photographic reconnaissance satellites: information about hardware.

The above summary description indicates that the national technical means used for SALT and ABM verification are multiple, redundant and complementary.

Although satellite observations are by no means the only source of information, they doubtless play an important role in the verification process.

When we compare the various treaties (and not only the SALT Treaty, discussed above), we find that there are a number of means of verification. A summary of such methods can be made as follows: inspections/observations, aerial observations, periodic meetings, national technical means, review conferences, consultations, notification to other parties, reference to the United Nations Security Council, inquiries, exchange of data/information, calibration tests, bilateral procedures and on-site instruments, manned/unmanned ("black boxes").

A comparison of the treaties shows further differences among them:

— Different party types;
— Multilateral/bilateral;
— Verification/no verification;
— Different kinds of limits (in energy, geographical area and time);
— Restriction on test sites.

Comparison with Seismic Verification of Nuclear Weapon Tests

It is interesting to compare the problems of using satellite observation for verification purposes to the development in the field of seismic methods for verifying nuclear tests. The first experimental data on nuclear explosions were obtained from seismic sensors in September 1957. The use of seismic data as a means of verification for nuclear underground testing was suggested in 1958. It took, however, about 5-10 years to obtain the basic understanding of the implementation of such a verification system. The seismological resemblance between data from nuclear tests and data from normal underground earthquakes constitutes a major problem in both detection and identification.

In 1958, a conference of experts met in Geneva to study the technical aspects of nuclear detection and identification. These experts initiated the still ongoing discussions about an international seismological verification system by describing a network of control posts.

In 1984, an experiment was conducted comprising an interchange of descriptions of seismic data (so called Level 1 data). This experiment was also intended to test communication systems and procedures. Also in 1984, an exchange of raw data (wave-form data or Level II data) was agreed upon. An experiment regarding such an interchange of data, with associated signal processing of the data, is planned to take place during 1988.

This brief description indicates that it takes time to build a technological framework for utilizing technical means and infrastructure for verification purposes.

Verification by an International Monitoring Agency

In view of the importance of space observation for various control functions and the creation of mutual stability and security, it is not surprising that the idea of using space observation for enhancing international stability was discussed as early as 1961. Later, following a suggestion by the President of France, a United Nations study was conducted to investigate the legal, technical and financial problems related to the use of satellite observations for monitoring military activities by an international satellite monitoring agency.

Due to the great difficulties in creating an international organisation for such purposes and the special problems in the European arena, it has recently been suggested that a regional organisation, instead of an international one, be set up as an intermediate step.

The main criticism of the proposal contained in the United Nations study can be summarized as follows:

- Existing treaties are either being verified by currently existing means or they are difficult to verify;
- Any such organisation would not only be very expensive, but also very difficult to implement, particularly in the United Nations environment;
- It is very difficult for an international organisation to solve the problem of confidence;
- Strict and undisputed rules are difficult to construct with regard to interpreted data;
- Interpretation of raw data is normally carried out using complementary information of an intelligence character; such information would be difficult to acquire, handle and use in an international satellite monitoring agency;
- The process of verification is not only of a technical nature.

It is important to realize that because of the ground resolution needed for verification, satellites in geosynchronous Earth orbit (GEO) cannot be utilized due to the large distances involved. Therefore, satellites in low Earth orbit (LEO), of the order of 400 km, are (at least for camera systems available today) a prerequisite. Continuous observations can therefore not be made of a region of interest for verification. If a tillable camera system is available (e.g., the SPOT observation camera), an area may be observed every other day (assuming no limitation due to weather conditions). Therefore a satellite verification system is best suited for observation of conditions which are slowly changing (over several days). For more rapid changes (less than a day), this system is not so well suited.

Prospects for the Future

The preceding discussion has dealt mainly with the use of space technology for various civilian and military purposes and, in particular, for conducting observations from spaceborne sensors for verification purposes. This important use of space and space technology for improving and strengthening security among nations is in addition to the well-known uses of space. The problems connected with the development of space and the use of space facilities are of several kinds. First is the traditional use of space for military support functions, as described earlier. Even though many of these functions serve as stabilizing factors, they are also elements in strategic and tactical C^3I functions and thus enhance war-fighting capacity.

Another, yet still more important problem area is the increased militarisation of space which is taking place—not only for support functions, but also for weapons functions of various kinds. The present legal regime for arms control in outer space puts up some barriers to the arms race, but in certain areas, loopholes do exist. Therefore the further militarisation and weaponisation of space cannot be completely controlled/limited by the present regime.

The question of ballistic missile defence is of significance for the strategic relationship between the super-Powers. Also, since parts of such systems can have an additional capacity for use against targets other than strategic weapons, the systems are of direct concern to other States. It is therefore important for the entire international community to control the development of weapons in space. Another important factor is the existence of operative anti-satellite (ASAT) weapons and the development of more sophisticated weapons of this kind. To facilitate efforts to find a better legal regime for outer space, it will be necessary to identify and define technologies and weapons systems in this area. With the necessary goodwill of nations, it should not be impossible to start such a process.

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SPACE TECHNOLOGY—SECURITY RELATED DEVELOPMENTS

Space is not an area that many would consider "militarized" in the conventional meaning of the term. There are currently no weapons orbiting Earth or military forces permanently stationed in space. Even the satellites that are regularly launched by both Super-Powers for military purposes seem benign and inoffensive in character. Apart from the fact that they do not possess the means to attack other objects in space, military satellites—especially those used for early warning, reconnaissance, and communication—are also widely perceived to enhance international peace and security. By supplying the super-Powers with accurate information on the military activities of each other as well as timely warning of an attack and reliable conduits for crisis management, satellites support deterrence, arms control verification and strategic stability in general.

While satellites will continue to play this role, the military use of space is nevertheless undergoing a fundamental transformation in two major respects. First, military satellites are becoming increasingly useful as warfighting aids for terrestrial armed forces. Virtually every type of military operation from small conventional conflicts to strategic nuclear war is now likely to involve the use of satellites in some significant way. For example, reconnaissance satellites are being used more and more to detect, track and target military forces such as naval ships; communication satellites can immeasurably increase combat effectiveness by the rapid and reliable distribution of military information; and navigation satellites can actively guide even the "dumbest" munitions to their targets with near-perfect precision. New military space systems will strengthen this trend still further. The growing military applications of space systems have understandably increased the incentives to deny their benefits to an adversary in wartime. At the same time they have also increased the incentives to protect satellites from attack. The USSR has already deployed an anti-satellite (ASAT) weapons system and the United States has one in an advanced stage of development. If present trends continue, it is unlikely that satellites will operate without challenge in wartime, at least in conflicts where the super-Powers are directly involved. This is the second basic trend.

Space may not remain a sanctuary from future conflicts in another respect. The Strategic Defense Initiative (SDI) launched by President Reagan in the now famous “Star Wars” speech of March 1983 has also raised the prospect that ballistic missile defence (BMD) systems will be deployed in space. Using space to defend against a ballistic missile attack has some major attractions. In particular, it makes it possible to intercept missiles during their initial ascent (the so-called boost phase), when they are relatively vulnerable and before their multiple warheads have separated from the booster. Subsequent layers of intercept systems further increase the chance of a successful defence. In the future, space platforms may also be used to launch attacks against targets on Earth. Both these possibilities are guaranteed to spur ASAT weapons development still further.

The changing nature of the military use of space is the subject of this paper. It will review both the peacetime and growing wartime uses of satellites as well as the potential development of space weaponry.

Peacetime Operations

In peacetime, military satellites serve several important functions. They are vital to the super-Powers’ intelligence gathering and arms control monitoring effort, help in the management of international crises, facilitate war planning, and are relied on to provide the earliest warning of attack. Each will be discussed in turn.

Intelligence gathering and arms control monitoring. Reconnaissance satellites have become the most reliable and productive source of intelligence for both Super-Powers. Photo-reconnaissance satellites return images of areas of the globe that, for all practical purposes, are not open to inspection by other means. Each side can monitor the other’s military forces and weapons systems to gauge their capabilities and plan accordingly. The same space systems are also used to monitor compliance with arms control treaties. If a violation of a particular agreement is suspected, coverage by photo-reconnaissance satellites can be increased to collect more evidence. SIGINT (Signals Intelligence) satellites are also valuable aids to verification. Intercepted telemetry signals from ballistic missile tests, for example, provide evidence of the range, pay load, throw-weight, accuracy, and number of warheads carried by a new missile. The United States also uses special nuclear explosion detection sensors aboard its DSP (Defense Support Program) early warning satellites and Navstar navigation satellites for monitoring compliance with the partial test-ban Treaty and the nuclear non-proliferation Treaty. Given the closed nature of Soviet society, the United States is plainly more dependent than the Soviet Union on reconnaissance satellites for intelligence gathering and arms control verification.

However, the Soviet analysts also need photo-reconnaissance satellites for observing activities in China, for strategic targeting purposes, and for corroborating intelligence obtained from other sources. While large quantities of information are available from the United States press and from Congressional hearings, highly classified United States military facilities can be inspected only from space. Moreover, the Soviet Union has a greater dependence on photo-reconnaissance satellites for monitoring activities in remote parts of the world, since the United States has more alternative sources such as SR-71 and TR-1 reconnaissance aircraft, which operate long-distance with inflight refuelling or from United States bases around the world. Although the Soviet Union also has long-range reconnaissance and SIGINT aircraft, these are generally considered inferior to their United States counterparts and do not have access to as many foreign bases.

War planning. Photo-reconnaissance satellites are the principal source of information for strategic war planning by the super-Powers. Without precise information on the location of targets such as missile silos and command centres, counterforce operations would not be possible. The mapping of the Earth's gravitational field by geodetic satellites is also essential for targeting ballistic missiles, while the guidance of United States strategic cruise missiles relies on digital topographic data derived from satellite imagery.

In similar fashion, both Super-Powers use SIGINT satellites for determining the locations of radar systems, particularly mobile systems, for targeting in wartime, and for measuring the frequency, strength and other characteristics of radar signals for electronic countermeasures (ECM) such as jamming and "spoofing". This helps bomber and reconnaissance aircraft to plan their penetration routes into enemy airspace and suppress the defences they encounter.

Crisis management. Reconnaissance satellites are invaluable for monitoring events or conflicts that threaten global or regional stability, particularly where the use of aircraft is difficult for geographical, logistical or political reasons. The Soviet Union in particular has come to rely on satellites for observing third world conflicts, as indicated by the frequency of launches during some crises and the adjustment of satellite orbits to increase the coverage of crisis areas.

Communication satellites are also increasingly relied on by the military to direct and control their forces during international crises. Similarly, the United States State Department relies heavily on the Defense Satellite Communications System (DSCS) for communications with its embassies abroad, and the North Atlantic Treaty Organisation (NATO) has developed its own communication satellites to link alliance capitals and military command centres. Satellite links were also the obvious technical solution for modernizing the United States-Soviet hot-line.

Early warning. In a serious crisis involving the Super-Powers, reconnaissance satellites are likely to provide the earliest indications that military operations are being considered. The dispersal of bombers and theatre nuclear forces from their peacetime bases, the "flushing" of strategic submarines from port, changes in communication patterns, and the general mobilisation of conventional forces would be indicators that could be detected by reconnaissance or SIGINT satellites. Signals intelligence could provide the only warning if images were unavailable for climatic or other reasons.

