Will NATO follow the Soviet Union in a space-based strategic defense?

The following report, titled "Space-Based Strategic Defence: How Space Battle Stations Could Alter the World Balance of Power" was prepared for the Foreign Affairs Research Institute by Air Vice-Marshal Stewart Menaul, a member of the British institute's Consultative Council.

Soon after the Reagan administration assumed office in January 1981, a report was prepared by the Defence Department for submission to Congress on beam weapons systems and in particular high-energy space-based laser battle stations. In the certain knowledge that the Soviet Union was devoting vast sums of money to research and development into high-energy lasers and charged and neutral particle beam technology, the report stated that "technology being developed in current Defence Department space laser weapons systems could make existing arsenals of strategic nuclear-armed weapons vulnerable, with large numbers of ballistic missiles and aircraft at risk to the deployment of a moderate number of chemical lasers operating with 4-meter diameter optics and 5 megawatts of power."

This aspect of strategic defence was woefully neglected by the Carter administration but defence advisers to the new administration take a more realistic and professional view of future developments in weapons systems and in particular the potential of space-based weapons. The report observed that laser battle stations in space offered the prospect of altering the world balance of power.

The Soviets could be first

The outstanding success of the Columbia Space Shuttle mission opened up a new era in space exploration and exploitation for both peaceful and warlike purposes. Until the launch of the Columbia, the United States had not undertaken a manned space mission for more than five years. In stark contrast to this disappointing performance, the Soviet Union had maintained a virtual commuter service to and from space with the Soyuz/Salyut space craft. During 1980 alone, in addition to numerous communications, reconnaissance, meterological, intelligence, early warning, and ocean surveillance satellite launches, the Soviets launched six manned flights including a 185-day mission—the longest in the history of space flights. The Soviet space programme has now amassed more than double the manhours achieved by the United States.

The space shuttle mission was an important step in the establishment of permanent space stations for a wide range of activities, among which will be the deployment of defensive systems, including high-energy lasers and charged and neutral particle beam weapons. There is as yet no positive evidence to indicate precisely what experiments the Soviet Union has been carrying out in its Salyut 6 space station over the past two years or what kind of equipment has been ferried to the station by tankers and other craft which have docked successfully on at least six occasions during 1980-81. The new Soyuz T spacecraft carrying three cosmonauts will enable the Soviets to increase their space programme in Salyut 6, or possibly a new Salyut 7 to be launched later this year. With the return of the cosmonauts Savinykh and Kovalenok in their Soyuz spacecraft after 75 days in Salyut 6, the Soviets announced that there would be a temporary halt to manned space missions to permit a detailed analysis and assessment of experiments carried out to date. There is little doubt that the Soviet programme in the near future will be expanded beyond the scope of that conducted in Salyut 6. They have surprised the West before in achieving the first manned space flight and the first anti-satellite capability. We should not be surprised if they are first with space-based defensive weapons system against high-flying aircraft and ballistic missiles.

Ballistic missile defence has been the subject of research and development by both the superpowers for more than a decade. The 1972 anti-ballistic missile treaty (ABM) and its 1974 protocol was part of the SALT I package and permitted each of the superpowers to deploy one ABM system with a maximum of 100 launchers and no more than 100 interceptor missiles at the selected site. Both superpowers had developed a form of terminal ABM defence, but at the signing of the treaty neither system offered much in the way of defence against single warhead ballistic missiles and even less against MIRVed re-entry vehicles. The Soviets


U.S. laser research.

deployed their Galosh system around Moscow. It consisted of four complexes each with 16 launchers and associated radars with hypersonic interceptor missiles. The system has recently been upgraded with modern phased-array radars and interceptors with improved performance. The United States, on the other hand, did not deploy its Safeguard system at Grand Forks ICBM site as originally intended, and consequently has no ABM defences deployed anywhere in the United States.

In the intervening years since the signing of the 1972 ABM treaty, both superpowers have engaged in research and development into ballistic missiles defence. The 1972 treaty comes up for review in 1982, and either or both superpowers may decide that it is outdated and should either be amended or abrogated. In any event, there is abundant evidence to indicate that the Soviet Union is developing ballistic missile defence systems for deployment on the ground and in space. The three main types of ballistic missile defence technology currently being investigated are 1) terminal defence in the atmosphere, or endoatmospheric; 2) mid-course, or exoatmospheric and a combination of terminal and mid-course; 3) directed energy weapons, including high-energy laser and charged and neutral particle beams.

The activities of the Soviet Union at their experimental establishments at Saryshagan, Semipalatinsk and Golvinno are clearly directed towards the production of both high-energy laser and particle beam weapons for deployment on the ground and in space. It is also important to remember that the Soviets have carried out 18 anti-satellite tests of which 11 have been successful, and it would not be surprising if they deployed a high-energy chemical laser in space well before the end of this decade.

The United States is at last reacting to the threat which space-based weapons pose to their strategic weapons systems. Expansion of the original Safeguard ABM system to provide defence for the ICBM site at Grand Forks is under active consideration. Tests at the army ballistic missile range on Kwajalein Island in the Pacific indicate that a "layered" defence system consisting of terminal and mid-course interception capability is now possible and could be deployed to protect Minuteman and later MX silos by the mid-80s.

