SECRET

MO 11/9/4
19th June 1984

Prime Minister

The main paper is comprehensive and interesting & repays a close read.

Do you:
(a) want the special briefing on space related activities intelligence (see para. 14)?
(b) discussion with Defence Secretary and FCS?

C.D.P 21/6.

PRIME MINISTER

ANTI-SATELLITE SYSTEMS AND ARMS CONTROL

In his letter of 24th February, Mr Coles said that before you reached a view on the proposal to explore with the Americans the case for constraints on anti-satellite systems (ASATs), you wished to consider a full paper on the military advantages and disadvantages to the West of the development of such systems and the implications / of activities in this field for arms control. We attach a joint FCO/MOD paper covering present and future satellite activities in space, particularly those of the US and the Soviet Union, ASAT developments, the military balance in space, and (briefly) the relationship between ASATs and the US strategic defence initiative and the longer term implications for Britain's deterrent.

2. The main points which emerge from the attached paper, which is deliberately comprehensive, are that:

a. East and West vary significantly in their dependence on different satellite types: the West places more reliance on surveillance and communications satellites, the Russians on tactical reconnaissance for real-time targetting especially in Naval operations;

b. the Soviet Union already has an orbital ASAT of limited reliability and capability against targets in low altitude orbit. The US is developing a Miniature Homing Vehicle (MHV) fired from an F-15 aircraft which is planned to be operational by 1987. When fully deployed by 1994, this should give a significantly more effective ASAT capability also against low altitude targets than the Soviet Union now possesses with its orbital ASAT;

c. each side is likely to be reluctant to accept that they could lose their strategic, operational and tactical eyes and ears at the outset of hostilities or even in a serious crisis. The development of ASATs is likely therefore to lead to pressure to develop anti-ASATs;

d. a comprehensive ban on ASATs or perhaps even partial limitations could have implications in the longer term for other space based military activity such as ballistic missile defence (BMD) under the strategic defence initiative, but the timescales for ASAT and SDI-related development are different.

3. US domestic political imperatives point to the need to achieve at least equality with the Russians in this area. There are also military arguments in favour of the US acquiring the capability to threaten those low altitude Soviet satellites capable of targetting Western naval assets. But, beyond this, the West's own dependence on communications and surveillance satellites is such that we have a good deal to lose from a free for all in space. An unconstrained "ASAT race" is bound to be costly and new resources would also be required for the complementary twist in the technical spiral of anti-ASAT systems. The money might well be better spent from a defence point of view.

4. These resource concerns apply with much more force to the possible longer term development of systems with both ASAT/BMD capabilities. While it is of obvious importance that the Americans should keep the closest watch on Soviet BMD research and as part of this need their own research capability, the development and production of these systems would add a new dimension to the arms race (in both defensive systems and the likely impact on offensive systems) without holding out any clear prospect of enhancing Western security. A fully effective BMD system would not of itself eliminate the threat of nuclear attack since air-breathing platforms (aircraft and cruise missiles) would remain; if they in turn could be neutralised, the West would be left to deal with Soviet conventional capabilities by

conventional means alone. The period during which such systems were being deployed would be likely to be a highly dangerous one, because of fears on each side of the other exploiting any limited window of opportunity. However, the overwhelming weight of scientific opinion even in the US believes that a totally leakproof system will never be achievable. The likely steady-state outcome would be one in which both the US and the USSR deployed at great expense systems which were not wholly effective against the other superpower's nuclear inventory, but which reduced rather than enhanced strategic stability, and which posed real problems for other nuclear powers such as the United Kingdom. While, therefore, we have to take into account the linkage in US eyes between limits on ASATs and their interest in BMD, it would appear that an arms control regime on ASATs which hampered the development of BMD on both sides would be in our national interests.

5. We remain, therefore, of the view that it would serve our interests if the US Administration could be persuaded to take a more positive approach towards ASATs controls. From the point of view of not starting down the road of an arms race in space, the ideal solution would be one in which ASATs were eliminated by the effective banning of both the orbital ASAT and the US MHV. The longer term arms control attractions of this course would need to be set against the military disadvantage of giving up the chance to target Soviet satellites with the capability to guide Soviet naval and air forces to attack NATO's sea lines of communication. There is, moreover, the problem of verification of such a ban which is addressed in the paper. For both military and verification reasons it is clear that - whatever its merits - this approach is not practical politics in relation to the United States.

6. We therefore address in paragraph 46 of the attachment other options. Our first preference would be an approach which combines options one to four, that is would place limits on low altitude ASATs which would prevent further development of US/Soviet competition in this area together with an indefinite ban on the testing, and therefore the development, of high altitude ASATs. If a limited low altitude ban were not achievable, we would still see significant advantage in a high altitude ban.

7. Events since proposals were first put to you suggest that opinion in the United States, both within the Administration and outside it, is moving towards the need for controls in this area falling short of a comprehensive ban on ASATs. The Americans have explored bilaterally with the Russians the possibility of discussions on ASAT control but the latter have so far rejected these, insisting on full-scale negotiations on the basis of their own proposals. The Russian approach of pressing for the banning of the use of force and of certain military deployments in outer space represents a sound propaganda position for them and one to which both we and the Americans need to be able to respond in a positive way. There is also a growing interest amongst our European partners in these issues, and the French have recently gone public with proposals of their own.

8. We therefore believe that we should now open up a dialogue with the Americans on the case for controls falling short of a comprehensive ban. We believe that we need no longer be concerned that the US will react adversely to a reasoned approach.

9. We therefore hope that you will endorse the recommendations in the attached paper. You may however wish to hold a further discussion with us about this, once you have read the paper and perhaps taken up the option of the special briefing to which paragraph 14 refers.

10. A copy of this minute and the attachment goes to Sir Robert Armstrong.

MH GH

19th June 1984

Reference 12 179
Labels

SUMMARY OF JOINT MOD/FCO PAPER ON ANTI-SATELLITE SYSTEMS AND ARMS CONTROL

ASAT SATELLITE SYSTEMS AND ARMS CONTROL

INTRODUCTION

1. This paper considers the desirability of establishing controls on anti-satellite (ASAT) systems. It expands on the arguments set out by the Foreign Secretary and Secretary of State for Defence in (1), that UK and Western interests could be well served by encouraging the US Administration to take a more positive attitude towards arms control proposals affecting these systems. It sets out in some detail the military advantages and disadvantages, as they are known, of the development of ASAT systems and the implication of activities in this field for arms control to meet the Prime Minister's remit (2). It also takes account of wider developments in space, including the US Strategic Defence Initiative (SDI), and touches on the possible implications for Trident.

2. Following an examination (3) last year of the Way Ahead for MOD in Space, the Chiefs of Staff commissioned a number of studies (4) on space capabilities and will consider the resulting Report in the coming autumn. ASAT issues will be only one of a range of subjects covered by these studies, which will also deal with means of reducing vulnerability of Allied ships to Soviet radar satellites, passive methods of denying information to other satellite systems, and the balance of advantage in disrupting satellite communications. Their results will provide a more detailed basis for future policy. However, as a result of work already done and reflected in this paper, the conclusions and recommendation in paras 47-50 below are believed to be valid. In particular, the proposed approach to the US on the policy issues of ASAT development and controls will provide a useful opportunity to gather further details relevant to the MOD studies.