Ballistic missile early warning satellites, on the other hand, would provide positive evidence that an attack had started. These satellites are expected to give up to 25 minutes warning time before the attacking intercontinental ballistic missiles (ICBMs) hit their targets, and somewhat less in the case of submarine-launched and intermediate-range missiles.

In addition to these four main missions, satellites provide general support for peacetime military operations through weather forecasting, navigation and communications.

Wartime Support Operations

Naval operations. Naval forces have probably been the greatest beneficiaries of military satellite support, with important services being provided by ocean reconnaissance, communication, navigation, and meteorological satellites.

For well over a decade the United States and the Soviet Union have employed satellites for ocean reconnaissance. The United States appears to use its satellites primarily for monitoring the world-wide deployment of naval forces. The Soviet system, in contrast, appears specifically designed to help prevent United States naval forces, especially carrier groups and attack submarines, from coming within striking range of the Soviet homeland in wartime. The Soviet radar and electronic ocean reconnaissance satellites would detect and track the movement of United States naval forces towards the Soviet Union, and then pass this information on to aircraft and submarines for targeting purposes.

Communication satellites, for the United States in particular, have become virtually indispensable for naval operations. According to one report, the United States Navy now relies on satellites for 95 per cent of its messages. Special terminals are fitted to all of the Navy's major surface ships, submarines, P-3C Orion aircraft, and shore stations around the world. The rapid collection, collation, analysis and dissemination of information from sensors around the world has also immensely facilitated the tracking of Soviet submarines.

Although the extent to which satellite receivers have been deployed throughout the Soviet fleet is unclear, it is known that certain warships and auxiliaries have been fitted with satellite antennas to serve as command centres afloat. Soviet ballistic-missile submarines (SSBNs) and nuclear attack submarines (SSNs) are also known to employ satellite terminals.

Naval forces, particularly submarines, have also been the principal beneficiaries of navigation satellites. The provision of common positioning information to ASW (antisubmarine warfare) aircraft, helicopters, surface ships, amphibious forces and other weapons platforms is expected to improve dramatically the efficiency of such missions as sonarbuoy and mine emplacement, mine clearing, and amphibious deployments, as well as naval air operations.

Finally, naval forces are among the largest users of information derived from meteorological satellites. Timely and accurate forecasts, particularly of adverse weather, are essential for naval operations. While the majority of weather reports are transmitted from shore facilities via communication satellites, the navy is also fitting DMSP (Defense Meteorological Satellite Programme) satellite receivers aboard its major aircraft carriers to provide weather data directly. Presumably, the Soviet navy derives similar benefits from the Meteor satellites, though the extent to which surface ships receive data directly from these spacecraft is unclear.

Of equal importance to naval operations is the data supplied by oceanographic satellites. Information on ocean conditions is important for sonar operations and interpretation and for optimum use of weapons. Wind speed measurements will help in the prediction of ambient noise and improve the accuracy of sonar readings, while information on the thickness of ice cover can help determine likely enemy surfacing locations. The same information can also be used by submarines to evade detection, for example, by locating ocean eddies that can hide submarines from sonar detection. Again, the existence of Soviet oceanographic satellites indicates that their navy finds these data useful for similar reasons.

Air operations. For air forces, images from reconnaissance satellites are useful for planning ground attack and long-range interdiction strikes. Timely and accurate weather information from meteorological satellites is used to schedule missions, determine the best route to approach a particular target, from what altitude, and sometimes even what type of weapons to use. As a result, the United States Air Force and Marines are procuring new transportable and rapidly deploy able terminals for receiving DMSP weather data. The Soviet Union probably finds meteorological satellites equally useful for the same reasons.

A major advance in the use of satellites in United States air operations will come with the full deployment of the Navstar Global Positioning System (GPS). In tests using the partially deployed system, helicopters have made blind landings within several feet of a designated spot; jet fighters have linked up with tanker aircraft for inflight refuelling; cargo aircraft have parachuted supplies within forty feet of a ground marker; and fighter-bombers have delivered conventional “iron bombs” to their target with the precision of “smart” munitions. In wartime, the efficiency of bombing operations is likely to improve significantly. Some predict that for close air support operations and long-range interdiction of ground targets, the “kill probabilities” could improve by several orders of magnitude.

Scant information is available on how the Soviet Union intends to employ its counterpart navigation satellite system in wartime, but given its similarities with Navstar, one can expect that it will be put to the same use.

Ground operations. Ground forces have probably been the last of the armed services to benefit from satellite support. This is now changing, however, as reconnaissance, communication, and navigation satellites begin to play a larger role in aiding land operations.

The use of reconnaissance satellites in wartime has traditionally been limited by the delays in acquiring and interpreting data and forwarding information to field commanders. However, new United States photo-reconnaissance satellites will probably be able to down-link imagery directly to senior field commanders for battle management and the targeting of enemy forces. The ground forces, however, will receive only intermittent "snapshots" of the battlefield; continuous real-time surveillance of events will not be available for the foreseeable future. It appears that Soviet use of digital transmission of reconnaissance data is relatively new, and it seems likely, therefore, that the United States is ahead in the use of reconnaissance satellites for tactical purposes.

The advent of small transportable satellite communication terminals and even back-pack radio transceivers, particularly for United States forces, has permitted an unprecedented degree of control over military operations. The adoption of small portable or easily transportable terminals by Soviet ground forces does not seem so widespread, which may reflect less advanced technical capability and, to some extent, Soviet command style. Nevertheless, the use of communication satellites by Soviet forces is becoming more evident, with terminals at army group and divisional headquarters.

When the United States Navstar GPS system becomes fully operational, United States ground troops will gain access to satellite navigation. Besides allowing ground forces to navigate better, particularly in desert and jungle areas, it should also improve the accuracy and co-ordination of artillery barrages, air support and parachute supply drops.

Nuclear operations. For planning a co-ordinated attack against an opponent's strategic forces, photo-reconnaissance and SIGINT satellites would be used to detect and target ICBM silos, bombers, submarines in port, and fixed command and control centres and even mobile command centres. Since the accuracy of ballistic missile warheads can be adversely affected by wind and rain, up-to-date satellite observations of the weather over the target area would be critical for modifying their guidance systems. Bomber crews would also need to take into account the weather en route to their targets. Ballistic-missile submarines would obtain last-minute position fixes from navigation satellites to update the inertial navigation systems of the missiles, and strategic bomber and tanker aircraft would also use satellite navigation in their missions. Valuable though satellites would be in supporting a first strike, they would not permit a fully disabling attack. Deployed submarines still remain undetectable from space, and dispersed mobile ICBMs will also be extremely difficult to find.

Satellites are expected to play a major role in assisting retaliation, however. The earliest confirmation of an attack would be provided by early warning satellites, allowing the option of launching a retaliatory strike before the arrival of the attacking warheads. At the very least, vulnerable strategic forces like bombers, tankers, and airborne command posts could be sent aloft to avoid immediate destruction. The early warning satellites could also indicate the general size of the attack, the approximate launch sites, and the types of missiles used. This knowledge could be useful for helping decision makers discern the purpose of the attack, especially if it is a relatively limited strike, and for deciding on the most prudent response. Locating the source of the attack would also provide information for targeting the adversary's remaining ICBM forces.

The space-based United States Nuclear Detection System (NDS) would complement the data supplied by the DSP early warning satellites, for example, by detecting the detonation of Soviet SLBMs up to 20 minutes before the arrival of the more accurate "silo-killing" ICBMs. The United States leadership would thus have confirmation of an attack before making the dangerous decision to save the threatened ICBMs by launching them promptly. The NDS would also indicate areas that had escaped destruction so that bombers, tankers, and command post aircraft could be directed to them.

Finally, communication satellites would be used along with other systems to set the retaliatory strike in motion. The United States has AFSATCOM (Air Force Satellite Communications System) terminals to receive launch orders aboard all the airborne command posts, on strategic bombers, on KC-10 tankers and at all Strategic Air Command posts and missile launch control centres. In the future, the Milstar system will provide strategic command and control links both during and after the attack. Soviet strategic forces are presumably connected in a similar way.

Space Weapons

The growing importance of space systems for war planning and operations has increased the incentives to deny their benefits to an adversary in wartime. There are three principal ways to accomplish this: first, the satellite itself can be attacked; second, the communications links with a spacecraft can be disrupted by electronic interference; and third, the ground stations that control satellites and receive data from them can be attacked. The launch facilities necessary to replace satellites lost to enemy action in wartime are similarly vulnerable.

There are advantages and disadvantages associated with each of these approaches. Destroying satellites may be more direct and less escalatory than attacking ground facilities, in part because this method would not involve loss of life, but depending on the nature and context of the attack, such action could be viewed as an unambiguous signal of attack and be highly escalatory. The destruction of an early warning satellite during the conventional phase of a super-Power conflict, for example, would surely be interpreted as a prelude to a nuclear strike. Furthermore, the attack would accomplish little if the destroyed satellite were promptly replaced by a spare satellite already in orbit or one prepared for immediate launch. Interfering with a satellite's communications links might be less inflammatory but would lack the certainty of success of more direct ASAT attacks. Spoofing (feeding false information to the satellite) might be more productive than outright attack and might be accomplished covertly in isolated instances. Destruction of satellite ground facilities would be effective, but short of a nuclear exchange, would not be attractive because of the obvious risk of escalation. Possible exceptions would be attacks against installations located outside the homeland and sabotage by special forces. The impact of such attacks would again depend on the level of redundancy and the time taken to regain control.

For each of these methods of disabling or otherwise interfering with the operation of a space system there are a variety of countermeasures.

While both Super-Powers have developed weapons to attack space systems, only the Soviet Union has an operational dedicated ASAT anti-satellite system. The Soviet ASAT system is called a "co-orbital interceptor", since it is launched into the same orbital plane as the target satellite. After one or two orbits, the interceptor satellite is manouevred into the vicinity of the target, a radar or infrared guidance system then draws the interceptor still closer to its prey, and an explosive charge is detonated, sending a cloud of shrapnel to disable the target. The interceptor satellite has been tested against targets on at least 20 occasions since 1968, most recently in June 1982. Of these, half have been judged failures. Since 1982, Soviet leaders have declared a moratorium on all further tests and have also offered to dismantle their system as part of a general space weapons ban.

Although its wartime effectiveness cannot be dismissed, the Soviet ASAT system does suffer from significant operational limitations. It appears capable of attacking only satellites in low earth orbit (below

5000 km), which leaves the vital United States early warning and communications satellites beyond its reach. It also does not appear configured for high-intensity ASAT operations since there are apparently only two launch pads dedicated to the ASAT mission. As the interceptor satellite must be launched into the same orbit as the target, it can be launched only when the launch site is under the target's orbital path, thus limiting the number of intercept opportunities each day against any given satellite.

Following a congressionally imposed moratorium on testing that began in 1986, the United States abandoned the further development of an air-launched ASAT system in 1988. Funds are being sought, however, for several different ASAT projects.

Many of the key technologies for ASATs are also being studied for possible use in ballistic missile defence (BMD) systems. Since ICBMs and SLBMs travel through outer space during their ballistic trajectories, reaching altitudes up to 1000 km, the development of prototype BMD systems is likely to produce effective anti-satellite weapons long before the more complex strategic defences—even in their most limited form—become attainable.

