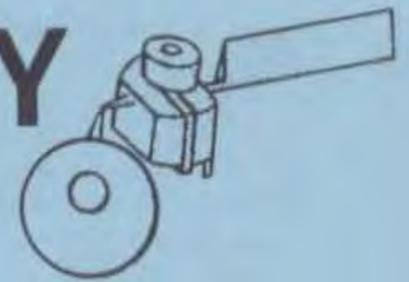




TRUST AND VERIFY



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Commercial Satellites and Verification

In recent months a spate of articles in journals such as *New Scientist* and *Bulletin of the Atomic Scientists*, as well as a number of academic papers, have brought the question of the use of commercial satellites for purposes of arms control to the fore. This article summarises some of the points made in these pieces of work, and lists a selection of them at the end.

It is now accepted that commercial reconnaissance satellites are good enough to observe military installations and certain types of equipment and that they might soon provide a real alternative to military spy satellites with all the secrecy and political manoeuvring that their use involves. Some experts now suggest that commercial satellites will eventually open the way for "independent arms control".

On 22nd February 1986, an Ariane rocket launched a SPOT satellite into orbit. Operated by the French Space Agency, CNES, SPOT (Système Probatoire d'Observation de la Terre) places at the disposal of the media, the public and the arms control experts, images of military and other installations down to the size of a house, previously only available to the operators of military satellites.

At that time the US was already operating Landsat 4 and 5, offering the highest resolution images available from satellites operating "in the open". Landsat, first operated by the US Government and subsequently by the Earth Observation Satellite Company (EOSAT), can pinpoint objects 30 metres across and carries sensors capable of detecting thermal infrared radiation.

SPOT, on the other hand, has two cameras with sensors that deliver resolutions of 10 metres across, and also carries three-colour sensors with resolutions of 20 metres in green, red or near-infrared bands.

SPOT's first high visibility public access role was the monitoring of the burning Chernobyl reactor and making available highly detailed unclassified images. After that journalists of the Stockholm-based Space Media Network (SMN) took advantage of the satellite's capabilities and used it to monitor secret Soviet research and military establishments, including the naval base at Severomorsk, the Semipalatinsk nuclear test site, the Krasnoyarsk missile early warning station and the laser laboratories of Sary Shagan.

In 1987 on the eve of the signing of the INF Treaty, SMN produced an SPOT image of the Soviet ballistic missile base at Yurya, near the Ural mountains, where the Soviet Union had deployed SS-4 and SS-20 bases. At the time Yevgeni Velikhov, Vice-President of the Soviet Academy of Sciences said of the SPOT images, "This is people's arms control". It was seen then, and is

still regarded now as a first step towards the international verification of arms control agreements. Since the early successes of SPOT, even higher quality images have become freely available. The Soviet Union, for example, sells pictures from its KFA-1000 and MK-4 cameras with claimed resolutions of 5-6 metres.

The McDonnell Douglas "Reconnaissance Handy Book" (P. Zimmerman) for the Tactical Reconnaissance Specialist claims that 6 metres is the approximate resolution necessary to detect a bridge, 15 metres to detect the presence of a surface ship (though not its type), 6 metres to find roads and airfields. Clearly if these figures were generally accepted, non-military satellites would have little role to play in arms control. However, many experts believe these "Handy Book" figures to be pessimistic. Both Landsat's and SPOT's images have been used to locate correctly naval bases, harbours, military airfields, missile sites and the Krasnoyarsk early warning station in experiments such as those by Norwegian scientists Tomas Ries and Johnny Skorge, Swedish journalist Christer Larsson, British scientist Bhupendra Jasani and US physicist Peter Zimmerman.

SPOT satellite images of the Soviet nuclear test site at Semipalatinsk are already of reasonable quality (see William Leith and David Simpson). It is now accepted that SPOT data, when interpreted correctly, can be used in association with seismic data to increase the accuracy in estimating origin, time, depth and yield of an underground nuclear explosion.

Risk of exposure from such methods might deter those states on the threshold of nuclear capability from taking further steps. Similarly, history suggests that action is more likely to be taken to retard such advances when such information is publicly disclosed.

SPOT has proved the potential of commercial satellites in arms control, prompting experts to make greater use of similar technologies. Both the Swedish Government and the Canadian Government conducted design studies (Projekt Tellus and Paxsat respectively) and other countries including Italy, Spain and South Africa are looking into the possibility of producing their own equivalents.