(1) PS/Foreign Secretary's letter to PS/Prime Minister dated 20 February 1984 and attachment.
(2) PS/Prime Minister dated 24 February 1984
(3) Attachment to COS(Misc) 190/938 dated 14 July 1983
(4) COS 20th Meeting/83 Item 4

PRESENT AND FUTURE SATELLITE ACTIVITIES IN SPACE

3. CHARACTERISTICS OF ORBITS. In terms of military significance satellite orbits may be grouped into four broad classes, low, high, geostationary and highly elliptical. The lowest practical circular orbital height is about 100 km (though at very low altitudes orbits are shortened by atmospheric friction) and the generally accepted upper limit of low orbits is around 2,000-3,000 km. Low orbits are used primarily for tasks which require the best possible resolution or angular discrimination from a sensor system. They are thus associated with satellites providing surveillance, reconnaissance, meteorological and oceanographic information. In the large tract of space between low and high orbit occur the Van Allen radiation belts which inhibit placement of satellites. The lower limit of high earth orbit is accepted as around 20,000 km with the upper limit at the transition to geostationary orbit at 36,000 km. High orbits have relatively few exclusively military applications. Their main use is in the coming generation of navigation systems which have dual military and civil functions. Geostationary orbits, in which the satellite remains stationary over a fixed equatorial point, are particularly well suited to communications requirements and certain forms of surveillance. Highly elliptical orbits are employed for tasks not readily achieveable from circular orbit, for example launch detection, abnormally low photo reconnaissance and communications at high latitudes. Elliptical orbits result in the satellite alternately dwelling over one hemisphere for long periods at high altitude, and skimming fast and low over the other hemisphere. For the purposes of this paper low orbit satellites are described as "low altitude" and all others as "high altitude".

SOVIET SATELLITE CAPABILITY

4. GENERAL. The large investment in the Soviet space programme, the number of satellites launched each year and the wide ranging scope of their functions all indicate that space is important to them, and this is supported by their writings. The scale of investment in space systems by the USSR is thought to exceed that of the rest of the world combined and has risen very steeply since

e 1970s. Some 80% of all their satellite launches have either specifically military or dual military and civilian applications.

5. MILITARY SATELLITE TYPES. Current military functions of Soviet satellites include surveillance, reconnaissance and intelligence gathering by photography (PHOTOSAT), Electronic Intelligence (ELINT, and, over the oceans, radar (RORSAT). The ELINT Ocean Reconnaissance Satellite (EORSAT) and RORSAT also have a near-real-time anti-ship targeting capability for suitably equipped missile-firing ships and submarines. Satellites are also used widely for communications (COMSAT), meteorology (METSAT) and navigation (NAVSAT). Early warning of US ICBM launch is provided by launch detection satellites (LDS), though they currently have no capability against submarine launched ballistic missiles (SLBM). Geodetic satellites provide detailed information for strategic missile guidance, and radar calibration satellites (RADSATS) provide data for testing their ABM system. Figure 1 shows the recent rates and types of Soviet Satellite launches and makes clear that almost all function at low altitude.

6. MILITARY VALUE. The Soviets obtain earlier warning of ICBM launches from their Launch Detection Satellites (LDS) than is obtainable from any ground based radar system. The LDS system is thus of major strategic importance to them even though at present it cannot detect SLBM launches. For tactical use in war at a level below strategic nuclear exchange the low orbiting ELINT, EORSAT and RORSAT are probably the most valuable Soviet satellite systems, although their capabilities can be degraded by counter-measures. Their loss would significantly degrade Soviet intelligence gathering and surveillance capability, and in the cases of EORSAT and RORSAT, remove an important element in their anti-ship targeting system. Nevertheless, the loss of these three systems would not have a critical impact on their combat capability especially on land and in the air. The PHOTOSATs are probably of almost equal importance in peacetime, but of much less importance in war, unless the conflict is protracted, owing to the relatively long delays between data collection and return to the USSR (typically 1-14 days) with the current systems. It is more difficult to assess the importance of COMSATs, METSATs, NAVSATs. In virtually all cases there are alternative methods available which, if less satisfactory,

y at least be adequate for most operational purposes.

7. FUTURE TRENDS. Significant developments in the Soviet space programme are expected over the next few years in line with the increase in Soviet resources devoted to space. Some new types of spacecraft are already in development, including a near-real-time PHOTOSAT. Space based R & D is also aimed at producing an improved radar satellite, and probably a new LDS system with a capability against SLBMs. We believe that experiments in Salyut 7 are aimed at detecting submerged submarines, though there is no indication of how successful they have been so far. Finally, the new 200 tonne payload heavy lift launch vehicle, the Space Plane, and the reusable orbiter, similar to the US Space Shuttle, offer a wide range of new possibilities, particularly in the area of space weaponry. It is too early to say what performance these new systems might achieve, or their importance to the USSR. However, it is clear that, when they mature, some of them could have a major impact on warfare in the future.

SOVIET ASAT CAPABILITY

8. THE ORBITAL ASAT. Current Soviet anti-satellite capability is provided by the orbital ASAT. It must be launched at a precise time and on an exact trajectory, so as to climb to intercept the target within two orbits. It is then exploded in close proximity to destroy or disable the target. Nine of the 15 tests of the operational variant, which uses a radar tracking and homing system, have been successful. It has been regarded as an operational system since 1971, although it has not been tested since June 1982. While the system is unique it has very serious limitations. It can only be used against a very limited range of targets in low altitude orbit. It has no capability against satellites in highly ellitical orbit, even at their lowest height, because of their very high speed at that point. It has not been tested against a target able to manoeuvre away from it and other counter measures may also be possible. Further weaknesses concern the lengthy response time and the limited availability of launch pads and launch vehicles: the launch pad can at present only be used four to six times in a 24 hour period and in wartime the orbital ASAT would have to compete with other Soviet satellite priorities. There is no evidence of any intention to overcome

present guidance and tracking limitations by using a nuclear warhead (which would contravene the 1967 Outer Space Treaty), or of attaining a capability against high or geostationary orbiting targets by using a bigger booster; it is not believed that the latter course would be cost-effective or sufficiently timely, and the US therefore do not assess the Russians as likely to pursue it.

9. OTHER CURRENT ASAT SYSTEMS. In addition to the orbital ASAT, Soviet anti-ballistic missiles could perhaps be used against satellites, but this is assessed to be unlikely. In the absence of prior testing to develop precision interception, nuclear warheads would have to be used and these would have unpredictable Electro Magnetic Pulse (EMP) effects on the Soviets' own satellites. Using ground based lasers, which have inherent failings in any space-related operation because they are affected by atmospheric attenuation and turbulence, the Soviets have probably had the capability since the early 1970s, given the right conditions, to degrade the electro-optic sensors of satellites. There is no evidence that tests of such a system in a weapon role have taken place.

10. ELECTRONIC COUNTER MEASURES (ECM). Satellites in high and geostationary orbits are not currently vulnerable to physical attack but their operation can be adversely affected by electronic warfare. There is no direct evidence of Soviet efforts though we would not expect to detect activity in this field. Satellite links are potentially vulnerable to jamming particularly at Ultra High Frequency (UHF) since they can be readily intercepted over a wide area of the earth. Jamming can be directed at the satellite (up-link) or the ground terminals (down-link). Satellites could also be affected by interception and deception. We know of no Soviet attempts at jamming but they put considerable emphasis upon Electronic Warfare in all other fields and have the capability to produce adequate radiated power in UHF and Super High Frequency (SHF) bands from land or ship based transmitters. Space based jammers which could readily be disguised as COMSATS are not likely before 2000. Airborne jammers could be developed, although this would be an expensive solution. On the other hand, protective measures against ECM are possible. Ground stations can be mobile to avoid down-link jamming, codes can mimimise dangers of intercept and

ception, and various signal techniques can reduce the effect of up-link jamming. Moving to the Extra High Frequency (EHF) band (eg the new US MILSTAR system) also reduces the risks of ECM. While the Soviets could develop suitable jamming equipment by the mid 1990s, counter measures are also likely to advance in sophistication.