BMD sensors and weapons that could have ASAT applications include both space-based systems to detect, track and intercept missiles in the early phases of their flight, and ground-based systems to track and intercept missiles during the terminal phase. Sensors that have been proposed for BMD systems include space-based sensors to track missiles and warheads during the boost and mid-course phases, neutral particle beam generators to help discriminate between warheads and decoys, and rocket-launched sensors and ground-based radars for the terminal defence phase. The weapons that are currently in vogue with SDI planners include space-based kinetic kill vehicles sometimes called "smart rocks" or "brilliant pebbles", ground-based lasers with space-based mirrors to redirect the beam to distant targets, and ground-based rocket interceptors.

Such a complex system faces enormous challenges. It is necessary not only to detect, track and intercept a ballistic missile in flight, but to do so while the offender does everything possible to complicate the task. And even in the absence of countermeasures, the task would be enormous. Many hundreds if not thousands of attacks would have to be coordinated by a computer-aided battle management system. Moreover, the system would have to function reliably without any realistic testing or training, since it is impossible to simulate the conditions of a full-scale nuclear attack.

In the presence of countermeasures, the defensive task becomes awesome to say the least. Possible countermeasures include increasing the number of warheads or decoys, using fast-burn boosters to reduce the time for boost-phase attack, and hardening the surface of the missiles. An alternative or complementary strategy would be to attack pre-emptively the space-based elements of the BMD system using ASAT weapons. Because of these difficulties, most analysts remain profoundly skeptical of the feasibility of deploying an effective BMD system.

Conclusion

The military use of space is on the verge of a dramatic transformation which presents policy makers with major dilemmas. The role of military satellites is changing in a fundamental way as they become increasingly useful for enhancing the combat effectiveness of armed forces. While this increases the incentives to develop ASAT weapons to attack them in wartime, it also means that the security of each side's satellites will become threatened. Neither Super-Power is likely to maintain the security of its own satellites against determined attack. Although there are a variety of ways to protect satellites, ensuring their survival will become increasingly expensive and difficult if ASAT development remains unconstrained.

This raises the question of whether it would be better to limit the development of ASAT weapons and live with the presence of military satellites, or alternatively pursue ASAT development and risk the destruction of space systems in wartime. For the United States, with a greater overall dependence on satellites, the benefits of a ban or limitations on ASATs would appear to outweigh the costs. Moreover, since the possible loss of early warning and communication satellites to ASATs could inject dangerous uncertainties into the strategic calculations of both sides during a major crisis, there are added reasons to favour arms control over unconstrained ASAT development.

Controlling ASAT weapons, however, creates new dilemmas. In particular, if ASAT arms control is to be meaningful, constraints must also be placed on BMD systems, at least on those capable of intercepting targets outside the atmosphere, since otherwise an ASAT agreement could be easily circumvented and rendered meaningless. Thus ASAT limitations demand much more than just restricting ASAT weapons.

For those who consider that further constraints on BMD research and development—in addition to those contained in the 1972 ABM Treaty—may be too high a price to pay for ASAT arms control, it is appropriate to review what is likely to result from SDI. The prospects for a comprehensive population defence are extremely remote. While some argue that partial BMD would strengthen deterrence, the uncertainties associated with executing a nuclear attack and the presence of invulnerable second-strike forces based on submarines makes nuclear deterrence already extremely robust. Even if the growing vulnerability of land-based deterrent forces to a first strike needs to be redressed, it seems likely that this could be achieved more effectively through such options as super-hardening, deep underground basing and mobility, rather than through active defences. The deployment of limited BMD systems may actually destabilize the situation by encouraging additional strategic *offensive* deployment by the adversary. As former United States Secretary of Defense Harold Brown said about SDI, "What is desirable is not feasible and what is feasible is not necessarily desirable".

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OUTER SPACE EXISTING: USE PATERNS AND EMERGING TRENDS

Introduction

Since the launching of the first man-made satellite into outer space in 1957, outer space questions have been discussed in various forums of the United Nations and its related organisations. From the point of view of this study, the main relevant organ is the Conference on Disarmament (CD) and its subsidiary body, the *Ad Hoc* Committee on the Prevention of an Arms Race in Outer Space, which has had on its agenda since 1982 an item entitled "Prevention of an arms race in outer space" and which has been *examining,* through substantive and general consideration, issues relevant to outer space. As far as peaceful uses of outer space are concerned, the most relevant body is the Committee on the Peaceful Uses of Outer Space (COPUOS), with its Legal Subcommittee, and its Scientific and Technical Subcommittee. The deliberations of COPUOS contributed to the conclusion of several international legal instruments concerning the peaceful aspects of the uses of outer space.

The space age, which began nearly four decades ago, has also been characterized by a rapid development in the field of space technology and by the inherent dangers of an arms race in outer space causing increased concerns. In 1978, the General Assembly formally recognized such concerns in the Final Document of its tenth special session, the first special session devoted to disarmament, and called for additional measures to be taken and appropriate international negotiations to be held on that issue. Many member states considered it necessary to take further measures to preclude the possibility of the militarisation of outer space.

Over the years, member states have pursued two separate set of outer space interests in international forums—those related to peaceful application and those related to the prevention of an arms race. As the scope of military and national security activities in outer space has grown, so have concerns by many States about the risk of an arms race in outer space. At the same time, there has been an attempt to keep in perspective the potential benefits of applying to civil purposes space technologies initially developed under military and national security programmes. It is in connection with military and related security activities that proposals have been made on a set of rules whose purpose would, be to increase confidence among States generally and particularly in specific areas of their space activities.

In 1993, there were about 300 operational satellites in orbit, more than half of them with military or national security-related missions. In addition to the two main space Powers, there is a large group of States that have achieved self-sufficiency with specific space missions. Also, there are a number of States that have space-related capabilities in specialized technologies or facilities, while there is a growing interest by the vast majority of States that would like to participate in the activities in outer space and to share space technology.

In view of the absence of full-scale arrangements to prevent an arms race in outer space, interest has grown in building confidence through acceptance of certain measures, guidelines or commitments among States regarding space-related activities. Many believe that such measures would constitute a constructive move towards the prevention of an arms race in outer space. The purpose of such measures is to obtain greater transparency and predictability in space activities in general, through such measures as prior notification, verification, monitoring, code of conduct; thus, contributing to global and regional security.

At its forty-fifth session, on 4 December 1990, the General Assembly adopted two resolutions concerning outer space. By resolution 45/55 A entitled "Prevention of an arms race in outer space" the General Assembly expressed its conviction, *inter alia,* "that further measures should be examined in the search for effective and verifiable bilateral and multilateral agreements in order to prevent an arms race in outer space", and reaffirmed "the importance, and urgency of preventing an arms race in outer space and the readiness of all States to contribute to that common objective, in conformity with the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer

Space, including the Moon and Other Celestial Bodies" (further referred to as Outer Space Treaty). It further recognized "the relevance of considering measures in confidence-building and greater transparency and openness in space", and requested the Conference on Disarmament "to continue building upon areas of convergence with a view to undertaking negotiations for the conclusion of an agreement or agreements, as appropriate, to prevent an arms race in outer space in all its aspects".

By the second resolution 45/55 B, entitled "Confidence-building measures in outer space", the General Assembly requested the Secretary-General to carry out, with the assistance of governmental experts, the present study. It reads as follows:

> *The General Assembly,*
>
> *Conscious* of the importance and urgency of preventing an arms race in outer space,
>
> *Recalling that,* in accordance with the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, the exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interest of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind,
>
> *Aware* of the fact that more and more States are taking an active interest in Outer space or participating in important space programmes for the exploration and exploitation of that environment,
>
> *Recognizing,* in this context, the relevancy space has gained as an important factor for the socio-economic development of many States, in addition to its undeniable role in security issues,
>
> *Emphasizing* that the growing use of outer space has increased the need for more transparency as well as confidence-building measures,
>
> *Recalling* that the international community has unanimously recognized the importance and usefulness of confidence-building measures, which can significantly contribute to the promotion of peace and security and disarmament, in particular through General Assembly resolutions 43/78 H of 7 December 1988 and 44/116 U of 15 December 1989,
>
> *Noting* the important work being carried out by the *Ad Hoc* Committee on the Prevention of an Arms Race in Outer Space of the Conference on Disarmament, which contributes to identifying potential areas of confidence-building measures,
>
> *Aware* of the existence of a number of different proposals and initiatives addressing this subject, which attests to a growing convergence of views,

TABLE 1

General Characteristics of Some Typical Space Missions

Mission	*Typical orbits*	*Power*	*Space craft features/ sensors/instrument*	*Notes*
		A. Science		
Atmospheric and upper atmospheric observation	Low altitude High inclination	Low Medium	Optical near infrared and infrared sensors	Life of 2-5 years
Radiation and magnetic field measurement	Elliptical, high altitude and high inclination	Low	Magnetometers, radiation sensors charged particle detectors	Life of 5-8 years
Solar	Solar orbits some out of solar plane orbits	Moderate	Electro-optical, radiation, magnetic and particle sensors, with complex thermal control	
Inter-planetary	Planetary, sling-shots	Moderate	Electro-optical, radian measurement sensors, special long-distance data transmission systems	Many include fly-bys, orbiters, landers, carrying similar systems as Earth science systems
		B. Earth Observations		
Land, vegetation and water resources monitoring	Low altitude inclined	Low-moderate	Optical infrared, multi-spectral sensors Synthetic Aperture Radars with large antennas, with wide band data links	Life of 5-8 years, some have off-truck pointing capability, some have on-board data
Atmospheric and meteorological monitoring	Low altitude inclined	Low-mddium	Optical, near infrared and infrared sensors	Life of 5-8 years
Environmental monitoring	Low altitude inclined	Low	Sensors to measure constituent gases in atmosphere	Life of 5-7 years
Air traffic monitoring	Medium altitude inclined	Very high	Space-borne radars with very large antennas	Lifeof 5 or more years

		C. Communications		
International and domestic	Highly elliptical, highly inclined Geo-Syn Equatorial	High	Multi-frequency transponders and antennas	10-15 year life with station-keeping capabilities—voice, data and video communications
Direct Broadcasting System	Geo-Syn equatorial	High	Multi-frequency transponders and antennas	Direct broadcast of radio and TV programmes 10-12 years of life
Mobile	Geo-Syn equatorial	High	Large low-frequency transmitters and antennas	e.g. M-Satellite of INMARSAT
Personal	Low-altitude constellation	Low-moderate	Ant. config. multiple satellites	Constellation of satellites
Military	Geo-Syn equatorial	High	UHF to EHF frequency transmitters and antennas, with encryption mechanism	Life of 10-15 years. Also used for data transmission
Search and rescue	Low altitude	Moderate	Receivers and transmitters with doppler effect measurement capabilities	Picks up signals from an activated beacon, when beacon-carrier is in emergency
		D. Navigation		
Navigation and global positioning	Medium altitude inclined	Moderate	Precision time and frequency measurement	Constellation of satellites, providing aircraft and land applications

1. *Reaffirms* the importance of confidence-building measures as means conducive to ensuring the attainment of the objective of the prevention of an arms race in outer space;

2. *Reconises* their applicability in the space environment under specific criteria yet be defined;

3. *Requests* the Secretary-General to carry out, with the assistance of government experts, a study on the specific aspects related to the application of different confidence-building measures in outer space, including the different technologies available possibilities for defining appropriate mechanisms of international cooperation in specific areas of interest and so on, and to report thereon to the General Assembly at its forty-eighth session.