Nevertheless, there are likely to be problems. Information used by some to monitor treaty compliance could be used by others to pinpoint targets or lead to new arms build ups based on perceived capability requirements worked out from satellite information. Clearly international watchdog agencies will be vital to the correct working of a network of commercial satellites. It will be important to ensure that commercial satellite images remain accessible to all. If operators began to discriminate with regard to customers, the usefulness of their images would be diminished. Indeed, both EOSAT and SPOT may have adopted practices that contradict their official commitment to "open skies" and "equal access". It is said that some users of the system obtain images far more rapidly than others. Similarly the Soviet trading company Soyuzkarta

does not release images of countries in the "socialist community" to outside users. Politics and profit are both likely to remain a problem in the future. Only if operated in a genuinely neutral manner, commercial satellites might well be fundamental to the verification of future arms control treaties.

However, images from commercial satellites could be used to demonstrate the truth or otherwise of allegations made by one country about the activities of another without necessarily provoking hostile reactions or compromising secret intelligence collection. Similarly, they might deter nations from making allegations that have political motives rather than an intelligence basis. While military satellites might well remain of a higher quality, an independent agency using commercial satellite images, could at least state whether its observations concurred, or otherwise, with the allegations.

However, the more commercial satellites there are in existence, the less likely it is that a country will be unable to buy the information it requires and the harder it will be for somebody to obtain exclusive rights to information.

At the same time, satellites could be used in conjunction with a greater range of other monitoring equipment such as ground-based inspections, and aircraft monitoring, provided that agreements include "open skies" arrangements for treaty verification.

Landsat images from the 1970s have proved important in plotting the history of changes to the face of the site. Since nuclear tests and test operations make a great impact on the earth's surface, (causing craters or spalling) new sites can be identified by comparing recent images with the earlier Landsat data. Sizes of craters and degrees of spalling can be used in association with other data to estimate the depth and yield of tests.

Analysis of SPOT images used in the US/USSR Joint Verification Experiment (JVE) in 1988 has also shown that other forms of surface disturbance can be logically interpreted as drilling sites, while roads linking test locations have also been located using these images. Equally important, SPOT images from 1986, when compared with images from 1987 and 1988 show the speed of development of the testing site. SPOT images have also been used to monitor cratering and explosive excavation experiments at test sites.

SPOT has already helped to identify nuclear test sites in India (in the desert near Pokharan) and in Brazil (near Cachimbo in the Amazon Jungle). In the future, improvements in commercial systems would allow even greater detail in monitoring tests and the development of test sites.

Clearly, ability to monitor nuclear testing is fundamental to the monitoring of nuclear proliferation. Leonard Spector's article (see below) concludes that commercial satellite images can make a "limited but valuable" contribution to nuclear non-proliferation.

To manufacture highly enriched weapons-grade uranium, a country must build a complex enrichment plant. To produce plutonium, a country requires a nuclear reactor. Israel, India, Pakistan and South Africa possess such facilities. Other countries are on their way to joining them. Commercial satellite images might be used in conjunction with the International Atomic Energy Authority's on-site inspections, which form the major part of the non-proliferation regime, to discover evidence of building or other activity likely to represent moves towards possession of such facilities or misuse of existing ones.

The use of images from commercial observation satellites to support nuclear non-proliferation efforts has been divided into three general categories.

1. Visual-spectrum images from SPOT 1, Landsat 4 and 5 and Soviet satellites distributed by Soyuzkarta, used to identify and examine specific nuclear installations or preparations for nuclear tests at known test sites, as outlined above.

2. Using infrared imagery from Landsat 4 and 5 to detect thermal emissions from particular nuclear installations and determine whether they are operating or shut down. However there would be problems in distinguishing between installations that are close to one another, such as the Cirus and Dhurva reactors at the Bhabha Atomic Research Centre in India.

3. Using visual images to observe surface changes accompanying underground tests, as outlined above.

Detection of new or still secret nuclear installations would be very difficult for commercial satellites using current resolutions. However, a series of images over a long period could provide evidence of developments or constructions at sites not yet known to be nuclear installations.

For scholars, researchers, the media and non-governmental organisations, such images will be particularly valuable, while for governments their degree of usefulness will probably depend on their access to similar material from military satellites. International groups and individuals ought to be able to use such information to strengthen efforts to hinder proliferation. Governments, too, might be able to use such images for diplomacy, since they could be used to show evidence of developments without revealing classified intelligence-gathering capabilities.

