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SECRETARY OF STATE

PRIME MINISTER

BALLISTIC MISSILE DEFENCE: UK POLICY TOWARDS THE US STRATEGIC INITIATIVE

In his letter of 18th June your Private Secretary indicated your wish to have a detailed Paper on military developments in space. We discussed some aspects of these with you on 16th July, in the context of Anti-Satellite Systems (ASATs).

2. We now attach a joint FCO/MOD Paper prepared by our officials to provide the basis for further discussion between us. The Paper deals with the major issues of Ballistic Missile Defence (BMD), and in particular with the Strategic Defence Initiative (SDI) launched last year by President Reagan. It outlines the overall concept of BMD, in terms of both comprehensive and partial defences; rehearses the strategic arguments for and against such a concept, and reviews the technical difficulties in achieving it; assesses, insofar as these can be predicted at this stage, its economic implications; describes relevant arms control factors; and examines special UK interests, including the implications for the future of our national deterrent. In a series of annexes, the Paper provides further details on the political and technical background to the SDI, US and Soviet capabilities, and civil uses of outer space. The conclusions and recommendations are contained in paragraphs 59 and 60.

3. The Paper underlines the complexity but also the timeliness of addressing the BMD/SDI issue and its huge potential impact - for good or ill - on intra-Alliance relations. Growing Parliamentary and public interest and the prospect of US/Soviet talks, if not this year then probably in the near future, make it highly desirable for the Government to define its position on this subject and to play a full and constructive role in the debate, which is already under way

among Western nations and their publics. Indeed, the possibility that President Reagan, if re-elected, may at his inaugural next January commit the Administration to carrying through the SDI unless by then America's principal European Allies have succeeded in bringing home the damaging consequences of doing so, reinforcesthe need for HMG to reach an agreed view soon, and to put it across vigorously in Washington.

4. The Paper explains what we believe the substance of that British position should be. In summary, there is little reason to believe that a fool proof comprehensive BMD system will be attainable; and on strategic, financial, political and Alliance grounds there must be considerable scepticism as to whether moves to deploy such a system would serve British or Western interests. The net result of any concerted move on the part of the United States or the Soviet Union or both to create such a system could well be a reduction rather than an increase in Western security, serious damage to the cohesion of the Alliance, and a new threat to our ability to maintain public support for the retention of an independent national deterrent. Thus at the end of the day, after prodigious expenditure by both sides, and perhaps a period of severe strategic instability, the development of BMD would seem likely to leave the fundamental nuclear balance between the US and the Soviet Union unchanged.

5. In your speech at the Guildhall on 11th July you rightly warned of the dangers of unrestrained military competition in outer space. We agree that there is a clear case at least for attempting, as you suggested on that occasion, to restrain such a development through arms control measures, and that the sooner negotiations to this end begin, the better. Chances to control new generations of weapons have been missed in the past: we hope history will not record the present as yet another moment of lost opportunity.

6. We recognise, however, that our views need to be balanced and well worked out if we are to influence US decisions and to promote a militarily realistic and politically cohesive approach among our

NATO and Community partners. We do not underestimate the problems, given the apparent commitment in Washington to pursuing their present approach to BMD. The key question is whether at this important juncture the Government should be willing to engage the Americans in serious discussion of the underlying arguments for and against such a concept. The lessons of the Siberian pipeline episode, and other recent causes for intra-Alliance disunity, suggest that when we are convinced of the soundness of our views we do better to emphasize these clearly and at an early stage to US leaders, than to risk allowing the momentum of events to dictate the future.

7. It is incidentally worth noting how far American thinking appears to have shifted away over recent months from the original objectives proposed by the President, which were stated as the search for the means to render all nuclear weapons "impotent and obsolete". This is an undoubtedly attractive proposition for all of us, whether in America, Europe or even the Soviet Union. But it has been clear from the start (and the US Administration have not disputed this) that the nuclear threat as such would not disappear even if a perfect BMD system were ever developed and put in place. The threat from non-ballistic systems - aircraft, cruise missiles, specially adapted submarines, even terrorists - would in practice always be with us. Moreover, a totally leakproof system even against ballistic missiles is now widely discounted even within the Administration. Recognising the flaw in the seductive prospect of substituting "mutual survival" for "mutual deterrence", SDI proponents now argue that the chief virtue of their efforts will be to enhance rather than replace the present strategy of deterrence. They also admit that for this purpose modernisation of their offensive nuclear forces will be increasingly important. In other words, nuclear weapons will remain, for the foreseeable future, at the heart of Western defence strategy and security.

8. There is also an important European dimension to future policy. Our French and German partners have already taken positions in private, and increasingly in public, sceptical of the US Administration's approach to the long-term future of Western security. If we are to move forward in defence and security terms in the general direction charted in the Paper on "Europe - The Future" which you circulated to your European colleagues, it will be important to retain the confidence of our French and German partners that we are prepared, when fully convinced of the reasons for doing so, to play our full part in intra-Alliance debates. If we fail to do so, we risk becoming less central to future, basic considerations of Alliance security interests and the debates about how best to handle these.