After the adoption of the above-mentioned resolutions, the United Nations General Assembly has adopted two resolutions under the agenda item entitled Prevention of an arms race in outer space". By resolution 46/33 of 6 December 1991, the Assembly again requested the Conference on Disarmament "to consider as a matter of priority the question of preventing an arms race in outer space", recognized, *inter alia,* "the relevance of considering measures on confidence-building and greater transparency and openness in space" and, by resolution 47/51 of 9 December 1992, recognized, "the growing convergence of views on the elaboration of measure; designed to strengthen transparency, confidence and security in the uses of outer space."

In fulfilling its mandate, the Group decided to divide the study into eight chapters. In addition, it considered it useful to include as annexes a number of texts relevant to the study, as well as a selected bibliography.

OVERVIEW

The dream of humanity to make the fullest possible use of outer space for the development of science and the well-being of humankind has not yet been fulfilled and thus remains a purpose to be achieved. There have been major achievements in space sciences including the Earth and atmospheric observational sciences, and lunar and interplanetary exploration, and these are becoming the basis of environmental sciences of the future. There have been significant achievements as well in space applications such as communications, navigation, search and rescue, meteorology, and Earth-remote sensing for many purposes. Space has become an important factor in the social and economic well-being of many States.

Since the launch of the first sputnik in 1957, the Union of Soviet Socialist Republics, the United States and a growing number of other countries have used space for military purposes. This fact determines the context in which the idea of confidence-building measures in outer space has been developed. Most of the approximately 300 satellites currently operational in Earth orbit are used in conjunction with military missions both for peacetime operations and increasingly directly in support of military forces on Earth. Communication, navigation, observation, weather and other satellites help, *inter alia,* to increase the effectiveness of terrestrial military systems.

The development of and/or access to a space launch capability is essential to the effective exploitation of space for peaceful and commercial purposes and in support of the arms regulation processes, as well as for military purposes. Much remains to be done, through satellites and other forms of space craft, in areas of space science, solar and interplanetary research, space biology, environmental and other purposes.

A. Current Uses of Outer Space

The development of space research and applications was made possible by the constant improvement of available launching systems, in some cases driven by military needs. Two categories of launch systems exist:

(a) Reusable space transport systems the primary function of which is to assure manned flights and service of in-orbit infrastructures; their reliability must be the highest possible, taking into account the human presence on-board;

(b) Expendable launching systems which according to their capacity in terms of thrust can put into different orbits payloads of varying masses. The recent evolution witnessed in the field of disarmament enables one to envisage the use of converted missiles to put payloads into low-Earth orbit.

Satellites typically are deployed in four types of orbits, which are defined by their altitude, period and inclination to the Earth's equator

(a) *Low Earth orbits* include those with altitudes of a few hundred to over 1,000 kilometres, which may be of any inclination, although typically such orbits are at high inclinations in order to maximize coverage of high-latitude portions of the Earth's surface;

(b) *Geosynchronous orbits* are at an altitude of nearly 36,000 kilometres, and have a period of about one day, permitting a satellite to view instantaneously nearly half the Earth's surface Such orbits are useful for communications, early warning or electronic intelligence collection. If the satellite is in the orbit plane of the Earth's equator (zero inclination), such orbits are called geostationary, and provide single satellite full-time coverage of an area;

(c) *Semi-synchronous orbits* have a period of 12 hours, with satellites at an altitude of about 20,000 kilometres. Circular semi-synchronous orbits are primarily used by modern navigation satellites;

(d) *Molniya orbits* are a subset of semi-synchronous orbits, which are highly elliptical, having low points (perigees) of a few hundred kilometres, and high points (apogees) of nearly 40,000 kilometres. Those orbits typically have inclinations of 63 degrees, and are used for coverage of polar and high-latitude regions.

Space systems may also be categorized by the functions they serve, as illustrated in table 1 and discussed in more detail in the following sections. As with other satellites, military satellites generally perform two types of functions: acquisition of information; and transmission of information. Satellites can be used to acquire information concerning the disposition of terrestrial military forces using imagery or by picking up electronic transmissions (electronic intelligence or ELINT, and signal intelligence or SIGINT). Other information acquisition functions include weather, missile alerting, and nuclear explosion detection. Certain information is relayed by communications and navigation satellites.

In recent years, there has been a trend towards greater openness and transparency with regard to many space activities, including a number that serve military purposes. Nevertheless, it should be recognized that some details on the precise capabilities and operations of satellites with military missions are likely to continue to be considered highly classified by States to which they belong.

It also must be noted that most space technologies are prime examples of technologies which have a dual-use potential. Satellites, which are essential in many applications in the civil sector, for example weather satellites, are also seen as significant force-multipliers when used for military purposes. The technology required to intercept satellites in space is, in some respects, similar to that required to intercept ballistic missiles or their warheads. Expertise in the anti-ballistic missile (ABM) field, could constitute a direct technological basis from which to design an ASAT capability. The reverse is not necessarily true.

1. Imaging Satellites

Imaging satellites, orbiting at altitudes of several hundred kilometres, make use of film, electro-optical cameras or radars, to produce high resolution images of the surface of the Earth in various regions of the spectrum. Such satellite imaging can be readily used to detect objects on the ground or at sea and, in the case of some military satellite systems of highest resolution, to identify and distinguish between different types of vehicles and other equipment. Perhaps their most significant applications have been as national technical means (NTM) of verifying arms limitation agreements.

Use of optical imagery from civilian satellites, such as LANDSAT, SPOT and the COSMOS series, have already been used to detect certain anomalies as in the case of the Chernobyl accident (1986) and the extent of environmental concerns in terms of the Gulf War (1991).Military reconnaissance satellites and their associated analytical capabilities are generally muchmore effective in this regard.

2. Signals Intelligence Satellites

Signals intelligence satellites are designed to detect transmissions from terrestrial communications systems, as well as radars and other electronic systems. The interception of such transmissions can provide information on the type and location of even low power transmitters,such as hand-held radios. However, these satellites are not capable of intercepting communications carried over land lines.

Signals intelligence consists of several categories. Communications intelligence is directed at the analysis of the source and content of message traffic. While most important military communications are protected by encryption techniques, computer processing can be used to decrypt some traffic, and additional intelligence can be derived from analysis of patterns of transmissions over time. Electronic intelligence is devoted to analysis of non-communications electronic transmissions. This would include telemetry from missile tests, or radar transmitters.

3. Early Warning Satellites

Early warning satellites carry infrared sensors that detect the heat from a rocket's engines. These satellites are used for monitoring missile launches to ensure treaty compliance, as well as providing early warning of missile attack. They can also be used to locate the launch sites of missiles used in combat operations.

4. Weather Satellites

The civil usefulness of weather satellites is generally recognized. They also provide vital support to military operations both in peace and in war. The cost-free access to data from weather satellites has been a fine example of international cooperation in the peaceful uses of outer space throughout the years and has proved to be fundamental in helping States develop better weather forecasting and in increasing natural disaster preparedness.

5. Nuclear Explosion Detection Systems

Since the early 1960s, satellites which are capable of detecting nuclear explosions on the Earth and in space have been deployed. Some of those satellites, along with weather and early warning satellites, carry several types of sensors to detect the location of nuclear explosions and to evaluate their yield. The information from these satellites could be also used for the purpose of planning military operations.

6. Communications Satellites

Communication represents one of the most widespread applications of modern satellites. Communication satellites are important both for military and civil applications. These satellites may be classified into three categories, according to their orbital characteristics: they are geosynchronous, semi-synchronous or non-synchronous. They may also be classified by their operating frequencies, bandwidth or by the type of traffic and service provided. Most communication satellites are in the geostationary Earth orbit. Satellites are today a routine and vital element of the international telecommunication systems, as well as many national networks, and in specialized systems, such as the international COSPAS-SARSAT search and rescue system.

7. Navigation Satellites

Navigation satellites were one of the earliest military applications of space technology, and are among the most useful to military forces on Earth. Military aircraft now use navigation satellites to guide them to aerial tankers for inflight refuelling as they fly non-stop from their home bases to conflicts thousands of miles away. They can also use navigation satellites to guide them to their targets with pinpoint precision, where they can drop their bombs with an accuracy that will rival that of much more expensive "smart" weapons.

8. Anti-Satellite Weapons

As the applications of military space systems have increased in importance over time for States with the most active space programmes, interest has grown in developing anti-satellite (ASAT) weapons to counter the contributions that a potential adversary's satellites might make to its combat effectiveness.

Any use of an anti-satellite weapon against an orbiting space object is feared to produce debris that in some cases could affect other space objects or may also fall over populated areas, with unpredictable consequences. This concern is more vivid *vis-a-vis* the environmental consequences of an uncontrolled re-entry in the atmosphere of the remains of a space object carrying a nuclear power source.

Early research into the development of an ASAT capability was initiated by the space Powers in the 1950s. The first successful ASAT intercept took place near Kwajalein Island in the Pacific Ocean in May 1963. A year later, nuclear-tipped ASATs became operational on Johnson Island. This programme, based on the Thor rocket, ended in 1976 and emphasis on research and development shifted to non-nuclear, kinetic-kill mechanisms. In the early 1980s, research focused on the developments of an air-launched hypersonic miniature homing vehicle, but the programme was frozen in 1988. Research continues on a ground-based kinetic-kill interceptor based on a solid fuel missile system.

Parallel in time to the project, which involved the Kwajalein Island testing, research was undertaken to develop a co-orbital interceptor designed to place a multi-ton satellite in low Earth orbit. The theory was that, by manoeuvring close to a satellite target and co-orbiting with it, an explosive charge could be detonated, which would shower the target with shrapnel. Satellites which are delicate, it was reasoned, could be readily destroyed by this method. Testing between 1968 to 1982 had limited success (approximately 70 per cent as mentioned in some publications) when using a radar homing device and much less when a heat-seeking homing device was used. The entire system was cumbersome and limited in employment. Although of marginal effectiveness, it was declared operational. The system has not been tested since 1982.

Work has also been carried out on the use of directed energy systems for ASAT missions. Various types of ground-based high-energy lasers, if sufficiently focused and coupled with highly accurate tracking, might be able to damage satellites in orbit as they pass overhead. It should be noted that much of the work on these ASAT systems has now become of lower priority, or has been terminated. This reflects the more cooperative relationship between the two States with the most active space programmes.

In summary, it appears that research specifically related to developing ASAT technology has been inconclusive and sporadic, although interest in the concept resurfaces from time to time. Aspects of this concept continue to be a subject of considerable controversy.

9. Anti-Missile Weapons

Anti-missile weapons involved in defending against offensive strategic missiles are relevant to this study to the degree that they represent a potential residual ASAT capability, are based in space, or employ space-based components.

Any satellite that passes through the limited attack zone of an anti-missile weapon would probably be as vulnerable to attack as would any strategic missile or warhead passing through that zone. In most instances, only satellites in low-orbit would be subject to such theoretical vulnerabilities.

It should be noted, however, that accurate high-energy lasers, space-based interceptors, and long-range anti-missiles systems could all contribute to extending the zone of vulnerability of satellites to anti-missile systems.