All evidence points to the fact that commercial satellites have a valuable role to play in future arms control agreements and in the hindrance of nuclear proliferation. Existing technologies have already proved themselves to have a "limited but valuable" role to play, and the potential for future development of such technology is immense. When used in conjunction with other forms of monitoring and verification, such as on-site inspections and aircraft-borne sensors, commercial satellite imagery, if properly regulated, could be fundamental to future arms control activities.

Recent articles and papers on commercial satellites and verification:

Monitoring Underground Nuclear Tests William Leith and David W Simpson, from Commercial Observation Satellites and International Security (St Martin's Press/Carnegie Endowment)

Monitoring The Greenhouse Effect From Space Bhupendra Jasani (Space Policy, May 1989)

Satellite Imagery And Topographic Data In Verification Research William Leith and David W Simpson, (Paper presented at the 11th Annual DARPA/AFGL Seismic Research Symposium 2-4 May 1989)

Peacemakers or Rent-Spies? Michael Krepon (Bulletin of the Atomic Scientists, Sept 1989)

Keep The Skies Open Leonard S Spector (idem)

A Peek at the French Missile Complex William A Kennedy and Mark G Marshall (idem)

Evidence of Spying Peter D Zimmerman (idem)

Military Intelligence - SPOT is not Enough Jeffrey Richelson (idem)

Chemical Progress Not All It Seems

It now seems likely that despite its much-publicised movement towards a ban on chemical weapons (covered in detail in "Trust and Verify" No.3) the United States will go on producing nerve gas even after a global ban takes effect.

A decision, taken in secret by President Bush and his advisors, will allow continued production of binary weapons, claimed by their supporters to be safer than "unitary" chemical weapons because they only become effective when two chemicals are combined after the weapon is fired.

The US will now seek revisions in the draft international treaty agreed at the 40 nation talks, which currently requires that production activities be halted immediately and the plants rendered inoperable within three months of an accord.

Elisa Harris, a chemical weapons expert from the Brookings Institution said continuing US production would be "very destabilising...it provides Third World Countries with an incentive to begin developing a chemical production capability immediately so they can then be amongst the countries that are allowed to continue production after the treaty enters into force. Once these countries have actually made a substantial investment in a chemical arsenal what guarantees do we have that they will eventually be willing to throw it all away?"

Apart from this potential disruption of progress in Geneva, Bush's decision seems likely to hinder movement towards a bilateral agreement between the US and the Soviet Union on reducing chemical weapons stocks before the conclusion of a global treaty. After Bush's UN speech, Soviet arms control adviser Viktor Karpov said that the Soviet Union would not take part in such reductions unless the US stopped producing new binary weapons.

Questions now arise as to whether the development and production of these new weapons can be halted by the 40 nation talks and banned in the global treaty under discussion. The slow progress of the talks and the quest for adequate and acceptable means of verification is unlikely to be helped by this latest development.

In The News

New Soviet Proposal at CFE Talks

Following the US proposal to the Vienna Talks detailed last month in "Trust and Verify" the Soviet Union presented its own package to the talks on 19th October, on verification, inspection and data exchange. The talks resumed on 9 November.

Moscow Admits Breach of ABM Treaty

In a surprising public statement, Soviet Foreign Minister Eduard Shevardnadze has admitted that the controversial Krasnoyarsk radar station had been in breach of the 1972 Anti-Ballistic Missile Treaty (ABM).

The United States has always maintained that the Siberian station, which the Soviet Union has now agreed to pull down, was a violation of the treaty but this is the first time the allegation has been openly accepted by a high ranking Soviet official. Mr Shevardnadze said that the Soviet military command had in fact deceived the country's leadership as to the purpose of the station. Said Mr Shevardnadze: "For four years the Americans accused us of violating the ABM treaty. But the whole truth and the whole story were not immediately clear to us."

French Plans To Complement SPOT

Aviation Week and Space Technology (23/10/89) reports that France is defining "a new radar-equipped Earth resources satellite that could be developed to complement its SPOT series of optical imaging spacecraft in the next century". Imaging resolutions of this new satellite could range from 2 to 50 metres. Validation tests are due to begin in 1992 and the French are seeking international partners to participate in the development with the French national space agency, CNES.

Nuclear Blast Triggers Earthquake

Reuters in Moscow reported that an underground nuclear blast at the Semipalatinsk test site caused a minor earthquake in Kazakhstan in mid October. The quake was reported to the Soviet parliament by anti-nuclear campaigner Olzhas Suleimenov.