11. FUTURE ASAT CAPABILITIES. There is no hard evidence of future Soviet plans with regard to anti-satellite systems, particularly those based in space. However, the new heavy lift launch vehicles currently under development will provide the Soviets with the means of deploying much larger and heavier satellites. When they become operational in the late 1980s, these could be used for weapon purposes perhaps to threaten satellites in higher orbits. In addition the Soviets have a vigorous R & D programme in technologies relevant to attacking objects in space, in particular high power lasers, particle beams and pointing and tracking systems, both space and ground based. Development of ASAT lasers capable of causing structural damage is however unlikely before 2005; rudimentary particle beam weapons are likely to take even longer. At the same time protective measures against ASATs, on which work is already in progress, will be further developed. Such measures as manoeuvring capability, hardening and shielding, orbiting spares and "shoot-back" ability, will give future satellite systems a degree of defensive capability, although at present no single measure is thought likely to be effective against all possible threats and all degrade satellites' primary mission to some extent.

WESTERN SATELLITE CAPABILITY

12. GENERAL. The Western Allies space capability is largely American. The only significant systems outside US hands are the UK Skynet communications satellites and those that are owned by France and NATO. The European Space Agency METSAT also provides information of military value but its availability during tension or war is doubtful. Similarly, US civil remote sensing satellites are of some military significance, but would probably be switched off during war.

13. Our detailed knowledge of current US military space systems

[redacted] scant and confined in the main to those systems whose output is shared with us. However that knowledge is controlled very closely by the appropriate US authorities. American reticence is partly due to the sensitivity of the technology and systems involved, and in lesser part to what is seen by some in Washington as premature enthusiasm about arms control in outer space on the part of some European Allies.

14. INTELLIGENCE COLLECTION. The USA routinely carries out photo-reconnaissance from low earth orbit. The USA has the advantage over the USSR in terms of resolution and timeliness of film returns. It can be assumed that the Americans have ELINT systems which are probably more advanced technologically than their Soviet equivalents. Full details of space related activities intelligence cannot be given within this paper's classification. A further restricted briefing on this area can be arranged if required, but the existence of additional systems affects neither the overall argument of this paper nor the conclusions and recommendation at paras 47-50.

15. COMMUNICATIONS. Communication satellites are playing an ever increasing role and NATO depends on them heavily. At present there are several systems of American communications satellites in geostationary orbit. They are sophisticated and very resistant to jamming but offer little excess capacity over the likely wartime requirement. These communication links would be prime targets in war time and if destroyed or incapacitated early in any future crisis would seriously degrade NATO's ability to coordinate its actions. In consequence a major improvement programme is underway to provide redundancy, hardening and greater survivability. The present US Defence Satellite Communication System (DSCS) with 7 satellites (4 located over the Atlantic, Indian Ocean, West Pacific and East Pacific, 2 in-orbit spares and 1 unserviceable) is to be upgraded by the DSCS III series providing SHF facilities, the first of which was launched in October 1982. UHF channels for control of strategic forces under the AFSATCOM programme are being provided on Satellite Data Systems (SDS) satellites in polar elliptical orbits with spare transponders carried on FLEETSATCOM (geostationary satellites providing naval strategic communications systems). EHF facilities, more resistant to jamming, are to be provided on FLEETSATCOM until the new MILSTAR communication satellites are ready.

16. SURVEILLANCE AND DETECTION. The US have LDS in geostationary orbit using infra red sensors with the capability to detect both land and sea launched missiles; the equivalent Soviet System has no capability against SLBMs. These satellites are also used to provide data relevant to arms control verification. New satellites are planned for the mid to late 80's with improved performance and survivability. Vulnerability of ground based data processing stations will be reduced with six mobile ground terminals.

17. METEOROLOGY AND NAVIGATION. There are three types of US meteorological satellite. Both the TIROS-N type of low earth polar orbiting satellite and the GOES geostationary satellite are freely accessible civil systems but could be switched off in war. The Defence Meteorological Satellite Programme is a USAF low orbiting system to which the RN and RAF have access in both peace and war. The current US navigation system employs Transit satellites and gives an accuracy of better than 200 metres. These satellites fly in a low earth orbit but the system is being superseded by the NAVSTAR Global Positioning System (GPS). NAVSTAR will provide a network of 18 satellites in high orbit to give highly accurate positions, velocity and time information to any user on or near Earth. Deployment of this worldwide 3 dimensional capability is expected to be completed by 1988. NAVSTAR is also planned to incorporate improved nuclear detonation detection sensors (IONDS) for accurate plotting of any nuclear explosion.

18. OTHER USES. There is no evidence that the US has a real-time satellite targeting capability against shipping comparable to the Soviet EORSAT and RORSAT. (The USN has chosen to rely so far on systems such as carrier based aircraft for this purpose.) Nor have the Americans any requirement for radar calibration satellites since they have not built an ABM system.

19. THE SHUTTLE. The use of the shuttle has given the US a clear lead and advantage in the flexible deployment of spacecraft even though they plan to procure only 4 shuttles which, with their long preparation times for launch, will constrain US satellite launching flexibility. The Soviet Union sees the shuttle as a major threat as they claim that it could be used to capture its satellites.

This is unlikely because satellites could easily be booby trapped with explosives. Other ASAT activities are perhaps more feasable, but the Americans deny that they would risk such valuable craft in this role. It is known that the US intends to carry out experiments in space using the shuttle as a test platform. Amongst those with a military role is the testing of lasers for communication purposes, and another experiment concerned with accurate pointing and tracking (TALON GOLD). Others have involved various optical and non optical sensors. Of 72 shuttle flights planned by 1987 some 27 (35 per cent) are reported to involve Department of Defence payloads.

20. ASATs. The US has no ASAT system currently deployed. The Miniature Homing Vehicle (MHV) currently under development is designed for two purposes; to place at risk certain Soviet satellites in low orbit; and to deter the Russians from using their own systems against US satellites. It consists of a 30 cm, 16 kilogramme device which tracks the target's IR emanations with its own sensors. Its on board computer guides it to collide with and destroy its target by kinetic energy rather than using a conventional explosive warhead. It attains its very high closing speed both by its own rocket motors and the use of a SRAM (Short Range Attack Missile) as a booster. The MHV is fired from an F15 fighter and is likely to be both accurate and flexible, with a maximum altitude of some 700 kms. Its capability against satellites in highly ellitical orbit is not yet known.