While space-based anti-missile weapons have been under serious study, not all of the technical challenges associated with such weapons have been solved. At present, there are no known programmes to deploy systems involving such weapons.

B. Emerging Trends

Outer space continues to assume a growing importance both for military and civilian activities, as discussed earlier in the section. The importance is illustrated, *inter alia,* by: *(a)* a growing number of countries exploring ways to use outer space; *(b)* military uses spreading from strategic to tactical purposes or missions; (c) communications technology for civilian purposes operating at higher powers and in new frequency bands; and *(d)* an increasing commonality of use of outer space between commercial and military applications. Although since the end of the cold war some aspects of military use of outer space by some powers has been reconsidered, research in this field is continued by the leading space countries.

1. Other States' Space Capabilities

A number of other States have or are planning to develop national space capabilities. While at present most of these national programmes or plans do not envision a military component, military capabilities could be built upon those programmes. Increased transparency in space programmes, including these programmes, would be an important factor in building confidence among States.

In implementing the recommendations of UNISPACE II, and on the recommendation of COPUOS, the United Nations Secretary-General, on the basis of United Nations General Assembly resolution 46/45 of 9 December 1991, requested Member States to submit annual reports on their space activities. The annual reports submitted by States were reproduced in the report of the Secretary-General submitted to the General Assembly at its forty-seventh session (A/47/383). Taking into account that report, the Assembly again requested the Secretary-General, under resolution 47/67 of 14 December 1992, to report to it at its forty-eighth session on the implementation of the recommendations of the Conference. Those requests pertaining to reporting on national space activities and on the implementation of recommendations of UNISPACE appear as regular items in the United Nations General Assembly annual resolutions on peaceful uses of outer space.

Describing the national programmes of individual States is beyond the mandate of this Study Group. Most of these activities are carried out for purposes such as telecommunications, meteorology, research and remote sensing of the Earth and other activities. It is worth noting that Member States of the European Space Agency (ESA) had decided to "Europeanize" a greater part of their national space programmes by integrating them into Agency programmes.

2. Increasing Numbers and Capabilities

During the 1980s, there was an expansion in the number and sophistication of military satellites. In addition to an increase in optical imaging capabilities, new radar imaging satellites were introduced that provide high resolution coverage under all weather and lighting conditions.

Just as armed forces are increasingly more dependent on satellites, those satellites are used more and more in a coordinated manner; for instance, information from weather satellites might help programming for cloud-free observation, or navigation satellites because of their precision can assist in accurate determination of satellite in-orbit location and control.

3. Dual Use Systems

Space technologies are to a large extent of dual use in their application, as to a lesser degree are the systems. While the technologies employed may be similar or identical, the purpose for which they are employed—military or civil—is normally identifiable, albeit sometimes with some difficulty. The military may also contract with commercial corporations in a manner similar to other customers when it appears cost-effective to do so and where their security and availability requirements can be met.

Roles likely to be exclusively military include imaging satellites employed as national technical means (NTM) for intelligent purposes as well as SIGINT and ELINT collectors. Their primary purpose is the collection of other types of military and strategic intelligence. They have a potential, as well, to locate targets for attack. These are more likely to be strategic than tactical targets. Early warning satellites can be used in the interest of ballistic missile defences, specifically providing information on the launching of ballistic missiles. Nevertheless many of these satellites, particularly imaging satellites, contribute significantly to the function of arms control verification. Commercial imaging systems are closing the technology gap in terms of resolution, and therefore may contribute significantly in increasing future transparency on a global basis. They do not yet have the capability to contribute to arms control verification in other than a support role in determining presence of major infrastructures and monitor possible environmental degradations.

There are a number of areas, low altitude weather satellites for example, that are based on nearly equal civil and military capabilities. Physically quite similar and often made by the same company, the military often make use of both systems. Discrete military and civilian low altitude navigational satellite systems are deployed. The military use of full Global Positioning System (GPS) capabilities, however, remain unavailable to civilian users. The military mapping community is a leading customer for commercially available remote sensing data and high resolution remote sensing film products, which are apparently derived from satellites whose primary mission was initially military map-making, is now becoming available to the commercial sector.

It is clear that a considerable potential now exists to make use of data gathered by military or commercial means on a broader basis. Clearly, in the post bi-polar world of space technology, cooperative efforts must be developed. Data collected should be utilized in an organized manner and on a global basis.

4. Combat Applications

The increased integration of military space capabilities with terrestrial military planning and that of space systems with each other have resulted in the expanding role of space and military space systems. One recent example of this was the Operation Desert Shield and Desert Storm where United States satellites for imaging, signals intelligence, early warning, weather, communications and navigation were extensively used.

APPENDIX 3B

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	Syracuse I- A	(On Telecom 1A)	4 Aug. 1984
communications	Syracuse I-C	(On Telecom 1C)	11 Mar. 1988
Japan			
Military communications	Superbird-X 1A	(On SCS 1A)	5 June 1989
UK			
Military	SKYNET 2B	9354	23 Nov. 1974
communications	SKYNET4-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	Cosmos 1805	SU ELINT 3-23	10 Dec. 1986
intelligence	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	Cosmos 1949	SU EORSAT 1-27	28 May 1988
ocean reonnaissance	Cosmos 2033	SU EORSAT 1-29	24 July 1989
	Cosmos 2046	SU EORSAT 1-30	27 Sep. 1989
Radar	*None since Cosmos 1932*		
ocean reconnaissance			
Military	Cosmos 1852	SU COM 1-313	16 June 1987
communications	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
	Cosmos 1856	SUCOM 1-317	16 June 1987
	Cosmos 1857	SUCOM 1-318	16 June 1987
	Cosmos 1858	SUCOM 1-319	16 June 1987
	Cosmos 1859	SU COM 1-320	16 June 1987
	Cosmos 1924	SUCOM 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	SUCOM 1-324	11 Mar. 1988
	Cosmos 1928	SUCOM 1-325	11 Mar. 1988
	Cosmos 1929	SUCOM 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	SUCOM 1-330	24 Mar. 1989
	Cosmos 2010	SUCOM 1-331	24 Mar. 1989
	Cosmos 2011	SU COM 1-332	24 Mar. 1989
	Cosmos 2012	SUCOM 1-333	24 Mar. 1989
	Cosmos 2013	SUCOM 1-334	24 Mar. 1989
	Cosmos 2014	SUCOM 1-335	24 Mar. 1989
	Cosmos 2015	SUCOM 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	SUCOM 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	SUCOM 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
	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
Electronic ocean reconnaissance	NOSS7	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	While 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-l	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-A2	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
	FLTSATCOM 8	F-8	25 Sep. 1989
	Leasat 1	Syncom IV F-2	30 Aug. 1984
	Leasat2	Syncom IV F-l	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	DSP10	F-13	6 Mar. 1982
	DSP11	F-12	14 Apr. 1984
	DSP SED 12	F-6R	22 Dec. 1984
	DSP SED 1 3	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
	Navstar2A-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
	1ONDS 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
	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	SDI STM-3	Delta Star	24 Mar. 1989
defence	SD1VUE	(On DSP-IF-14)	14 June 1989

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OUTER SPACE: EXISTING LEGAL FRAMEWORK

Since the beginning of the space era, several international instruments concerning both military and peaceful aspects of the exploration and uses of outer space have been concluded. The existing treaties concerning activities of States in outer space could be divided into three categories: global Multilateral agreements, regional multilateral agreements and bilateral agreements. In addition, the General Assembly of the United Nations has adopted a number of resolutions containing declarations of principles concerning the spaceactivities of States.

An attempt to identify several confidence-building components in some of these treaties is made in table 2.

A. Global Multilateral Agreements

1. Outer Space Treaty

The 1967 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies* (Outer Space Treaty) established the principles governing peaceful activities of States in outer space. According to article I, the exploration and use of outer space, including the Moon and other celestial bodies, shall be *(a)* "carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind"; *(b)* "shall be free for exploration and use by all States without discrimination of any kind, on the basis of equality and in accordance with international law"; and *(c)* "there shall be freedom of scientific investigation, ... and States shall facilitate and encourage international cooperation in such investigations".

Further, activities of States Parties to this treaty shall be carried out "in accordance with international law, including the United Nations

Charter, in the interest of maintaining international peace and security and promoting international cooperation and understanding" (art. III). In article IV, paragraph 1, the States Parties undertake, *inter alia,* not to place "in orbit around the Earth any object carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner". The Treaty further provides that the Moon and other celestial bodies shall be used exclusively for peaceful purposes, and forbids "the establishment of military bases, installations and fortifications, the testing of any kind of weapons and the conduct of military manoeuvres on celestial bodies."

The treaty regulates some other relevant questions, such as international responsibility (art. VI), international liability for damage due to such activities (art. VII), the question of jurisdiction, control and ownership over launched objects (art. VIII), cooperation among the States Parties, consultations in case of potentially harmful interference with activities of other States Parties (art. IX); there is an opportunity to observe the flight of space objects launched by other States (art. X); and "all stations, installations, equipment and space vehicles on Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on the basis of reciprocity" (art. XII).

2. Other Global Multilateral Agreements

(a) The first global multilateral treaty regulating military activities of States in outer space is the 1963 *Treaty on Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water* (PTBT). Under article I of the Treaty, the States Parties have undertaken "to prohibit, to prevent, and not to carry out any nuclear weapons test explosions, or any other nuclear explosion, at arty place under its jurisdiction or control" in the atmosphere; beyond its limits, including *outer space;* or under water, or any other environment. The Treaty does not provide a verification mechanism and it is left to the States Parties to do so by their own national technical means (NTMs).

(b) The 1967 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space stipulates obligations of the States Parties in case that "the personnel of a spacecraft have suffered accident, or experiencing conditions of distress or have made an emergency or unintended landing" in territory of another State, and that they shall *(a)* "notify the launching authority or, if it cannot identify and immediately communicate with the launching authority, immediately make a public announcement by all appropriate

means of communication at its disposal;" and *(b)* "notify the Secretary-General of the United Nations, who should disseminate the information without delay by all appropriate means of communication at his disposal" (art. 1). The remaining provisions regulate in details the obligations of the "launching authority" and the obligations and rights of the other contracting Parties involved in such accidents, as well as further obligations of the Parties to notify the Secretary-General of the United Nations on steps undertaken regarding their search and rescue operations.

(*c*) *The 1971 Convention on International Liability for Damage Caused by Space Objects* provides that "a launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth or to aircraft flight" (art. II). The remaining articles elaborate the obligations and rights of States Parties in the event of damage, such as the procedure to claim compensation, including the establishment of a claim commission, liability of international organisations which conduct space activities, etc.

(d) Under the 1975 *Convention on Registration of Objects Launched into Outer States Parties* undertake an obligation that they shall, when a space object is launched into Earth orbit or beyond, register such objects in an appropriate register and inform the Secretary-General of the United Nations of the establishment of such a register (art. II). The Secretary-General shall maintain a Register in which the information furnished in accordance with article II shall be recorded. Article IV enumerates the information that shall be furnished by each State of registry, such as name of the launching State or States; an appropriate designator of the space object; date and territory or location of launch; basic orbital parameters, and general function of the space object. For more details, see chapter VII of this study.