Open Skies In Canada

Canada has offered to host an international conference on the concept of "open skies" reports Jane's Defence Weekly (14/10/89). US President Bush proposed an international policy of "open skies" during the NATO Summit in Brussels in May this year. It was in fact similar to a proposal made by Eisenhower in 1955, then rejected by Nikita Khrushchev as part of an espionage plot.

The Canadian conference would discuss the feasibility of developing a co-operatively designed surveillance system to be incorporated into an agreement on unrestricted aerial surveillance of North American, European and Soviet territory, including such issues as the type of aircraft and sensors to be used, frequency of surveillance flights, notice of flights and host country observation.

INF Count

Jane's Defence Weekly (14/10/89) gives the latest figures for the destruction of weapons eliminated under the Intermediate-Range Nuclear Forces (INF) agreement, as of 2/10/89.

According to the US On-Site Inspection Agency, all Soviet SS-12s (718), SS-5s (6), SS-CX-4s (80) and all US Pershing 1-As (169) have been destroyed. 276 SS20s, 150 SS23s and 96 SS4s have also been destroyed on the Soviet side and 35 Pershing 2s and 172 Ground-Launched Cruise Missiles on the US side. These figures bring the total weapons now destroyed under INF to 1326 out of 1846 for the Soviet Union and 376 out of 846 for the United States.

Soviet SDI Inspections

The United States and the Soviet Union are expected to agree on reciprocal inspections of SDI research facilities, after an offer made by the U.S. It is thought that the Soviet Union will respond with a similar offer when the US proposal is officially presented at Geneva. Ambassador

Henry Cooper, Chief US Negotiator for the Defense and Space talks in Geneva said that the objective is "strategic stability" by exchanging data annually on "a wide range of strategic defense activities starting at the development stage".

North Korea - US Fears Nuclear Proliferation

US Secretary of State James Baker has called upon the Soviet government to assist in applying the safeguards of the International Atomic Energy Authority to the North Korean nuclear reactor at Yongbyon, as laid out in the Nuclear Non-Proliferation Treaty (NPT) of which North Korea is a signatory.

US intelligence has gathered information on the reactor over a considerable period and the details released this month state that the graphite reactor has been operating for approximately two years using natural uranium fuel.

Despite the NPT, North Korea has so far refused to allow an inspection of the facility. The Pyongyang government has reportedly referred to its fear of a nuclear threat in the Korean peninsula, meaning US forces based in South Korea.

Mr Baker's public statement reflects not only its fears about proliferation but also what Simon Tisdall describes as its "delicately evolving relationship with Seoul" (Guardian 26/10/89). It also gives the superpowers the opportunity to work together on the issue of proliferation, since the Soviet Union shares US fears about proliferation of nuclear weapons to the third world. Soviet Foreign Minister Eduard Shevardnadze responded sympathetically to Mr Baker's concerns regarding North Korea when the two men met in October.

VERTIC NEWS

VERTIC Director Dr Patricia Lewis gave a talk on arms control verification at the Chemical Weapons Research Establishment at Porton Down in mid-November.

VERTIC personnel involved in the production of the verification protocols for an amended Partial Test Ban Treaty attended a meeting at the Parliamentarians Global Action headquarters in New York to discuss progress on the project. Also attending were the international group of verification experts who are acting as referees to the project.

American student, Fred Johnston, from Washington College, is working in the VERTIC office until Christmas. Apart from helping with the administration work, he is writing a report on the current status of the START talks.

The collection of papers presented at last December's "Ways out of the Arms Race" conference has now been published by World Scientific Publishers. The conference was held at Imperial College, London, from 2nd to 4th December 1988 and was attended by scientists and arms control experts from Europe (both East and West), North America, South America and Asia.

Also recently published is the collection of written contributions from the "Workshop on Verification of Nuclear and Conventional Arms Reductions", which took place from November 30 to December 2, 1988. The book is edited by J. Altmann and J. Rotblat and published by Springer-Verlag.

What is VERTIC?

VERTIC is an independent organisation aiming to research and provide information on the role of verification technology and methods in present and future arms control agreements. VERTIC co-ordinates six working groups comprising 21 UK consultants and 11 overseas advisors. VERTIC is the major source of information on verification for scientists, policy makers and the press. VERTIC is funded primarily by grants from foundations and trusts and its independence is monitored by an Oversight and Advisory Committee.

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