21. MHV had its first successful test in January 1984; Initial Operational Capability (IOC) is planned for 1987. By 1994 the Americans plan 112 MHVs to be available for firing from 40 specially modified F15s. These will be split between air bases on the US East and West coasts so as to allow greater operational flexibility, including the option of two attacks on a transiting satellite in quick succession. If the US chose to change their current plans by modifying air bases elsewhere in the world, or to adapt the system to operate with carrier based aircraft, their options would be still greater but costs would rise. Since they predict only some 46 key Soviet targets, all in low orbit, (EORSATs,RORSATs, next generation ELINT, future real-time PHOTOSATs, the military SALYUT manned space station and HI RES and MED RES PHOTOSATs of which

would be resident in orbit in peacetime and 26 would be replacement satellites launched in crisis or war) the Americans should achieve a significantly more effective ASAT capability than the Soviets now possess with their orbital ASAT. The US has no plans to modify the MHV to reach out to high or geostationary orbits, as a result of their present assessment of Soviet space capability.

22. FUTURE ASAT CAPABILITIES. As part of the Strategic Defence Initiative (SDI) discussed at paras 29 & 30 below, the US are researching into the feasibility of advanced Directed Energy Weapon (DEW) systems. This work includes 3 projects known as "The Triad": a chemical laser ('ALPHA'), a Large Optics Demonstration Project and an Acquisition Testing and Pointing Experiment ('TALON GOLD'). These or other developments may in the long term also give the US the ability to achieve the physical destruction of satellites in high or geostationary orbit.

23. ELECTRONIC COUNTER MEASURES. Little is known of US capability in this particularly sensitive area, but it can be assumed that they are devoting considerable efforts to electronic warfare both in the defensive and offensive modes.

THE MILITARY BALANCE IN SPACE

24. GENERAL. Any assessment of the broader military advantage in future ASAT controls must take account of:

a. the respective deployment of, and dependence upon, satellites by both sides;

b. the financial implications; and

c. the wider strategic factors governing the credibility and stability of deterrence.

25. DIFFERENTIAL SATELLITE DEPENDENCES. East and West vary significantly in their dependency on different satellite types. The data in the preceding section indicate that the West is more reliant than the East on Surveillance and Communications satellites. The Russians, on the other hand, rely more on satellites in the tactical reconnaissance real time targeting role, especially in

val operations, where their anti shipping capability is a serious threat to NATO's Atlantic reinforcement route. Since the Soviet armed forces operate largely on or close to the European land mass they could use currently redundant land lines for command and control more easily than the Western forces who are widely dispersed over the globe and therefore depend more on the survival of geostationary COMSAT systems. Moreover NATO's posture as a defensive alliance means that, strategically it must depend more on surveillance (especially by satellites) to cancel out the advantage which an attacker would otherwise gain by surprise. Given that the impending US acquisition of the MHV may spur the Soviets to regain their present ASAT lead, there are thus good arguments for considering carefully whether it might be in the West's advantage to try to secure some protection for satellites rather than allowing a total free for all in space.

26. FINANCIAL IMPLICATIONS. The assessment of resources devoted to space does not lead to any firm conclusion on overall advantage. Although US cost estimates suggest that the Soviets spend more than the rest of the world put together, they do not necessarily achieve US levels of value for money. Their system of frequent launches is probably not economically optimal and their very expensive manned research programme seems to achieve little militarily that unmanned US satellites cannot. Although some protection of satellites can be achieved against ASATs (by means of manoeuvrability, redundancy, hardening or a "shoot back" capability) all these survivability measures tend to degrade the satellites' primary mission and could, in turn, be countered by more sophisticated ASAT devices. Protection for satellites by means of acceptable arms control arrangements must therefore be less expensive than such a process. The US currently plan expenditure of $143 million in FY 1985 on the MHV, which is not yet in full production. Any move forward from the present relatively crude systems, and particularly into joint ASAT/Ballistic Missile Defence (BMD) system, would involve massive increase in resources, with consequent impact on defence spending in other areas.

27. IMPLICATIONS FOR STRATEGIC EQUILIBRIUM. At a time of rising tension, strategic instability could be much increased by the development of effective ASAT capabilities, at both high and low orbits, by either side. A proven capability on one side to destroy the other's satellites would give rise to a great temptation to use it, especially if neither side could be confident that the

ther would resist temptation. The implications will worsen as satellites come to play an increasingly vital role in the future. A situation in which either the US or USSR could lose their strategic operational and tactical eyes and ears at the outset of hostilities, or even of a serious crisis, would not be acceptable to either. The development of ASATs would be likely therefore to lead (as it has done with other weapons systems) to the development of anti-ASATs and other means of satellite protection which would be open to the same objections, on grounds of cost and destabilisation, as the present generation.

28. OVERALL ADVANTAGE. It is difficult to conclude that either side has a clear overall advantage. The Soviets carry out many more satellite launches, but their satellites tend to be much simpler, less reliable, and shorter lived than those of the US and can carry out fewer tasks. They thus need large numbers of reconnaisance satellites to provide continuous coverage. On the other hand, the scarcity of Western satellites and launch capability means that the US probably enjoys less back up or redundancy, and could not achieve the same "surge capability" in their launch rate in time of war or crisis. In general US capability seems as least as good if not better than the Soviets' in all areas for which there is detailed information. Deployment of the MHV will more than compensate for the only obvious US inferiority: the ability to threaten satellites in low orbit. Figure 2 sets out in tabular form available comparative data on the US and Soviet programmes. In sum, the US maintain far fewer satellites than the Russians in low orbit, but each has a more important role to play than its Soviet equivalent. Those US satellites in high orbit are also more essential to the US defence capability than similar Soviet systems are to Moscow.

ASATs, DABM AND THE UK DETERRENT

29. US STRATEGIC DEFENCE INITIATIVE (SDI). A comprehensive ban on ASATs, and perhaps even partial limitations could have implications in the longer term for other space based military activity such as the system of Defence against Ballistic Missiles (DABM) proposed by President Reagan in his 'Star Wars' speech of March 1983. The SDI, as it is officially known, involves research into the feasibility of defence solely against BMs, based on multiple layers. An essential

[redacted]ole is envisaged for orbiting ABM satellites, probably employing DEWs to destroy enemy missiles, starting in their boost phase before their MIRVed warheads have separated off. If such systems could be successfully developed - and that prospect is far from clear - they would possess an intrinsic ASAT capability. Thus, in the longer term, the acceptance at this stage of limits on ASATs by the US could constrain the eventual development of elements of the SDI option.

30. On the other hand, it should be recognised that the time-scales for ASAT and DABM development are somewhat different. The former are now in the process of development and deployment; decisions by either the US or the Soviet Union to move beyond the research stage on DABMs are unlikely to be taken in this decade. DABMs options may not be ripe for full-scale development until the next century. If in the near future an agreement on ASAT constraints were reached which at a later stage proved to stand in the way of a decision to develop DABM potential, then it would be open to either side at that time to require appropriate changes in an ASAT agreement, in order to allow further DABM work to continue. For the latter to happen, changes would in any case be necessary to the 1972 ABM Treaty; amendments to any ASAT agreement would have to be made in the same context.

31. From a series of presentations that the US gave in early 1984 to its NATO allies on the SDI, it is clear that there are still widespread and significant doubts about the technical feasibility and vulnerability to counter measures of the DABM option, about its affordability and the impact it would have on other defence spending, and about the possibility of deploying an operational system within the next 20 years at the earliest. The politico-strategic implications of such a concept, which have already given rise to considerable concern on the part of the Allies, have also yet to be discussed in any detail with the Americans.