(e) The basic instruments of the International Telecommunication Union (ITU) are the *Constitution and the Convention* as adopted in 1992 and complemented by the Radio Regulations and the Final Acts of the World, Administrative Radio Conferences. The main role of the Union is to allocate bands of the radio frequency spectrum, to allot radio frequencies and any associated orbital positions on the geostationary orbit. In addition, each satellite operator, irrespective of the mission of the satellite, has to notify the International Frequency Registration Board (IFRB) of its plans, thus, ensuring an optimal functioning as well as avoiding harmful interference.

(f) The 1978 Convention on the Prohibition of Military or Any Other Hostile Use of-Environmental Modification Techniques (ENMOD Convention) prohibits 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 (art. 1) and defines these techniques as those changing—through deliberate manipulation of natural processes—the dynamics, composition or structure of the Earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space (art. II). The States Parties have undertaken "to consult each another and to cooperate in solving problems which may arise in relation to the objectives of, or in the application of the provisions of, the Convention"; such consultations and cooperation may also be undertaken through appropriate international procedures within the framework of the United Nations and in accordance with its Charter, as well as of a Consultative Committee of experts as provided for in paragraph 2 of article V (art. V, para. 1). The composition and the procedure of the work of the Consultative Committee of Experts are elaborated in an annex to the Convention. In addition, Understandings Regarding the Convention (related to arts. I, II, III and VIII) are relevant for the interpretation of the Convention.

(g) The 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies has further elaborated the principles established under the Outer Space Treaty concerning States' activities on the Moon and other celestial bodies. The Moon shall be used exclusively for peaceful purposes and the Agreement prohibits any threat or use of force or any hostile act or threat of hostile act on it. It also confirms the obligations of States not to place in orbit around or other trajectory to or around the Moon objects carrying nuclear weapons or any other weapons of mass destruction, nor to establish military bases, installations and fortifications. The Moon Agreement also requires that "States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of their activities concerned with the exploration and use of the Moon". The required information shall include the time, purposes, locations, orbital parameters and duration of each mission to the Moon as soon as possible after launching, while information on the results of each mission, upon its completion (art. 5, para. 1). In addition, the States Parties "shall inform the Secretary-General, as well as the public and the international scientific community, of any phenomenon they discover in outer space, including the Moon, which

could endanger human life or health, as well as of any indication of organic life" (art. 5, para. 2). Under article 9, "States Parties may establish manned and unmanned stations on the Moon. A State Party establishing a station shall use only that area which is required for the needs of the station and shall immediately inform the Secretary-General of the United Nations of the location and purposes of that station. Subsequently, at annual intervals that State shall likewise inform the Secretary-General whether the station continues in use and whether its purposes have changed."

B. Bilateral Treaties

(a) The 1972 Anti-Ballistic Missile Treaty (ABM Treaty), signed between the USSR and the United States, is of unlimited duration, and is of special significance to the study. The objective of the Treaty is to limit, ABM systems and their components designed to intercept strategic ballistic missiles or their warheads in flight. This includes ABM launchers, interceptors, and radars constructed and developed for an ABM role or tested in an ABM mode. Article 1 sets forth the basic principle of the treaty, namely to limit the deployment of ABM systems to agreed levels and regions. The treaty bans the development, testing, and deployment of ABM systems and/or their components that are sea-based, mobile land-based, air-based, and, the most important in the context of the study, space-based (art. 5).

Apart from weapon limitation, the ABM Treaty is also relevant to the study because of the norms it has established on the use of NTMs for verification purposes. This is the first agreement (along with the SALT I agreement) to refer to verification by these means, as may be seen from article 12, paragraph I, which codifies national means of verification and specifies that they shall be carried out in a manner consistent with generally recognized principles of international law. Here the concept of non-interference with NTMs (art. 12, para. 2) is also important since NTMs include ground and space-based systems. This concept also implicitly includes the protection of such space-based systems as reconnaissance satellites (art. 12, para. 3) and thus protection against any from of interference. Legitimacy was therefore given by the Parties to the treaty to their satellite activities for monitoring arms limitation and disarmament agreements. In addition, to promote the objectives and implementation of the provisions of the treaty, a Standing Consultative Commission is established, within the framework of which the Parties will consider, *inter alia,* questions concerning compliance with the obligations assumed; provide on voluntary basis such information as either Party considers necessary to assure confidence in compliance with the obligations assumed; questions involving unintended interference with NTMs of verification, possible changes in the strategic situation that have a bearing on the provisions of the Treaty, etc.

(b) Non-interference with NTMs has also been stipulated in other USA/USSR agreements. Like the provisions of the ABM Treaty, the verification measures in *the 1972 Strategic Arms Limitation Talks* SALT I Agreement and *the 1979 Strategic Arms Limitation Treaty* SALT II are of special relevance to outer space. According to the provisions of article 9, paragrah 1 (c) of SALT II Treaty the development, testing or deployment of systems for placing into Earth orbits nuclear weapons or any other kind of weapons of mass destruction, including fractional orbital missiles, are prohibited. *The 1991 START-I Treaty* also provides that "each Party shall use national technical means of verification" (art. IX, para, 1); each is enjoined, too, "not to interfere with the national technical means of verification" (art. IX, para. 2). *The 1993 START-II Treaty* of 3 January 1993 between the Russian Federation and the United States provides that the verification provisions of START-I Treaty shall be used for the implementation of this Treaty.

(*c*) Some other bilateral instruments which, although they do not stipulate arms limitation or disarmament measures, have some relevance to the study should be mentioned here. One is the 1971; *USA/USSR Agreement to Reduce the Risk or Outbreak of Nuclear War.* Under this Agreement, each Party undertakes to notify the other in the event of an accidental or unauthorized incident, that might cause a nuclear war. In article 4, the notification requirement includes advance notice of planned launches in the case that any such launches extend beyond the national territory of the launching Party and in the direction of the other Party. However, it is article 3 that is more directly relevant to the context of the study, since the Parties of that treaty legitimized the existence and the use of certain satellite systems for military purposes.

(d) These two aspects of the 1971 Agreement were further codified in another bilateral instrument signed on the same day—namely, the *1971 Agreement on Measures to Improve the USA-USSR Direct Communication Link.* The advances in satellite communications technology that had occurred since 1963 offered the possibility of greater reliability than the arrangements originally agreed upon. The Agreement, with its annex detailing the specifics of operation, equipment, and allocation of costs, provides for the establishment of two satellite communications

circuits between the USA and the USSR, with a system of multiple terminals in each country. The United States is to provide one circuit via the Intelsat system, and the Soviet Union a circuit via its Molniya II system. In addition, each Party shall be responsible for providing to the other Party notification of any proposed modification or replacement of the communication satellite system containing the circuit provided by it that might require accommodation by Earth stations using that system or that might otherwise affect the maintenance of the Direct Line Communication Link.

(e) With the view to supplement earlier measures of communication at the Government-to-Government level, *the 1987 USA/USSR Nuclear Risk Reduction Centres Agreement* and its Protocols I and II, further codify the use of satellite communication in the interest of mutual security. Communication between the two countries is based on direct satellite links. These links are used for the exchange of information and for notifications as required under certain existing and possible future arms control and confidence-building agreements. Protocol I, article 1, calls for notification of ballistic missile launches under article 4 of the 1971 Nuclear Accident Agreement and under paragraph 1 of article 6 of the 1972 Prevention of Incidents on and Over High Sea Agreement. To achieve this, Protocol II, article 1, stipulates the establishment and maintenance of an INTELSAT satellite circuit and a STATSIONAR satellite circuit to provide facsimile communication among each Party's national Nuclear Risk Centres.

(f) Two other bilateral agreements with some bearing on the subject of the study are *the 1988 Agreement on Notification of Launches of Intercontinental Ballistic Missiles and Submarine-launched Ballistic Missiles* and *the 1989 Prevention of Dangerous Military Activities Agreement.* Article 1 of the 1988 Agreement stipulates that each Party shall provide notification, no less than 24 hours in advance, of the planned date, launch area, and area of impact for any launch of a strategic ballistic missile (ICBM or SLBM), as well as the geographic coordinates of the planned impact area or areas of the reentry vehicles. The Parties further agree to hold consultations, as mutually agreed, to consider questions relating to implementation of the provisions of the Agreement. In the 1989 Agreement, words and terms such as lasers and interference with command and control networks are defined.

This Agreement also codifies the use of lasers in peacetime. Article 2 stipulates, for example, that each Party shall take the necessary measures directed towards preventing the use of "a laser in such a manner that its radiation could cause harm to personnel or damage to equipment of the armed forces of the other Party". There is also an obligation of the Parties to notify each other in case of such use of a laser (art. IV, para. 2). Further, for the purpose of preventing dangerous military activities, as well as expeditiously resolving any incident, the Parties shall establish and maintain communications as provided in annex 1 to this Agreement (art. VII). In addition, a Joint Military Commission is established to consider questions of compliance with the obligations assumed under the Agreement (art. IX).

A number of bilateral and regional treaties were concluded among different States containing provisions concerning space-related matters.

C. United Nations General Assembly Resolutions on Declarations of Principles

On recommendation of COPUOS, the General Assembly has adopted a number of sets of principles governing the space activities of States: the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space (1963); the Principles Governing the Use of Artificial Earth Satellites for International Direct Television Broadcasting (1982); the Principles Relating to Remote Sensing of the Earth from Space (1986); and the Principles Relevant to the Use of Nuclear Power Sources in Outer Space (1992).

(a) On 13 December 1963, the United Nations General Assembly adopted resolution 1962 (XVIII) containing the *Declaration of Legal Principles Governing the Activities of States in the Exploration and the Use of Outer Spaced* On the basis of the principles contained in the Declaration, a number of multilateral agreements were negotiated and concluded under the auspices of the United Nations (as indicated in sections A and B above). The Declaration provides, *inter alia,* that "If a State has reason to believe that an outer space activity or experiment planned by it or its nationals would cause potentially harmful interference with activities of other States in the peaceful exploration and use of outer space, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State which has reason to believe that an outer space activity or experiment planned by another State would cause potentially harmful interference with activities in the peaceful exploration and use of outer space may request consultation concerning the activity or experiment" (Principle 6).

(b) On 10 December 1982, the General Assembly adopted resolution 37/92 containing the *Principles Governing the Use by States of Artificial*

TABLE 2

CBMs in Some Multilateral Arms Limitation and Disarmament Agreements

(a) Multilateral Agreements Related to Outer Space

Name of Agreement	*Place and date of Signature Entry into force*	*Duration Number of Parties*	*What confidence-building measures does it have?*
PTBT	Moscow 5 August 1963 10 October 1963	Unlimited Right to withdrawal 119 States Parties	No verification clauses; but NTMs have been routinely used for verification purposes.
Outer Space Treaty	London, Moscow, Washington 27 January 1967 10 October 1967	Unlimited Right to withdrawal 93 States Parties	Opportunity to observe the flight of space objects; on-site inspection on the Moon and other Celestial Bodies; consultations if an activity is potentially harmful to those of others; an obligation to inform the United Nations Secretary-General of the nature, conduct, locations and results of their activities in outer space; the Secretary-General should be prepared to disseminate such information immediately and effectively; stipulates that all installations, equipment and space vehicles shall be open to representatives of other States Parties, on condition of reciprocity.
Rescue Agreement	New York 22 April 1968 3 December 1968	Unspecified Right to withdrawal 69 States Parties	Specifies an obligation to notify the launching authority in case of accident; notify the United Nations Secretary-General about it; the Secretary-General shall disseminate the information received.
Liability Convention	New York 29 March 1972 1 September 1972	Unspecified Right to withdrawal 35 States Parties	Questions arising from damage are solved through a Claim Commission.
Registration Convention	New York 14 January 1975 15 September 1976	Unspecified Right to withdrawal 37 States Parties	Stipulates the framework for reporting to the United Nations Secretary-General information regarding name of launching State; appropriate designator; date and location of the launching of objects in space; basic orbital parameters, general function; changes in orbital parameters after launch, recovery date of the spacecraft.