Layered ballistic missile defence

Most of the early BMD systems were based on terminal defence in which perimeter acquisition radars (PAR) attempted to acquire, track and identify incoming missiles while missile-site radars (MSR) directed interceptor missiles to destroy the re-entry vehicles. Time is of the essence in this form of ballistic missile defence and could be as little as 15 seconds in which to complete the whole interception process. With more sophisticated radars, computers and hypersonic interceptor missiles, very considerable improvements have been achieved in terminal defence. This endoatmospheric part of a more elaborate ballistic missile defence system and known as LOADS is available now, but more important is the mid-course part in which detection, tracking and interception could be achieved in the mid-course, or exoatmospheric, portion of a missile's trajectory in space.

One method of doing this which is currently undergoing tests at the army test centre on Kwajalein island is by using an electro-optical, long-wavelength, infrared sensor to detect and track ballistic missiles in mid-course. The sensors can be launched to the edge of space by rockets where they can scan a large area of space and detect the infrared energy emitted by a ballistic missile in flight. The sensor could also be carried into space by a shuttle. The sensor relays information on the progress of a missile to a computer on the ground which processes the information and classifies the target as missile or manned aircraft. The sensor can detect, track, identify, and classify multiple targets and even differentiate between real RVs and decoys. Interception is accomplished by hypersonic missiles armed with conventional warheads. The great advantage of mid-course interception is that the time scale for detection, acquisition, tracking and interception is measured in minutes instead of seconds.

The Department of Defence states that the LOADS segment of the layered defence system could be deployed in two or three years time and the exoatmospheric segment two years later, but there are still problems to be overcome. Some experts are questioning the wisdom of continuing with the layered defence system in light of the progress being made in high-energy lasers and other more exotic forms of ballistic missile defence for deployment on the ground or in space. All agree that the most effective system will be the one that can attack ballistic missiles in the boost phase of their trajectory.

High-energy laser weapon breakthrough

The report now before Congress recommends an accelerated development programme in the field of chemical laser weapons for deployment in space. A breakthrough in chemical laser development in the past two years, according to the Defence Department, makes possible a feasibility demonstration of high-energy lasers both in space and within the atmosphere. The United States Senate has demanded that a realistic space-based laser programme be generated immediately, and claims that interservice rivalry and reluctance to give up old established practices and existing weapons systems is the main cause of slow progress in the development of a United States ballistic missile defence system.

Laser beams are widely used in ranging, tracking and guidance systems on a variety of offensive and defensive missiles and aircraft and experiments have been completed to demonstrate the effectiveness of high-energy lasers as weapons for use against aircraft and tanks. The United States has installed a 400 kw carbon dioxide laser in a Boeing NKC-135 aircraft which has demonstrated the ability of this relatively low-powered laser to destroy static targets and antitank missiles in flight. A test against a supersonic air-to-air missile was not successful, but a further test is to be carried out in the near future. Successful tests have been carried out against Firebee drones and further tests are planned, including one against a Polaris missile in flight.

U.S. could be operational by 1985

All three services in the United States are conducting research and development in high-energy lasers. The Senate has recommended that a single authority, and eventually a new command structure, should be created to manage and direct the space-based ballistic missile defence programme. Currently, emphasis is on demonstrating the capability of chemical lasers with precision pointing and tracking equipment in the 5 megawatt range with 4-meter diameter optics. Such a system could produce 1-5 kilo-joules/cm sq. on a target in space at ranges up to 2,200 miles. Present strategic ballistic missiles are vulnerable to the thermal energy of lasers at 1 kilo-joules but they could be hardened by use of ablative materials to resist up to 10-20 kilo-joules/cm sq. This would involve a reduction in range or payload or both and would be an expensive and time-consuming process. Higher power outputs from chemical lasers are possible and 50 space battle stations equipped with 25 megawatt/15 meter dioptics weapons could cope with at least 1,200 missiles.

There are, however, problems to be overcome before such space battle stations could be deployed. The Defence Department report claims that with appropriate funding and some priority, a 5 megawatt/4 meter diameter laser could be ready by 1985 to provide a measure of defence against ballistic missiles. Higher powered systems will take longer but all the experts except those who are opposed to any form of space defence agree that by the end of this decade or early in the next effective defence against ballistic missiles will be achieved.

It is possible that the Soviet Union is ahead of the United States in the development of chemical lasers. There is now evidence to show that the Soviet Union has conducted successful tests with a flash-initiated, iodine-pulsed laser against re-entry vehicles from one of their ICBMs, probably an SS-17. The United States has also tested an iodine-pulsed laser and among many experiments now being undertaken in the United States are tests with carbon dioxide hydrogen fluoride and deuterium fluoride lasers.

