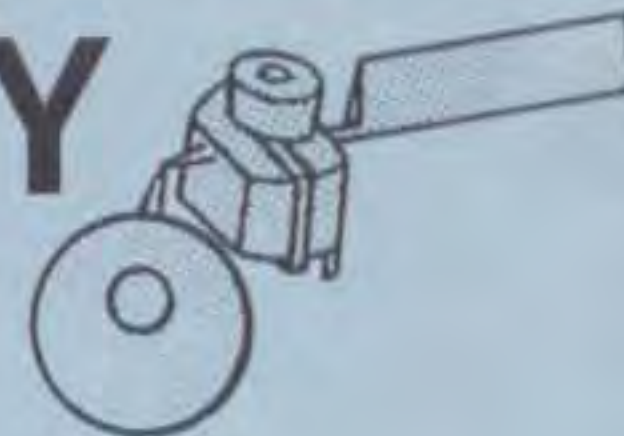




TRUST AND VERIFY



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Radar Revolution

The launch of the first European Remote Sensing Satellite (ERS-1) from French Guiana, scheduled for May, has been portrayed in the British press as a major revolution in satellite technology. The *Daily Telegraph's* Roger Highfield, the *Independent's* Peter Bond and the *Guardian's* "EG" education supplement all described the likely impact of the £700 million effort to launch Europe's first major satellite to study the environment. The ERS will be carried into orbit by the Ariane 4 rocket.

As Peter Bond wrote in the *Independent* (29/4/91), referring to both ERS and the recently launched Soviet Almaz satellite, "These satellites rely on a technique called synthetic aperture radar (SAR). Instead of the usual "passive" instruments that detect natural infra-red or visible radiation coming from Earth, a radar satellite transmits its own signal and records its reflection." As a result ERS will be able to pierce dense blankets of cloud or smoke impenetrable to the French SPOT or US Landsat satellites, or the Meteosat weather satellite.

SAR has been developed over the last 13 years since its first use in 1978 on the Seasat mission. It was also employed for short periods on Space Shuttle missions in 1981 and 1984. It consists of a side-looking radar that obtains detailed black and white images by computer processing of a continuous series of overlapping return signals.

ERS-1 will use a 10m antenna to transmit a radar beam over a 100km wide strip to one side of its orbital path. European scientists are hoping for images with a resolution of 30m; Soviet scientists claim 15m resolution for Almaz.

ERS, which uses British-built radar equipment, will be used to learn more about the earth's climate and response to global warming. Attention will be focused on polar ice-caps and glaciers in the hope of providing early warning of melting caused by excessive temperature rises.

As well as the high-resolution images, lower resolution images from ERS will allow scientists to study various aspects of oceanology. Because of innovative microwave and infra-red equipment, the satellite also has wind-speed and direction measurement applications, as well as aiding the study of ocean currents and submarine contours. The Along-Track Scanning Radiometer, which Roger Highfield describes as "the responsibility of Prof. John Harries's space science department at the Rutherford Appleton Laboratory in Oxfordshire", will allow highly accurate measurements of surface temperature of the oceans.

ERS will be placed into a near-polar orbit at an altitude of 785km, enabling it to cover the whole of the earth's surface once every three days. The vast amount of data provided by ERS - more than 100 megabits per second at times, or the equivalent of 5,600 pages of text - will be received by a network of ground stations, not yet

complete. The most important is at Kiruna in Northern Sweden. The European Space Agency plan to gather and disseminate data within three hours to national centres. There will also be four processing and archiving facilities, including one in Farnborough, UK.

There are some opponents of the ERS programme, which will not be able to monitor the growing hole in the ozone layer, who believe that ERS was planned without first clearly defining its objectives and that smaller craft could carry out specific tasks more cheaply. They give the example of the NASA satellite due for launch in September to monitor the processes controlling the ozone layer.