32. TRIDENT. It does however seem likely that, if both the US and the USSR were to move decisively towards the acquisition of a DABM system, there could, eventually, be an impact on the deterrent value of the UK's Trident force. Whether or not it proves

possible to create a DABM system which is close to leakproof against a strategic attack by another superpower, the capability deployed in pursuit of that goal would be a greater threat to the numerically smaller strategic forces of a secondary nuclear power such as the UK would remain even with Trident. Unless effective countermeasures can be developed, the long term credibility of the UK's independent nuclear deterrent might therefore eventually be threatened, though not until well beyond the turn of the next century, by deployment of a Soviet DABM system.

POSSIBILITIES FOR ARMS CONTROL

BACKGROUND FACTORS

33. MILITARY FACTORS. In any decisions on British policy towards arms control in space, the balance of military advantage discussed at paras 24 to 28 above must be the paramount factor. On the basis of this assessment, two points clearly emerge:

(a) It is a political and military imperative for the US at least to achieve parity in ASAT capability with the Soviet Union, by completing the current development programme of its own ASAT system, due to enter operational service by 1987; and,

(b) that some elements of controls on ASAT systems deserve serious study by the Alliance.

A total ban would be unacceptable to the US and would, moreover, remove the Western capability to enhance deterrence by placing at risk certain Soviet satellites at low-altitude which threaten naval assets. In considering further exchanges with the US Administration about arms control possibilities, it will therefore be appropriate to focus largely on the prospects for controls on high altitude ASATs, which neither side has yet shown any evidence of wishing to test or deploy.

. OTHER FACTORS. In addition to the military factors broader considerations must be weighed in any judgement of the overall balance of advantage in arms control in this area. Two points are particularly relevant:

a. Timing. In the case of other military systems, a prime obstacle to arms control agreements has often been the current imbalances between the super-powers, and the reluctance of either to accept reductions in established arsenals, or to make concessions in areas where one has a significant lead over the other. However, as has been shown, development of ASAT technology is still at a fairly primitive stage. And provided

the US present programme proceeds to the deployment stage, a rough similiarity in capabilities should exist in that neither extends beyond low orbit. On the other hand once high-altitude ASATs begin to be tested, protection for satellites by any form of verifiable agreement will become very much harder to achieve. Now, therefore, should be the moment when it could be in the self-interest of both super-powers to seek an agreement which could stabilise the competition and enhance their security.

b. Domestic Political Factors. In Parliamentary and other public statements the Government has publicly expressed support for measures to prevent an arms race in outer space. In addition, there is evidence of growing public interest in military activities in space. Parliament and the public might not understand if the Government seemed unwilling to explore possibilities for constraints which already have won the support of many of our Allies. Conversely, the uninhibited development of military capabilities in space risks adding to the distorted but not uncommon perception that governments are unable to keep a firm grip on the arms race. The impact of these could in turn influence the degree of public support for the government's defence policy and programmes, notably in the case of TRIDENT.

35. INTERNATIONAL AGREEMENTS AND PROPOSALS. There are no international conventions banning the development or deployment of ASATs. Current treaties prohibit: interference with satellites monitoring compliance with the SALT agreement; the testing or

deployment of nuclear weapons in outer space; and the development, testing or deployment of anti-ballistic missiles (ABM) systems in space. In 1983 the Soviet Union tabled a draft Treaty at the UN, proposing a ban on the use of force in outer space, the deployment of weapons there, and the abolition of current or projected ASAT capabilities; this Treaty has now been formally put to the Conference on Disarmament (CD) in Geneva for negotiation. Separately they have proposed a moratorium on ASAT activities. Of our Allies, all of whom apart from the US are on record as favouring controls on anti-satellite systems, the French, Germans, Italians, Dutch and Canadians have been active in arguing for various types of restraints.

36. US/UK RELATIONSHIP. The UK is largely dependent on the US for space derived intelligence and a wide range of technical support. If it were felt by the Americans that the UK were taking a hostile line to US interests in space, this information flow could be jeopardised. The resultant impact on our military capability would be serious. But the probability of such a UK/US rift could be minimised by careful handling of any approach to the Americans.

37. IMPLICATIONS FOR THE ALLIANCE. On the other hand, space issues and their relevance to arms control look set to cause considerable debate within the Alliance in coming years, irrespective of the position we ourselves may take. Other European countries have already been critical of US intentions and may become more so as public concern increases. Some US officials have shown signs of resentment at this. We may have a role to play in keeping those strains under control and steering the Alliance towards more constructive and cohesive positions.

38. US ADMINISTRATION VIEWS. On 2 April, President Reagan sent to Congress his required comprehensive Report on US policy towards ASAT controls. In summary, this stated that no such controls had yet been identified which would serve Western interests, mainly because of inherent verification problems, and the need to counter certain Soviet threats against Western forces. For that reason, the President ruled out near-term negotiations with the Soviet Union on such controls, but confirmed that the US would be ready to continue examination at the CD in Geneva of current space issues. The President also made it clear that the US would continue to study

Space arms control "in search of selected limits on specific types of space systems of activities in space". His Report concluded: "The door is not closed to effective ASAT arms control measures. The US will consider verifiable and equitable arms control measures that would ban or otherwise limit testing and deployment of specific weapon systems, should those measures be compatible with US national security." The Report focusses largely on the possibilities of a comprehensive ASAT ban and lays heavy emphasis on the verification problems in any such arrangement. It notes that "test bans for a more limited class of ASAT systems may be verifiable and these are being studied to determine if they are in our national interest." There is no direct evidence, according to the Report, of a Soviet programme for high-altitude ASATs, and no US plans to develop a high-altitude capability in their present ASAT programme.

US CONCERNS OVER ASAT ARMS CONTROL

39. US concerns over verification problems in any limits on ASATs, and worries about the continuing need to hold at risk certain Soviet threats to Western forces, have been evident for some time. American scepticism about control of ASATs needs to be carefully considered especially in view of their much greater familiarity with the technical problems involved. In addition, although it is not directly addressed in the President's report we believe there is apprehension among US officials about the possible consequences of arms control limitations on ASATs for the later development and deployment of space weapon systems required for the SDI. The following points, however, should also be borne in mind in considering these three issues. Firstly their concerns about verifiability are based on two factors: their belief that Soviet undertakings to eliminate their present ASAT capability could not be adequately verified; and the suggestion, mainly from Pentagon officials, that the Russians could develop without US detection, a future system capable of destroying US satellites, which they would then be able to produce and deploy rapidly, giving them a strategic lead through an arms control break out. The first concern must be treated particularly seriously, and is largely responsible for the present assessment that any controls on ASATs should for the moment be limited to high orbit systems. The US-Soviet negotiations of 1978-9 on an ASAT agreement indicated the difficulties of drawing

p a verification regime acceptable to both the Russians and the Americans which could guarantee the elimination of present capabilities.

40. VERIFICATION OF NEW SYSTEMS. However, while verifying the elimination or reduction of already deployed systems is extremely difficult, testing of new systems should be verifiable with adequate confidence. This assessment is shared by the US. New Soviet deployments without prior full system testing are inherently improbable, though not technically impossible. Annex A indicates the range of problems involved in verifying controls on space systems. (It makes clear that verification would be harder in the case of ground based laser systems, but the inherent weaknesses of such systems against space targets have already been noted in para 9). In this complex field there are differences of expert opinion, but we believe that verification problems may not be wholly insuperable, especially if the distinction between high and low orbiting systems can be preserved. Survivability measures could in any case be taken as an insurance against Soviet bad faith in the observance of any agreement. There is no doubt, however, of our need to secure more information on the technical issues involved.