Under a programme called Triad, the Defence Advanced Research Projects Agency (DARPA) is investigating three technologies: acquisition, precision pointing and tracking under code name Talon Gold; high-efficiency chemical lasers code-named Alpha; and mirror and beam control optics code-named Lode. Many other experiments are being conducted with the aim of producing a chemical laser with an output of 5 megawatts or more and accurate pointing and tracking optics using 4 meter, or greater diameter optics with the object of demonstrating an effective chemical laser in space by the mid-80s and for possible deployment by the end of this decade or early in the next. It is now a race against time to beat the Soviets in this new and decisive race for control of space.

Development of X-ray lasers

In addition to the activity in the field of chemical lasers by both the superpowers, there is intense activity in particle beam weapons development. The Lawrence Livermore Laboratory is engaged in a project called Dauphine in which a breakthrough has been achieved in the production of X-ray lasers. Recent tests of an X-ray laser at the Nevada underground nuclear test range in a vacuum chamber simulating conditions in space, used a small, compact X-ray laser device pumped from a small-yield nuclear detonation to produce a pulsed beam of very high intensity. The X-ray laser units are so small that a single bay on the Space Shuttle could carry into orbit a number sufficient to cope with a Soviet nuclear attack on the United States. There are still problems to be ironed out, but this type of ballistic missile defence shows great promise. It is just possible that the Soviets have developed such a system at their experimental site at Saryshagan.

Unlike chemical lasers, which destroy their targets with a beam of thermal energy, the X-ray laser produces shock or impulse kill of the target and the use of ablative materials as a means of hardening against chemical lasers will not provide protection against X-ray lasers deployed in battle stations in space. In the words of one Pentagon official, "the X-ray laser has the potential to tip the battle in favour of the defence for the first time in the history of nuclear warfare." There are many difficulties to be overcome before an effective chemical or X-ray laser BMD system can be deployed in space, but there is no doubt that it can be done by the end of this decade or early in the next. Many U.S. senators are not satisfied with the degree of priority or funding being devoted to this all-important aspect of strategic defence and have called for an accelerated programme. As Senator Wallop put it, "We have within our capability the possibility of developing weapons whose only real role in the world is to kill the things that kill people."

Charged and neutral particle beams

The Defence Advanced Research Projects Agency (DARPA) has been funded to develop and demonstrate beam propagation of both charged and neutral particle devices for deployment in space and in the atmosphere. The successful mission of the Columbia space shuttle has provided a much needed boost to developments of defensive weapons systems as opposed to offensive systems, and posed the question whether further development of offensive systems such as ground-based and submarine ballistic missile systems is necessary for the 1990s and beyond. The strategy of mutual assured destruction, which the Soviet Union has never subscribed to, is obsolete. Space is already a battleground whether we like it or not, and the Soviet Union has demonstrated its determination to operate in this theatre by deploying an effective antisatellite capability which the United States is only now attempting to emulate. BMD systems will inevitably follow.

Particle beams travel at nearly the speed of light, but charged particle beams are subject to interference from the earth's magnetic field and a good deal of experimentation will be necessary before an effective accelerator, pointing and tracking system can be designed. The Lawrence Livermore Laboratory is experimenting with charged particle beams and successful tests have been completed with electron beams as a preliminary to demonstrating the utility of a charged particle beam weapon within the atmosphere. A larger, more advanced accelerator is under development aimed at demonstrating beam propagation by about 1983. There is a long way to go before charged particle beams can be deployed in space or on the ground as weapons systems but their arrival in the antisatellite and anti-ballistic missile role is only a question of time.

Neutral beam experiments being conducted at Los Alamos are designed to demonstrate the superiority of such systems when deployed in space. Neutral particle beams avoid the effects of the earth's magnetic field and could be effective over long distances in the vacuum of space against ballistic missiles in the boost phase of their trajectories. Since particle beams operate at nearly the speed of light they are capable of handling large numbers of targets including those capable of manoeuvre in flight. The energy from a particle beam penetrates deep into the target, thereby killing even heavily shielded missiles using ablative materials against the effects of chemical lasers.

Unlike laser energy, which must remain on target for a sufficient time, albeit a short time, to cause thermal stress depending on range and target hardness, particle beam energy is capable of near instantaneous destruction of either the inside or the nuclear warheads within its nose cone or both.

But even with accelerated development, higher priority and increased funding it is unlikely that charged or neutral particle beam weapons for deployment in space or on the ground could be ready before the middle or end of the next decade. Nevertheless, the technology required for such weapons is already being developed, it is simply a question of time and money before they become available.

The winner controls the planet

The revolution in strategic defence is taking place now and represents a potential greater than the discovery of nuclear weapons. In time, the new weapons will provide strategic policy options that will relegate weapons of mass destruction to the dustbin of history. The whole concept of strategic defence is based on the principle of defending and protecting human beings and property rather than continually providing for their mass destruction. With high priority and sufficient funding such strategic defensive weapons could begin to become operational towards the end of this decade, increasing in effectiveness in the 1990s to the point where all ground-based and submarine-launched ballistic missiles would become highly vulnerable in the boost phase of their trajectories. Whatever the purists and faint-hearted in the West may think, the Soviet Union is relentlessly striving to acquire the capability to dominate space militarily. The United States has at last begun to take the threat seriously, for which Europe must be thankful, since only the superpowers are in this race and the one that wins will control this planet.