CFE In The Balance

Reports from various sources over the last two weeks suggest that the fate of the Conventional Forces in Europe Treaty (CFE) depends largely on Soviet President Gorbachev selling a compromise plan, proposed by US President Bush, to the Soviet military establishment. Delays in ratification of the treaty have been caused principally by the transfer of three Soviet motorised rifle divisions from the army to the navy to avoid treaty limitations.

President Bush, with Allied backing, has offered to let the Soviet Union retain the motorised divisions provided it removes the same number of tanks, armoured personnel carriers and artillery pieces from army divisions in the treaty-limited area. Diplomatic sources also say President Gorbachev will be allowed to destroy these items outside the CFE zone, unlike other treaty-limited items. The US has proposed a one-off binding declaration to be signed separately from CFE freezing levels of disputed equipment now assigned to coastal defence and naval infantry. At the resumption of the CFE 1-A talks in Vienna, some officials were expecting a reply from President Gorbachev within two to three weeks.

START Talks Resume

The delayed Strategic Arms Reduction Treaty (START) negotiations between the United States and the Soviet Union resumed in Geneva on 19 April. Concerns over Soviet adherence to the CFE Treaty and the situation in the Baltic Republics had held up progress. It is still expected that a treaty will be signed later this year.

According to Richard Burt, who resigned as Head of the US Delegation to the Geneva nuclear and space talks, only "second order" problems remain. Burt's assessment of the outstanding difficulties was outlined in *Defense News* (22/4/91):

- verification of the number of strategic bombers and air-launched cruise missiles on each side
- perimeter portal monitoring involving the stationing of personnel at sites owned by the other side
- a missile verification regime
- withholding of encrypted missile test data

- removal of warheads from multiple-warhead missiles to permit greater flexibility in the deployment of nuclear forces

START verification issues have been discussed in some detail in earlier editions of *Trust and Verify*.

Iraq: Details of NBC and Ballistic Missiles

After an initial response on 18 April deemed inadequate by the United Nations, the Iraqi government has now provided the International Atomic Energy Authority with a detailed list of its nuclear facilities. An inspection by the IAEA began at the time of going to press. The IAEA has been instructed by the UN to take possession of Iraq's nuclear material - 10kg of 80% enriched uranium and 12.5kg of 93% enriched uranium - and destroy it or render it harmless, as required under the Gulf War ceasefire agreement. The fate of the uranium after Allied bombing raids on nuclear installations is uncertain, although *The Times* (2/5/91) reports that Iraq moved some of it before the raids took place. Iraq is now refusing to reveal the exact locations until the UN guarantees they will not be destroyed by new air strikes. The UN position is that Iraq cannot impose conditions on its own compliance with a UN resolution.

As part of the Gulf War ceasefire agreement, Iraq has also published a detailed list of the ballistic missiles and chemical munitions remaining in its inventory. 52 ballistic missiles along with 6920 120mm "missile" warheads are listed, along with a total of over 11,000 chemical warheads of all types. The details also showed that Iraq had produced a large amount of Tabun and Sarin, as well as mustard gas, for stockpiling. The figures presented suggest that US intelligence reports during the war were considerable underestimates.

Soviet Testing Discussed At US Workshop

At a recent seismology workshop in the United States, Soviet scientist Vitaly Adushkin of the Institute of Earth Physics gave a presentation on one of the Soviet Union's principal seismic stations used to monitor underground nuclear tests. Much of the information regarding the Borovoye station was being made available for the first time.

Borovoye is in NW Kazhakstan, about 650 km NW of the Semipalatinsk test site. It operates a number of different types of seismometer, some of which employ digital recording techniques. Very low background noise levels together with the application of routine signal enhancement methods, allows detection of as many as 1000 seismic events per day from all parts of the world.

Included in Adushkin's presentation were seismograms from both Soviet and American nuclear tests. Explosions carried out at the Nevada test site as low as magnitude 3.1 (i.e. sub-kiloton) are recorded. Detailed magnitude-yield curves have been compiled for all major test sites, including within-site variation at Nevada and Semipalatinsk.