41. THE RISKS OF BREAK OUT. There remains the risk, which some Americans have identified, that the Soviets might be able to evade verifiction measures by separately testing out individual sub-systems for an ASAT. This could enable them to assemble the tested components into a complete ASAT system which they would then have the capability of testing overall by openly breaking out of the arms control regime at any time and proceding to deployment. But although this would give a certain technical lead, it is unlikely that it would provide an immediately significant military advantage, since at the moment of open break out the complete system would not have been operationally tested and time would probably have to elapse before it could be proven and produced in numbers. An ASAT arms control break out in wartime would therefore be unlikely to influence that particular conflict, and a peace time break out would warn the Americans that Soviet desire to achieve dominance in space was now stronger than their concern to observe Treaty obligations. As para 6 of Annex A suggests, the intensity of the US reaction in such circumstances is likely to be so great as to cancel out any advantage which the Soviets might hope eventually to gain by breaking out of an ASAT agreement.

42. LOW ORBIT SATELLITES; PROBLEM OF THE SDI. Secondly the continuing need to hold at risk Soviet low-altitude targeting satellites is recognised, but again is not relevant to consideration of controls on high-altitude ASAT systems. Thirdly the problems of the compatibility of the US SDI with ASAT constraints must be taken seriously. There would be a technical link between systems (of a more advanced nature than those at present in development) designed to destroy satellites and those with a role of defence against ballistic missile (DABM). Research and development of DABM related systems such as TALON GOLD might be difficult to distinguish from ASAT work. A sophisticated form of DABM would certainly be ASAT-capable, and, with the passage of time, the reverse could also be true. However, as noted above, long-term possibilities need not inhibit addressing the present ASAT problem now, if it should appear feasible to limit ASATs effectively in the Western interest for the coming decade. On the contrary, for the purposes of policy-making and in further exchanges with the Americans, it seems desirable to retain a distinction between the two issues.

43. OTHER US VIEWS. There is growing interest elsewhere in Washington in the possibilities of controlling ASATs and other space weapons. Congress has only authorised further funding for ASAT development in return for the detailed Report by the President on arms control prospects. Full ASAT testing will not be allowed to proceed until Congress has received a further account of the Administration's intentions on arms control. A joint Resolution of Congress, already passed unanimously by the Senate Foreign Relations Committee has called for the President to negotiate a treaty banning space weapons. Democratic candidates for President all strongly favour arms control in space, and specifically limits on ASATs. On the other hand there is also a vociferous space lobby, sometimes known as the "High Frontier" group, and mainly representing military and industrial interests, who oppose any restriction on US activity in space. They argue that it is there that the US can maximise its comparative advantage in high technology over the Soviet Union, and that space based activities can help revitalise the American economy.

44. OVERALL US POSITION. In recent months, and partly as a result of pressures from Congress and some Allies, the Administration's approach towards arms control has become more sympathetic. This change is reflected in the President's Report to Congress, and was a striking feature of the US presentation to NATO on 11 April of a comprehensive review of ASAT issues. They now acknowledge the potential benefits of certain measures of arms control, in contrast to the dismissive attitude which was prevalent for the past three years. While continuing to resist comprehensive restraints on the current generation of low orbit ASATs, for the military reasons described above, the US are now more firmly committed to consider specific controls on particular systems and especially those with a high altitude capability. The US will consider verifiable and equitable arms control measures that would ban or otherwise limit testing and deployment of specific weapon systems, should these measures be compatible with US national security." This new approach by the Americans is reflected in private contacts which we understand they have initiated with the Russians on the possibility of formal discussions about controls on ASATs and perhaps other aspects of military developments in space. It is still unclear whether such discussions will get off the ground, although both sides now appear disposed to pursue them. In these circumstances, a British approach in Washington along the lines recommended in para 50 below seems now much less likely to elicit negative US reaction.

45. ASSUMPTIONS. Policy options for HMG range from favouring the wholly unconstrained development of anti-satellite capabilities (at both low and high altitudes) to stringent controls on all types of systems and a series of declaratory measures. For reasons explored in para 32 above the former option does not appear likely to serve our national interests. In considering possible new arms control measures for ASATs, it is assumed that a total ban on all such systems can be discarded as it is both unrealistic (because of explicit US objections) and militarily undesirable (because of the need to retain a counter to certain Soviet low altitude systems). It is also assumed that Western interests will be served by US acquisition of a low-altitude ASAT system at least equal in capability to that already deployed operationally by the Soviet Union.

16. ALTERNATIVES. A list of possible new measures is attached at Annex B. Of these, the first four would be of real military and political significance; the remaining five would touch only marginally on the development of ASAT capabilities on both sides.

a. Option 1

An indefinite ban on testing, and therefore development of high-altitude ASATs would be a significant corner-stone for any future regime of arms control in outer space. It is believed to be one of the options currently under study by the US.

b. Options 2 and 3

Limits on low-altitude ASATs would prevent further development of US-Soviet competition in this area.

For the reasons given in paragraph 33 of the paper it is far from desirable to freeze the Americans in a position of inferiority by abandoning all work on low altitude systems. But once parity has been achieved, there could be considerable advantage in considering a block of further developments. Recent contacts in Washington indicate that US officials are thinking along similar lines.

c. Option 4

A regime of specific confidence building measures, to which US officials are already attracted, could be a useful adjunct to concrete constraints. But in itself it would not greatly enhance UK or Western security. In addition, sole reliance on such measures, especially of a declaratory nature, would be inconsistent with the Western requirement, well-established in other areas of arms control, for balanced and verifiable agreement with real military significance. In a field as important as the military development of outer space, it is arguable that we should not settle for what by comparison would be seen as less.

CONCLUSIONS

47. The available intelligence data and technological development indicate the increasing military importance of Space. The two Superpowers have large civil and military space programmes, with the Soviet Union devoting an apparently greater level of resources than the US.

48. In terms of military advantage, it is clearly in the Western interests for the US ASAT capability to catch up with that of the USSR. In terms of high orbit capability, however, there appears to be a good case for seeking further concrete constraints in the interests of Western security, of maintaining credible and stable deterrence, and of preventing further cost spirals for space weaponery.

49. In the long term an effective ASAT ban is likely to be incompatible with the DABM system envisaged in the US SDI. However there are many questions about the feasibility and desirability of the SDI. In any case the deployment of a DABM system is likely to be much further off than the need for a decision on control of ASATs.

RECOMMENDATION

50. Whilst being careful not to jeopardise the flow of technical data and space derived intelligence, it will serve UK interests to engage the US Administration in a substantive dialogue on ASAT issues, in order to;

a. Elicit from them more information (especially about their verification concerns) than they have so far made available;

b. Outline to them our reasons for favouring a more positive approach towards controls;

c. Explore further with them the basis of the President's remarks as highlighted in para 38 and the possible measures summarised at Annex B.