ITU Convention	Geneva December 1992 Enters into force on 1 July 1994	Unlimited Right to withdrawal 128 States Parties	The Union maintains and extends international cooperation among all members for the improvement and rational use of telecommunications of all kinds; coordinates efforts to eliminate harmful interference between radio stations of different countries; fosters international cooperation in the delivery of technical assistance to the developing countries, etc.
ENMOD Convention	New York 18 May 1977 5 October 1978	Unspecified Right to withdrawal 57 States Parties	Consultation and cooperation among parties in solving problems concerning the implementation of the Convention; a Consultative Committee of Experts may undertake to make appropriate finding of facts and provide expert views relevant to any problem raised; in case of a breach of obligations, any State Party may lodge a complaint with the Security Council.
Moon Agreement	New York 18 December 1979 11 July 1984	Unlimited Right to withdrawal 8 States Parties	Requires informing the United Nations Secretary-General of activities concerned with the exploration and use of the Moon; the required information should include: the time, purposes, locations, orbital parameters and duration of each mission to the Moon; shall inform the Secretary-General of any phenomenon they discovered in outer space, including the Moon; information on manned or unmanned stations on the Moon; on-site inspection by all Parties; consultation in case a State Party believed unfulfilment of obligations, and if such consultation does not result in settlement, any Party may seek the assistance of the United Nations Secretary-General.

Note: The extracts regarding confidence-building measures are for illustrative not interpretative purposes. They do not represent a judgement or endorsement by the Group of Experts. Readers are advised to refer to the original documents for additional detail.

(b) Bilateral Agreements Related to Outer Space

Name of Agreement	*Place and date of Signature* *Entry into force*	*Duration* *Number of Parties*	*What confidence-building measures does it have?*
Nuclear Accident Agreement	Washington 30 September 1971 30 September 1971	Unlimited USSR, USA	Mutual notification in case of accidental incident involving a risk of outbreak of nuclear war; establishment of Direct Communication Link; consultations to consider questions relating to implementation of the Agreement.
Hot Line Agreement	Washington 30 September 1971 30 September 1971	Unspecified USSR, USA	Provides the establishment of a satellite communication system to increase reliability of the Direct Communication Link.
ABM Agreement	Moscow 26 May 1972 3 October 1972	Unlimited Right to withdrawal USSR, USA	Provides for verification measures by National Technical Means (NTMs), as well as establishing the principle of non-interference with NTMs; establishment of a Standing Consultative Commission to consider question concerning compliance.
SALT-I	Moscow 26 May 1972 3 October 1972	Five years (Expired in 1977) USSR, USA	Provisions similar to those in the ABM Treaty
TTBT	Moscow 3 July 1974 11 December 1990	Five years Right to withdrawal USSR, USA	Similar to those in the ABM Treaty and SALT-I.
PNET	Moscow 28 May 1976 11 December 1990	Five years, with possibility of extension USSR, USA	NTMs; allows access to sites of explosions; establishes Joint Consultative Commission for information necessary for verification.
SALT-II	Vienna 18 June 1979 Five years USSR, USA Has never entered into force	Five years USSR, USA	NTMs; voluntary data exchange within the framework of Standing Consultative Commission.

Nuclear Risk Reduction Centres	Washington 15 September 1987 15 September 1987	Unlimited Right to withdrawal USSR, USA	Protocol I provides for notification of ballistic missile launches under Article 4 of the 1971 Nuclear Accident Agreement, and under paragraph 1 of Article 6 of the 1972 Prevention of Incidents on and over High Seas Agreement; Protocol II provides for the establishment and maintenance of facsimile communications between each party's Nuclear Risk centres (an INTELSAT satellite circuit and a STATSIONAR satellite circuit).
INF Treaty	Washington 8 December 1987 1 June 1988	Unlimited Right to withdrawal USSR, USA	Provides for verification measures by NTMs; paragrah 2, subparagraph *(a)* confirms the principle of non-interference with NTMs; provides intrusive on-site inspections.
Notification of Launches	Moscow 31 May 1988 31 May 1990	Unspecified Right to withdrawal USSR, USA	Provides for notification, not less than twenty-four hours in advance, of planned date, launch area, and area of impact for any launch of an ICBM or SLBM; including the geographic coordinates of the plannced impact area or areas of the RVs.
Prevention of Dangerous Military Activities	Moscow 2 June 1989 1 January 1990	Unlimited Right to withdrawal USSR, USA	Stipulates an obligation of the Parties to notify use of a laser; establishes and maintains communications as provided in its annex I; establishes a Joint Military Commission to consider questions of compliance with obligations.
START-I[b]	Moscow 31 July 1991 Has not entered into force	15 years Right to withdrawal USSR, USA	Provides for extensive on-site inspections and continuous monitoring activities; use of NTMs of verification; confirms the principle of non-intereference with such means; rights and obligations concerning notification of different activities are elaborated in a Notification Protocol; establishes a Joint Compliance and Inspection Commission, etc.
START-II	Moscow 3 January 1993 Has not entered into force	As long as START-I Right to withdrawal RF,USA	Provides that the provisions of the START Treaty shall be used for implementation of this Treaty; establishes a Bilateral Implementation Commission for resolving questions related to compliance with the obligations assumed, and to agree on additional measures to improve effectiveness of the Treaty.

a. Number of States Parties as of 1 January 1993.
b. The START-I Treaty was converted into a multilateral treaty by the signing of the Lisbon Protocol on 23 May 1992 by Belarus, Kazakhstan, the Russian Federation, Ukraine and the United States.

Earth Satellites for International Direct Television Broadcasting. It provides, *inter alia,* that "activities in the field of international direct television broadcasting by satellite should be carried out in a manner compatible with the sovereign rights of States" (Principle 1); and "in a manner compatible with the development of mutual understanding and the strengthening of friendly relations and cooperation among all States and peoples in the interest of maintaining international peace and security" (Principle 3).

(*c*) On 3 December 1986, the United Nations General Assembly adopted resolution 41/65 containing *Principles Relating to Remote Sensing of the Earth from Space.* These Principles provide, *inter alia,* that remote sensing activities "shall not be conducted in a manner detrimental to the legitimate rights and interests of the sensed State" (Principle IV) and that "a State carrying out a programme of remote sensing shall inform the Secretary-General of the United Nations" and shall "make available any other relevant information to the greatest extent feasible and practicable to any other State, particularly any developing country that is affected by the programme, at its request" (Principle IX).

(d) On 14 December 1992, the United Nations General Assembly adopted resolution 47/68 containing the *Principles Relevant to the Use of Nuclear Power Sources in Outer Space.* The Principles define guidelines and criteria for the safe use of nuclear power sources. They provide, *inter alia,* that the results of safety assessment of nuclear power sources carried out by a launching State "shall be made publicly available prior to each launch, and the Secretary-General of the United Nations shall be informed on how States may obtain such results of the safety assessment as soon as possible prior to each launch" (Principle 4). Also, the launching State operating "a space object with nuclear power sources on board shall in a timely fashion inform States concerned in the event this space object is malfunctioning with a risk of re-entry of radioactive materials on the Earth"; such information shall be also transmitted to the Secretary-General of the United Nations "so that the international community will be informed of the situation and will have sufficient time to plan for any national response activities deemed necessary" (Principle 5).

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AGREEMENT GOVERNING THE ACTIVITIES OF STATES ON THE MOON AND OTHER CELESTIAL BODIES*

OPENED FOR SIGNATURE AT NEW YORK: 18 December 1979

ENTERED INTO FORCE: 11 May 1984

Depositary. Secretary-General of the United Nations

Total number of parties as of 31 December 1992

The States Parties to this Agreement,

Noting the achievements of States in the exploration and use of the moon and other celestial bodies,

Recognizing that the moon, as a natural satellite of the earth, has an important role to play in the exploration of outer space,

Determined to promote on the basis of equality the further development of co-operation among States in the exploration and use of the moon and other celestial bodies,

Desiring to prevent the moon from becoming an area of international conflict,

Bearing in mind the benefits which may be derived from the exploitation of the natural resources of the moon and other celestial bodies,

Recalling the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, the Convention on International Liability for Damage Caused by Space Objects, and the Convention on Registration of Objects Launched into Outer Space,

* General Assembly resolution 34/68, annex. 231

Taking into account the need to define and develop the provisions of these international instruments in relation to the moon and other celestial bodies, having regard to further progress in the exploration and use of outer space,

Have agreed on the following:

Article 1

1. The provisions of this Agreement relating to the moon shall also apply to other celestial bodies within the solar system, other than the earth, except in so far as specific legal norms enter into force with respect to any of these celestial bodies.

2. For the purposes of this Agreement reference to the moon shall include orbits around or other trajectories to or around it.

3. This Agreement does not apply to extraterrestrial materials which reach the surface of the earth by natural means.

Article 2

All activities on the moon, including its exploration and use, shall be carried out in accordance with international law, in particular the Charter of the United Nations, and taking into account the Declaration on Principles of International Law concerning Friendly Relations and Co-operation among States in accordance with the Charter of the United Nations, adopted by the General Assembly on 24 October 1970, in the interest of maintaining international peace and security and promoting international cooperation and mutual understanding, and with due regard to the corresponding interests of all other States Parties.

Article 3

1. The moon shall be used by all States Parties exclusively for peaceful purposes.

2. Any threat or use of force or any other hostile act or threat of hostile act on the moon is prohibited. It is likewise prohibited to use the moon in order to commit any such act or to engage in any such threat in relation to the earth, the moon spacecraft, the personnel of spacecraft or man-made space objects.

3. States Parties shall not place in orbit around or other trajectory to or around the moon objects carrying nuclear weapons or any other kinds of weapons of mass destruction or place or use such weapons on or in the moon.

4. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on the moon shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration and use of the moon shall also not be prohibited.

Article 4

1. The exploration and use of the moon shall be the province of all mankind and shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development. Due regard shall be paid to the interests of present and future generations as well as to the need to promote higher standards of living and conditions of economic and social progress and development in accordance with the Charter of the United Nations.

2. Stales Parties shall be guided by the principle of co-operation and mutual assistance in all their activities concerning the exploration and use of the moon. International co-operation in pursuance of this Agreement should be as wide as possible and may taker place on a multilateral basis, on a bilateral basis or through international intergovernmental organisations.

Article 5

1. States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of their activities concerned with the exploration and use of the moon. Information on the time, purposes, locations, orbital parameters and duration shall be given in respect of each mission to the moon as soon as possible after launching, while information on the results of each mission, including scientific results, shall be furnished upon completion of the mission. In the case of a mission lasting more than sixty days. information on conduct of the mission, including any scientific results, shall be given periodically, at thirty-day intervals. For missions lasting more than six months, only significant additions to such information need be reported thereafter.