The Soviet Union's claimed ability to verify a comprehensive nuclear test-ban has been questioned in the past; the details provided by Adushkin's presentation suggest that the claims may have a firmer technical and scientific basis than was previously assumed.

(This article was provided by VERTIC Working Group member, Dr Roger Clark).

Helios - Restricted Access

At the beginning of April, France proposed that the European Community set up a military satellite surveillance system under the wing of the Western European Union (WEU) (*Jane's Defence Weekly* 6/4/91). France appeared to have dropped its reservations about using the Helios observation satellite, due for 1992 launch by a French-Italian-Spanish consortium, as the core of a future surveillance system. A later report (*Jane's Defence Weekly* 20/4/91) indicated that data gathered by Helios would still be subject to restrictions.

VERTIC's Dr Patricia Lewis said in the report that "the arrangement may be similar to that which the USA has with NATO". A daily report based on US intelligence-gathering activities is passed on to NATO, but raw material is given only to the closest allies. The Helios consortium already allows for varying degrees of access among its members according to the level of financial input.

In The News

Space Shuttle on SDI Mission

On 28 April the US Space Shuttle Discovery set off "on a "Star Wars" research flight in which the craft will perform cartwheels in space to help scientists design sensors that can track and destroy enemy missiles", reports the *Western Mail* (29/4/91). The experiments will also contribute to work on distinguishing missiles from chemical camouflage or natural phenomena such as the aurora borealis. However, the *International Herald Tribune* (30/4/91) reported problems aboard the shuttle related to two data recorders which has caused some Pentagon research to be scrapped. The Discovery mission is the first military shuttle flight not to be carried out in secret.

SDI v ABM

The Strategic Defense Initiative (SDI) is on a collision course with the 1972 Anti-Ballistic Missile Treaty (ABM) in the eyes of many, if not most, observers, according to *Aviation Week and Space Technology* (29/4/91). At a recent US Senate hearing, Stephen Hadley, a Pentagon expert on treaties, said that the mid-1990s would see problems in the areas of testing in space and theatre defences. Members of the Senate are asking to be told how the Soviet Union is to be persuaded to amend the ABM treaty to allow for further development of the already hugely expensive SDI programme. Meanwhile House Armed Services Committee Chairman, Les Aspin has asked for a restructuring of the entire SDI programme. Aspin also rejects the proposed Brilliant Pebbles concept to deploy 1,000 warhead-killing rockets in space.

Less Money - Longer Life - Fewer Satellites

According to US Air Force officials, the United States Department of Defence will be launching fewer military remote sensing satellites during the 1990s due to reduced defence budgets and to the increased durability of satellites in orbit. The Titan 4 rocket launches will be reduced from 14 to 10 at Vandenberg, California and from 33 to 29 at Cape Canaveral, Florida, between 1991 and 1997. Titan 4s from Vandenberg are believed to launch photoreconnaissance and remote sensing radar satellites. Those from Cape Canaveral are thought to place intelligence satellites in orbit to listen in to radio broadcasts. (*Space News*, April 22 - 28 1991).

Japanese Earth Observation

Japan's National Space Development Agency is planning three Earth-observing satellite missions, reports *Space News* (18-24/4/91). The first, the Earth Resource Satellite 1 will be launched in early 1992, the first remote sensing satellite developed by Japanese industry. This will be followed by the Advanced Earth Observing Satellite (ADEOS) in 1995 and a third system, not yet finalised, due for launch in 1998/9. Among the tasks of the initial satellite, which like the European ERS-1 will use a synthetic aperture radar, will be geological mapping. The later systems will monitor global winds and the ozone layer.