FIGURE 1

The functions of Soviet spacecraft launched in 1982 and 1983

Type	Numbers Launched 1982	1983	Orbit Type Altitude	Shape
Reconnaissance				
- Photographic	36	37	L	E,C
- ELINT	7	5	L	C
- EORSAT (1)	3	2	L	C
- RORSAT (2)	4	0	L	C
Communications	33	32	L,S,G	C,E,C
Navigation	10	13	L,H	C
ASAT				
- weapon	1	0	L	E
- target	1	0	L	E,C
Military Support				
- Radar Calibration	5	8	L	E,C
- Meterology Calibration	2	2	L	C
- ICBM Launch Detection	5	3	S	E
- Geodesy	1	1	L	C
Man-Related	9	7	L	C
Science, Interplanetary	0	6	all	all

Notes:

1. ELINT ocean Reconnaissance Satellite
2. Radar ocean Reconnaissance Satellite

C = near-circular
E = elliptical
G = geostationary : 36,000km
H = high : 20000km
L = low : below 2000km
S = semi-synchronous, highly elliptical

Fig - 1

SECRET UK EYES A

FIGURE 2

COMPARISON OF US AND SOVIET MILITARY SPACE CAPABILITIES

	SOVIET			US		
TYPE	NAMES	NUMBER TYPICALLY IN ORBIT IN PEACETIME	CAPABILITIES	NAMES	NUMBER TYPICALLY IN ORBIT IN PEACETIME	CAPABILITIES
Photographic	HIRES MEDRES ERPHO	Up to 5	High and medium resolution, intermittent cover, no real-time downlink. Crisis surge capability. Also LANDSAT type systems.	KH 11 Big Bird	1-2	High and medium resolution frequent cover, real time transmission.
Elint	ELINT 2 ELINT 3	occasional 6	Detection of radar emissions frequent cover, periodic data down link when passing over ground station	?	?	? Some capability little information
Ocean Targetting	(a) RORSAT (b) EORSAT	Up to 2 Up to 2	Cover not continuous (a) Radar and (b) Elint radar detection of ships over 100m in length degraded by		-	So far as is know reliance on other systems

FIGURE 2

COMPARISON OF US AND SOVIET MILITARY SPACE CAPABILITIES

	SOVIET			US		
TYPE	NAMES	NUMBER TYPICALLY IN ORBIT IN PEACETIME	CAPABILITIES	NAMES	NUMBER TYPICALLY IN ORBIT IN PEACETIME	CAPABILITIES
Ocean Targetting (continued)			bad weather and rough seas. Both systems real time down link for targetting			
Communications	SPCS MPCS MOLNIYA I MOLNIYA EHKRAW RADUGA GORIZONT	3 + 5 16-24 8 4 1-3 4 (+ Spare) 3 (+ Spares)	7 Operational networks, wide coverage of government civil military comms. Spare capacity. 6 new geostationary systems planned	DSCS II DSCS III FLEETSATCOM FSATCOM	7 (+ Spares) 1-2 ?	Wide coverage of diplomatic military, strategic and tactical comms. Planned improvement with MILSTAR. Access to civil networks.
Navigation	NAVSAT 2 NAVSAT 3 GLONASS (experimental)	6 (+ Spares) 4 9 - 12	2 Operational systems for ships accuracy to 100m. GLONASS coming into service, similar to US Navstar	TRANSIT SYSTEM NAVSTAR	? 18 (under development)	Accuracy better then 200m. NAVSTAR/GPS system planned for completion 1987/88 to give accuracy better than 50m?

FIGURE 2

COMPARISON OF US AND SOVIET MILITARY SPACE CAPABILITIES

	SOVIET			US		
TYPE	NAMES	NUMBER TYPICALLY IN ORBIT IN PEACETIME	CAPABILITIES	NAMES	NUMBER TYPICALLY IN ORBIT IN PEACETIME	CAPABILITIES
Military Support	(a) LDS (b) METEOR 2 (c) METEOR-PRIRODA (d) GEOSAT (e) RADSATS	5-9 4-5 1-2 0-1 ?	(a)ICBM launch-warning only (b) (c) Meteorology (d) geodetic mapping for ICBM targeting information and (e) radar calibration for ABM system	(a) LDS (b) METSAT (c) TIROS-N (d) Radar Calibration	2 ?	(a) ICBM and SLBM launch warning, new satellites planned Defence (b) meteorology satellites (c) and civil systems (d) radar calibration for space tracking
Manned Programmes	(a) SALYUT (b) PROGRESS (c) SOYUZ (d) COSMOS 929	0-1 0-1 Type 0-1	(a) Space station with several years life serviced by (b) unmanned cargo (c) and manned transport craft. (d) Additional space modules can be attached. Military experiments including laser tracking, and ASW undertaken.	(a) Shuttle	0-1	Several flights a year limited duration, military related experiments and payloads 4 Shuttles currently being procured

FIGURE 2

COMPARISON OF US AND SOVIET MILITARY SPACE CAPABILITIES

	SOVIET			US		
TYPE	NAMES	NUMBER TYPICALLY IN ORBIT IN PEACETIME	CAPABILITIES	NAMES	NUMBER TYPICALLY IN ORBIT IN PEACETIME	CAPABILITIES
ASAT	ORBITAL ASAT ?		Limited operational orbital system; ground based laser experiments, electronic warfare capability	F15 MHV ?	112 Planned on 40 aircraft	Operational system under development, flexible with fast response time, 10C 1987. Laser experiments and electronic warfare capability

ANNEX A

VERIFICATION AND IMPLICATIONS FOR EFFECTIVE ARMS CONTROL

1. GENERAL. In the context of a possible treaty controlling the development and deployment of ASATs, the problems posed by the need to ensure adequate verification depend strongly on the areas to which the treaty applies. In some cases, such as banning the development of a conventional orbital ASAT capable of attacking targets in geostationary orbit, adequate verification of compliance would appear to be relatively straightforward. Conversely, in other cases, including banning ground based laser ASAT weapons, the verification problems would seem to be very difficult indeed. These and other areas are discussed separately below.

TECHNICAL BASIS OF VERIFICATION

2. It is likely that any verification arrangements will depend largely on the continued observation of all satellite launches and in-orbit tests by both the USA and USSR, together with careful monitoring of launch sites and associated command and control facilities. So-called "National Technical Means (NTM)" will be used for these purposes; they include the following:

a. long range radars, such as the NORAD network operated by the USAF;

b. optical imaging equipment, including the US Ground-based Electro-Optical Deep Space Surveillance (GEODSS) System;

c. photo-reconnaissance satellites;

d. interception of telemetry from both attacking and target vehicles.

In all the above techniques, the US would appear to be better placed than the USSR, either because of superior technology or the possession of a more comprehensive world-wide network of facilities. Consequently, the Soviets may feel at a disadvantage, although

their deficiency may not be serious enough to prevent an agreement from being reached.

3. Using the techniques listed above, it should be possible to detect unambiguously any tests of complete ASAT systems depending on high explosive warheads or impact damage mechanisms. It will be less easy to discover any tests of laser weapons; the evidence for these is likely to depend mainly upon telemetry and, if damage is severe, perhaps on imaging. It may be very difficult to reach a conclusive verdict, and close-up inspections of targets, ground facilities and suspected orbital lasers may be essential. The deployments of "space mines", which could consist of apparently harmless satellites carrying nuclear or conventional explosives, activated in time of war to manoeuvre close to their target and explode, could not be discovered without close examination of every satellite.

4. It has been assumed so far that ASAT weapons would not be deployed without prior testing, on the basis that military commanders will not accept hardware upon which they must rely without adequate proof, under proper conditions, of effectiveness and reliability. Moreover, regular tests would probably be necessary, following deployment, to monitor performance and for training purposes.