2. If a State Party becomes aware that another State Party plans to operate simultaneously in the same area of or in the same orbit around or trajectory to or around the moon, it shall promptly inform the other State of the timing of and plans for its own operations.

3. In carrying out activities under this Agreement, States Parties shall promptly inform the Secretary-General, as well as the public and

the international scientific community, of any phenomena they discover in outer space, including the moon, which could endanger human life or health, as well as of any indication of organic life.

Article 6

1. There shall be freedom of scientific investigation on the moon by all States Parties without discrimination of any kind on the basis of equality and in accordance with international law.

2. In carrying out scientific investigations and in furtherance of the provisions of this Agreement, the Stated Parties shall have the right to collect on and remove from the moon samples of its mineral and other substances. Such samples shall remain at the disposal of those States Parties which caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation. States Parties may in the course of scientific investigations also use mineral and other substances of the moon in quantities appropriate for the support of their missions.

3. States Parties agree on the desirability of exchanging scientific and other personnel on expeditions to or installations on the moon to the greatest extent feasible and practicable.

Article 7

1. In exploring and using the moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment, whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise.

2. States Parties shall inform the Secretary-General of the United Nations of the measures being adopted by them in accordance with paragraph 1 of this article and shall also, to the maximum extent feaslble, notify him in advance of all placements by them of radio-active materials on the moon and of the purposes of such placements.

3. States Parties shall report to other States Parties and to the Secretary-General concerning areas of the moon having special scientific interest in order that, without prejudice to the rights of other States Parties, consideration may be given to the designation of such areas as

international scientific preserves for which special protective arrangements are to be agreed upon in consultation with the competent bodies of the United Nations.

Article 8

1. States Parties may pursue their activities in the exploration and use of the moon anywhere on or below its surface, subject to the provisions of this Agreement.

2. For these purposes States Parties may, in particular:

(a) Land their space objects on the moon and launch them from the moon;

(b) Place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the moon.

Personnel, space vehicles, equipment, facilities, stations and installations may move or be moved freely over or below the surface of the moon.

3. Activities of States Parties in accordance with paragraphs 1 and 2 of this article shall not interfere with the activities of other States Parties on the moon. Where such interference may occur, the States Parties concerned shall undertake consultations in accordance with article 15, paragraphs 2 and 3, of this Agreement.

Article 9

1. States Parties may establish manned and unmanned stations on the moon. A State Party establishing a station shall use only that area which is required for the needs of the station and shall immediately inform the Secretary-General of the United Nations of the location and purposes of that station. Subsequently, at annual intervals that State shall likewise inform the Secretary-General whether the station continues in use and whether its purposes have changed.

2. Stations shall be installed in such a manner that they do not impede the free access to all areas of the moon of personnel, vehicles and equipment of other States Parties conducting activities on the moon in accordance with the provisions of this Agreement or of article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

Article 10

1. States Parties shall adopt all practicable measures to safeguard the life and health of persons on the moon. For this purpose they shall

regard any person on the moon as an astronaut within the meaning of article V of the Treaty on Principles Governing the Activities of states in the Exploration and Use of Outer Space, including the moon and other Celestial Bodies and as part of the personnel of a spacecraft within the meaning of the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space.

2. States Parties shall offer shelter in their stations, installations, vehicles and other facilities to persons in distress on the moon,

Article 11

1. The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement, in particular in paragraph 5 of this article.

2. The moon is not subject tonational appropriation by any claim of sovereignty by means of use oroccupation, or by any other means.

3. Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become the property of any State, international intergovernmental or non-govemmental organiztion, national organisation or non-governmental entity or of any natural person. The placement of personnel, space vehicles, equipment, facilities stations and installations on or below the surface of the moon, including structures connected with its surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the moon or any areas thereof. The foregoing provisions are without prejudice to the international regime referred to in paragraph 5 of this article.

4. States Parties have the right to exploration and use of the moon without discrimination of any kind, on the basis of equality and in accordance with international law and the provisions of this Agreement.

5. States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement.

6. In order to facilitate the establishment of the international regime referred to in paragraph 5 of this article, States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of any natural resources they may discover on the moon.

7. The main purposes of the international regime to be established shall include:

(a) The orderly and safe development of the natural resources of the moon;

(b) The rational management of those resources;

(c) The expansion of opportunities in the use of those resources;

(d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration.

8. All the activities with respect to the natural resources of the moon shall be carried out in a manner compatible with the purposes specified in paragraph 7 of this article and the provisions of article 6, paragraph 2, of this Agreement.

Article 12

1. States Parties shall retain jurisdiction and control over their personnel, space vehicles, equipment, facilities, stations and installations on the moon. The ownership of space vehicles, equipment, facilities, stations and installations shall not be affected by their presence on the moon.

2. Vehicles, installations and equipment or their component parts found in places other than their intended location shall be dealt with in accordance with article 5 of the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space.

3. In the event of an emergency involving a threat to human life, States Parties may use the equipment, vehicles, installations, facilities or supplies of other States Parties on the moon. Prompt notification of such use shall be made to the Secretary-General of the United Stations or the State Party concerned.

Article 13

A State Party which learns of the crush landing, forced landing or other unintended landing on the moon of a space object, or its component parts, that were not launched by it, shall promptly inform the launching State Party and the Secretary-General of the United Nations.

Article 14

1. States Parties to this Agreement shall bear international responsibility for national activities on the moon, whether such activities are carried out by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions of this Agreement. States Parties shall ensure that non-governmental entities under their jurisdiction shall engage in activities on the moon only under the authority and continuing supervision of the appropriate State Party.

2. States Parties recognize that detailed arrangements concerning liability for damage caused on the moon, in addition to the provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies and the Convention on International Liability for Damage Caused by Space Objects, may become necessary as a result of more extensive activities on the moon; Any such arrangements shall be elaborated in accordance with the procedure provided for in article 18 of this Agreement.

Article 15

1. Each State Party may assure itself that the activities of other States Parties in the exploration and use of the moon are compatible with the provisions of this Agreement. To this end, all space vehicles, equipment, facilities, stations and installations on the moon shall be open to other States Parties. Such States Parties shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited. In pursuance of this article, any State Party may act on its own 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.

2. A State Party which has reason to believe that another State Party is not fulfilling the obligations incumbent upon it pursuant to this Agreement or that another State Party is interfering with the rights which the former State has under this Agreement may request consultations with that State Party. A State Party receiving such a request shall enter into such consultations without delay. Any other State Party which requests to do so shall be entitled to take part in the consultations. Each State Party participating in such consultations shall

seek a mutually acceptable resolution of any controversy and shall bear in mind the rights and interests of all States Parties. The Secretary-General of the United Nations shall be informed of the results of the consultations and shall transmit the information received to all States Patties concerned.

3. If the consultations do not lead to a mutually acceptable settlement which has due regnal for the lights and interests of all States Parties, the parties concerned shall take all measures to settle the dispute by other peaceful means of their choice appropriate to the circumstances and the nature of the dispute. If difficulties arise in connexion with the opening of consultations or if consultations do not lead to a mutually acceptable settlement, any State Party may seek the assistance of the Secretary-General, without seeking the consent of any other State Party concerned, in order to resolve the controversy. A State Party which does not maintain diplomatic relations with another State Party concerned shall participate in such consultations, at its choice, either itself or through another State Party or the Secretary-General as intermediary.

Article 16

With the exception of articles 17 to 21, references in this Agreement to States shall be deemed to apply to any international intergovernmental organisation which conducts space activities if the organisation declares its acceptance of the rights and obligations provided for in this Agreement and if a majority of the States members of the organisation are States Parties to this Agreement and to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. States members of any such organisation which are States Parties to this Agreement shall take all appropriate steps to ensure that the organisation makes a declaration in accordance with the provisions of this article.

Article 17

Any State Party to this Agreement may propose amendments to the Agreement. Amendments shall enter into force for each State Party to the Agreement accepting the amendments upon their acceptance by a majority of the States Parties to the Agreement and thereafter for each remaining State Party to the Agreement on the date of acceptance by it.

Article 18

Ten years after the entry into force of this Agreement, the question of the review of the Agreement shall he included in the provisional agenda of the General Assembly of the United Nations in order to consider, in the light of past application of the Agreement, whether it requires revision. However, at any time after the Agreement has been in force for five years, the Secretary-General of the United Nations, as depsitory, shall, at the request of one third of the States Parties to the Agreement and with the concurrence of the majority of the States Parties convene a conference of the States Parties to review this Agreement. A review conference shall also consider the question of the implementation of the provisions of article 11, paragraph 5, on the basis of the principle referred to in paragraph 1 of that article and taking into account in particular any relevant technological developments.

Article 19

1. This Agreement shall be open for signature by all States at United Nations headquarters in New York.

2. This agreement shall be subject to ratification by signatory States. Any Stale which does not sign this Agreement before its entry into force in accordance with paragraph 3 of this article may accede to it at any time. Instruments of ratification or accession shall be deposited with the Secratary -General of the United Nations.

3. This Agreement shall enter into force on the thirtieth day following the date of deposit of the fifth instrument of ratification.

4. For each State depositing its instrument of ratification or accession after the entry into force of this Agreement, it shall enter into force on the thirtieth day following the date of deposit of any such instrument.

5. The Secretary-General shall promptly, inform all signatory and acceding States of the date of each signature the date of deposit of each instrument of ratification or accession to this Agreement, the date of its entry into force and other notices.

Article 20

Any State Party to this Agreement may give notice of its withdrawal from the Agreement one year after its entry into force by written notification to the Secretary General of the United Nations. Such withdrawal shall take effect one year from the date of receipt of this notification.

Article 21

The original of this Agreement, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations, who shall send certified copies thereof to all signatory and acceding States.

In witness whereof the undersigned, being duly authorized thereto by their respective Governments, have signed this Agreement, opened for signature at New York on 18 December 1979.

List of Signatories and Parties

(i) Signatures affixed on the originel of the Agreement deposited with the Secretary-General of the United Nations.

(ii) Instruments of ratification, accession *(a)* or succession(s) deposited with the Secretary-General of the United Nations.

State	*(i) Signature*	*(ii) Deposit*
Australia	—	7 July 1986(a)
Austria	21 May 1980	11 June 1984
Chile	3 January 1980	12 November 1981
France	29 January 1980[1]	—
Gautemala	20 November 1980	—
India	18 January 1982	—
Mexico	—	11 October 1991(a)
Morocco	25 July 1980	—
Netherlands	27 January 1981	17 February 1983[2]
Pakistan	—	27 February 1986{a)
Peru	23 June 1981	—
Philippines	23 April 1980	26 May 1981
Romania	17 April 1980	—
Urugua	1 June 1981	9 November 1981

A dash (—) after the name of a country indicates that the action has not been taken.

1. With the following statement:

   "France is of the view that the provisions of article 3, paragraph 2, of the Agreement relating to the use or threat of force cannot be construed as anything other than a reaffirmation, for the purposes of the field of endeavour covered by the Agreement, of the principle of the prohibition of the threat or use of force, which States are obliged to observe in their international relations, as set forth in the United Nations Charter."

2. For the Kingdom in Europe and the Netherlands Antilles.

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