Canadian Remote Sensing

Canada will expand its remote sensing programme during the 1990s. As well as the Radarsat launch, due for 1994, Canada is also participating in programmes with other countries. It is involved in the European Space Agency's polar orbiting mission due for launch in 1998/9, and the ERS-2 follow-up to ERS-1. It is also considering participation in the Japanese J-ERS-1 and ADEOS satellite projects.

Landsat Could Die

Environmental and space researchers in the United States are questioning the ability of the Landsat programme to conduct accurate global change research unless the design for an upgraded version, the Landsat 7, is approved immediately. Landsat 7 will cost around \$400 million. The scientists, including Alden Colvocoresses of the US Geological Survey, also say that the Landsat satellites, owned by the US Government and operated by EOSAT, should be brought back into the public domain to ensure its survival as a non-military satellite programme. (*Space News*, 1 - 7 April 1991).

Poor Prospects For Naval Arms Control

A report to Congress published recently by the United States Department of Defence shows little optimism for talks on naval weapons with the Soviet Union in the near future. However, reports *Defense News* (22/4/91), it does support a "congressional proposal aimed at prodding Moscow to publish more information on its naval forces". The report concludes with the following statement: "The geopolitical and economic asymmetries between the United States and the Soviet Union and the accompanying differences in the roles and missions of their respective naval forces make the construction of an equitable naval arms control regime very difficult." The report is a result of a request by the Senate Armed Services Committee for a report on the costs and benefits of pursuing three areas of naval arms control: limits or a ban on naval tactical nuclear weapons, bilateral limits on nuclear attack submarines and confidence building measures. The report also claims that treaty compliance would be extremely difficult to verify. VERTIC scientists believe these difficulties can, for the most part, be overcome.

Alternative Approach To Cruise Verification

A special report in *International Defense Review*, (April 1991) by Brigitte Sauerwein and Pamela Pohling-Brown. Entitled "Verification - Distrust Legitimised" looks at the history of the need for verification, key aspects of verification and "an alternative approach to distinguishing cruise missiles", namely the "gradiometer" developed by Charles Stark Draper Laboratories. This new instrument is sensitive to the location, mass density and spacial extent of the internal

components of a cruise missile. "The main differences between conventional and nuclear versions of cruise missiles consist in the mass density, length and the location of the corresponding warheads (so)...it should be relatively easy for a gradiometer to distinguish between nuclear and conventional missiles"

OOVs Declared

The following is the latest data from Vienna on the Objects of Verification (OOVs), based on final exchange of information on 18 February. These are still subject to change.

Belgium	50
Bulgaria	93
Canada	13
Czechoslovakia	185
Denmark	64
France	236
Germany	470
Greece	61
Hungary	58
Iceland	0
Italy	190
Luxembourg	2
Netherlands	88
Norway	59
Poland	134
Portugal	28
Romania	127
Spain	94
Turkey	150
United Kingdom	225
US	169
USSR	910

Total for West 1899

Total for East 1507

French Verification Unit Established

The French journal *L'Armement* (Feb/Mar 1991) described the establishment of a verification unit within the ministry of defence to fulfil obligations under the CFE treaty. The article outlines the unit's functions, structure and conditions of activity.

Soviet Uranium Hoard

Vitaly Konovalov, Soviet Minister for nuclear power and industry told the Atomic International Forum in Tokyo on 8 April that the elimination of missiles under the 1987 INF Treaty has led to excessive stockpiling of uranium by the Soviet Union. The Soviet Union wants to export 5,000 tons of uranium peroxide (refined natural uranium) between 1991-5 and the country has a confirmed reserve of 2 million tons of natural uranium, reports *Defense News* (15/4/91). Under the terms of the Nuclear Non-Proliferation Treaty (NPT) the Soviet Union cannot export weapons grade uranium. Konovalov apparently indicated that the Soviet Union would abolish small- and medium-sized nuclear weapons, stop producing weapons-grade uranium and consequently, would shut down nuclear reactors designed to produce military nuclear materials. No time scale was mentioned.