5. <u>INCENTIVES TO NON COMPLIANCE AND BREAK OUT</u>. An alternative view has been proposed in connection with ASAT treaty verification. Some Americans are concerned that the Soviets might be content to develop and test separately the technologies required for an ASAT weapon, and would then be prepared to assume that the complete system would function as designed when used in war, without prior testing of it in integrated form. This is because of the disproportionate effect which even a few successfully functioning ASAT systems could have against the very limited numbers of NATO assets in space, especially in geosynchronous orbit. Given the undeniable military attraction of non compliance with an ASAT ban, it is difficult wholly to refute this idea, although it seems to be unlikely, especially considering the usual Soviet preference for thoroughness in testing and training.

6. There exists a further possibility that having covertly developed ASAT sub-systems, the Soviets might abrogate any ASAT Treaty, openly test the complete system, and use their resultant technological lead to achieve an Arms Control break out in which they might gain some years lead over the Americans. It is difficult to imagine however the peacetime circumstances in which this would be a rational option for them given the likely intensity of the American reaction.

7. INSURANCE MEASURES AGAINST ARMS CONTROL INFRINGEMENTS. The consequences of covert Soviet infringement revealed either in war or peacetime break out could be mitigated by providing redundant satellites or carrying out certain survivability (hardening and manoeuvrability etc) enhancements. These measures would of course be more expensive than total reliance on Soviet good faith but probably considerably less than the cost of unrestricted military competition in space.

8. MONITORING TECHNOLOGY DEVELOPMENT. In general, it must be accepted that it is very difficult to monitor the developments of the technologies relevant to ASAT applications, partly because such work is often far from obvious, but also because most of these technologies are required for other fully justified purposes. For example, precise pointing and tracking capabilities are vital to astronomical telescopes operating in all wave-length bands of interest, and the acquisition of and guided approach to an orbiting target is vital to spacecraft docking manoeuvres. Systems of power transmission between satellites and spacecraft and the ground may be developed using high energy lasers. Consequently, it does not seem to be feasible to ban the development of technology of potential use to ASATs, even if reliable monitoring was possible.

9. MONITORING ASAT TEST PROGRAMMES. It would appear to be feasible to verify compliance with a future ASAT treaty by monitoring space activity to check that ASAT tests are not being carried out. Confidence in being able to detect such tests will vary according to individual type, as discussed below.

10. TESTS OF PRESENT WEAPONS. If the present Soviet orbital ASAT was banned, any tests in the future would be immediately known. It is less certain that the Soviets would be able to detect, using their existing resources, tests of the US direct ascent weapon launched from the F-15 fighter, because this does not go into orbit. Of course, even if tests were not undertaken, stockpiles of both of these weapons could be maintained, and only intrusive on-site inspection could reveal this reliably. However, it is a matter for debate as to how useful such stockpiles would be without appropriate training, although modern computer simulation training may be a substitute for this to some extent.

11. FURTHER DEVELOPMENTS OF PRESENT WEAPONS. Any complete system tests to develop further the Soviet orbital ASAT would be detected immediately. It is less certain that additional US F-15 ASAT tests would be discovered, but the possibility would be sufficiently great to inhibit further development, should a ban be agreed. Consequently, the present generation of weapons would continue to have very restricted performance envelopes and would pose no threat to many important spacecraft systems on both sides.

12. HIGH ALTITUDE WEAPONS. The conclusions in para 9 apply, with more certainty, in the case of high altitude weapons. Thus a ban on these would almost certainly be fully verifiable (but not the dissenting view reported in para 5).

13. SPACE BASED WEAPON PLATFORMS. Weapons platforms equipped with conventional high velocity missiles or electromagnetic guns would provide viable ASAT capabilities. However, complete system tests would be observable, so compliance with any relevant treaty could be checked. A problem might arise if the weapons carried were defined as "defensive" only; this problem is due to the fact that the effective range of a missile in space is determined largely by its guidance system, so can be very large. It would therefore be prudent to include such missiles or guns when negotiating a treaty.

14. NUCLEAR WARHEADS. Nuclear warheads could be fitted to most of the vehicles discussed above, with a reasonable assurance that they would be effective against target satellites, owing to the very

large range of the particles and radiation emitted by a nuclear explosion in space. In addition, such warheads could be employed on many ICBMs and space boosters, with similar results. Tests would probably not be necessary and are, in any case, already banned by treaty. However, the long-range effects of such nuclear explosions might destroy or disable all satellites at ranges up to a few hundred kilometres, depending upon the extent to which they had been hardened against such an attack.

15. SPACE-BASED LASERS. Verification of a ban on space-based laser weapons-deployment of which is unlikely to happen in this century - would be very difficult, owing to their long range and to a possible absence of severe physical damage to the exterior of the target. In fact, identification of the target might prove to be a major problem. Intercepted telemetry might provide some assistance in monitoring tests of this kind, but it is more likely to require an agreement that satellites suspected of carrying laser weapons be subjected to in-orbit inspection from close range, using other spacecraft. This would, of course, add to the complexity of any treaty negotiations and may be entirely unacceptable to one or both sides.

16. GROUND BASED LASERS. From a verification point of view, ground-based lasers present special difficulties since they can be located well within the borders of the country in question, and can perhaps be disguised as astronomical telescopes. Adequate verification would require a search for all facilities with large diameter optical systems capable of tracking satellites, together with subsequent on-site inspections. Even these measures would not eliminate moderately high power laser systems claimed to be employed for ranging and tracking purposes. There would, however, be inherent problems in operating ground based laser systems in poor visibility.

17. CONCLUSIONS. Although the development of sub-system technologies relevant to ASAT systems cannot be monitored or controlled successfully, it should be possible to detect with adequate reliability tests of complete systems. This is most likely to be the case when dealing with current ASAT systems using conventional

high explosive warheads or the kinetic energy of impact to destroy a target. Laser weapons bases on the ground or in space would present more formidable difficulties, and reliable verification might then have to involve close inspection of satellites in orbit or of suspect ground facilities. In conclusion, adequate verification of an ASAT treaty depends, finally, upon whether the military authorities in the USA and USSR would be willing to rely upon a weapon system which had not been fully tested under realistic conditions. If they can be assumed to require complete system testing, a treaty should be verifiable, albeit with difficulty in some areas. Redundancy and survivability measures could be taken as an assurance against covert Treaty infringement or open break out.

ANNEX B

POSSIBLE NEW ARMS CONTROL MEASURES FOR ASATs

1. Indefinite ban on testing, and therefore development of high altitude ASATs.

2. Limit on low altitude ASATs to one system on each side (US/Soviet).

3. Indefinite ban on further (post-US deployment) testing or development of existing low altitude ASATs.

4. Confidence-building regime along CDE lines: prior notification of launches, and provision of details of satellites (launch time/site; physical characteristics; degree of manoeuvrability; satellite life-time; and orbital characteristics).

5. Direct communications links between US and Soviet master satellite control facilities.

6. Reaffirmation of commitments to ASAT-relevant elements of the ABM Treaty.

7. Declaratory measures on no-first attack on satellites in orbit and/or non-use of force against satellites.

8. Continuation of work in the Geneva Conference on Disarmament, reviewing international agreements governing satellites and the possible need for new ones.

9. Resumption of US-Soviet bilateral negotiations on ASATs.

Verification. Provision for adequate verification of any or all of the above measures will be an essential part of any arms control agreement; such provision might have to include an element of on-site inspection.