Major Proposes Arms Register

British Prime Minister John Major has said that the United Nations should consider setting up an effective system of monitoring the sales of arms to unstable areas. He proposed an arms sales register where all transfers would be recorded by suppliers. The register should focus on the five permanent UN Security Council members - US, USSR, UK, France and China - who are

"the most important arms producers in the world". The proposal met with widespread support from all shades of political opinion and the peace movement. The European Community have supported Mr. Major's proposal rather than establish stricter European-wide controls.

Publications

Verification Report 1991, edited by J. B. Poole (VERTIC/The Apex Press, £20.00/\$35.00). See below under "VERTIC News".

Verification: Monitoring Disarmament, edited by Francesco Calogero, Marvin L. Goldberger and Sergei P. Kapitza (A Pugwash Monograph published by Westview Press.)

12 chapters written by experts from East and West covering among other topics the technical basis for verification of a low threshold or comprehensive test ban, verification of compliance with the ABM treaty and the elimination of nuclear warheads.

International Verification Organisations, edited by Ellis Morris for the Centre for International and Strategic Studies, York University, Toronto, Canada. It looks at verification regimes and existing and possible future international verification organisations, including the UN. Covering CTBT, chemical weapons, arms control in outer space, the Non Proliferation Treaty and bilateral agreements.

Verification Technologies - Measures for Monitoring Compliance with the START Treaty (Summary) - a publication of the Congress of the United States Office of Technology Assessment. A brief overview of the proposed monitoring process and special sections covering ICBMs, SLBMs and ALCMs.

Report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament on its Work During the Period 8-18 January 1991, (CD/1046).

The report outlines the three working groups convened under the CD covering verification issues, technical issues and legal and institutional issues. It also contains a proposed preliminary structure for a Convention on Chemical Weapons. One appendix to the report contains papers reflecting results of work undertaken on issues relating to the convention such as Ad Hoc Verification and on-site challenge inspections.

VERTIC News

Verification Report 1991

Verification Report 1991, Yearbook on arms control and environmental agreements, will be available in late June. Published by VERTIC in association with The Apex Press, the report brings together technical experts and analysts from around the world to describe advances, hold-ups and ways forward in the field of verification. The report will be published annually and looks certain to become the standard text on verification. Edited by John Poole, copies of Verification Report can be obtained direct from VERTIC, 33 Southampton Street, London WC2E 7HE. Cheques/Money Orders in UK Sterling should be made payable to VERTIC. The report costs 20.00/\$35.00 (postage and packing: UK - £1.50, Europe/USSR - £3.50, Elsewhere - £5.50).

Articles

The February edition of the *Bulletin of Arms Control* (Council for Arms Control/Centre for Defence Studies - Kings College, London) contains an article by Dr. Patricia Lewis on the PTBT Amendment Conference. In it Dr Lewis says that the "key point" is that "the US and UK say that while we have nuclear weapons we need to keep on testing; and they can't see a time when we won't have nuclear weapons, therefore they can't see a time when we will have a CTBT. So it is a circular argument which ensures that a test ban cannot be negotiated until all nuclear weapons have gone, yet the nuclear weapons will continue to be made because we do not have a test ban". Dr Lewis also reiterates that "the consensus of scientific opinion is that a global Comprehensive Test Ban Treaty (CTBT) is verifiable.

VERTIC Working Group member Dr. Roger Clark recently had two abstracts published in *Geophysical Journal International* (vol 105 p685 and 686). The abstracts, "Regional Range Identification and Yield Estimation of USSR Nuclear Explosions" and "Underground Nuclear Explosions and Triggered Earthquakes?" were based on papers presented at the UK Geophysical Assembly 15 at Leicester University, England (3 - 5 April 1991). Another working group member, Ben Doody, presented a paper to the same assembly entitled "Studies of the Seismic Noise at BSVRP Seismic Station at Garn, Tadzhikistan".

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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