9. Taking all these considerations into account, we believe the present Paper provides the right material for reaching a clear and consistent British position. We strongly endorse its conclusions and recommendations and look forward to discussing it soon. We hope that the results of these discussions will indicate the best way in which we can approach the undoubtedly complex problems of handling these issues in our own and Alliance security and political interests.

10. Copies of this minute and the attachment go to the Lord President of the Council, the Chancellor of the Exchequer and Sir Robert Armstrong.

MH GH

October 1984

DEFENCE: Military Uses of laser techology in Space

Dec 79

Oct 84

BALLISTIC MISSILE DEFENCE (BMD): IMPLICATIONS FOR UK POLICY TOWARDS THE US STRATEGIC DEFENCE INITIATIVE (SDI)

SUMMARY OF INTERIM REPORT BY OFFICIALS

1. Introduction. Since President Reagan's "Star Wars" speech of March 1983, US work and public interest in Ballistic Missile Defence (BMD) has accelerated. There have been increased intra-Alliance consultations. The present report is an interim assessment, providing for decisions on near-term UK policy.

(Paras 1 - 5)

2. Comprehensive BMD. The US envisage a leakproof multi-layered system of BMD, using a variety of methods including new technologies and space-based components. Only ballistic missiles are covered by the SDI, other nuclear systems would remain, at least initially, unaffected. Arguments expressed in favour include: ethical ? merit; popularity with US public opinion; enhanced US guarantee ? to Europe; strengthening deterrence; incentives for deep cuts in offensive nuclear systems; damage limitation in the event of deterrence failing; and the need for prudent hedge against equivalent Soviet efforts. Arguments expressed against include: the project's technical uncertainty; the relative ease and cheapness of countermeasures the probability that numbers of offensive systems would be driven up, rather than down; the increased risks inherent in the automaticity of BMD systems; the non-ballistic nuclear threats which would remain; and the dangers of destabilisation, especially during the transition from deterrence to defence. There are also major arms control and financial implications (which are addressed seperately below).

(Paras 6 - 10)

3. Specific European Concerns. With comprehensive BMD, the top rung of flexible response would have to depend on air-breathing systems and theoretically the strategic balance could be preserved. But in practice European public and political apprehension would focus on the risk of the US becoming decoupled from their defence with the nuclear threat to Europe remaining greater than that to America; the increased risk of war limited to Europe; and the squeezing of US conventional force levels. Damage is thus likely

to result to Alliance cohesion without real compensating benefit. Deployment of BMD is also likely to have serious implications for small nuclear powers.

(Paras 11 - 17)

4. Partial BMD Systems would provide 'leaky' defence and would be subject to many of the same considerations as comprehensive BMD. It might also lead to a switch to targeting civilian population, as well as allowing easier exploitation of gaps in the defence by offensive countermeasures. Again offensive forces are likely to be increased, rather than reduced, as a result.

(Paras 18 - 21)

5. Point or (Limited Area) Defences of key military installations (including ICBM silos) would be of only limited relevance to SDI though some of the previous arguments apply. Its specific merits and drawbacks would require further consideration if Point Defence rather than comprehensive BMD were to be pursued by either side.

(Paras 22 - 24)

6. Financial Implications are impossible to assess precisely, given the range of variables. But, clearly, the eventual cost of a full BMD system would be enormous, perhaps $1000 billion over say 30 years. The US could afford this, but the expense would cut into defence and other programmes, particularly conventional forces. Overall, the diversion of US resources into BMD is unlikely to be helpful for conventional defence of Europe. The Soviet Union could if necessary also find the resources for BMD.

(Paras 25 - 30)

7. Arms Control. Risks: significant further BMD development would require wholesale changes in the present arms control regime. It would tend to undermine the 1972 ABM Treaty (important to East/West security), worsen wider East/West relations, harm the prospects for arms control in other areas, make the future of the NPT more precarious, and increase the danger of a new arms race. Given present uncertainties it is hard to construct an arms control regime, but there are arguments in favour of some

limitations even now. Opportunities: Negotiations over BMD could spread into offensive nuclear systems which might help to break the present US-Soviet impasse.

(Paras 31 - 40)

8. Special UK Interests. If the SDI provoked increased Soviet BMD deployments, there could be serious implications for the UK's national deterrent. Although these might be overcome by means of a countermeasures programme, BMD considerations may start to affect the domestic and political debate over Trident. Spaced-based BMD weapons could threaten satellites and might thus also have effects on intelligence capabilities. It will be important to handle the US with care to avoid unnecessary friction and damage to present co-operation in both areas. The implications of the SDI for the UK economy are unlikely to be helpful. There is also an unclear future US requirement for BMD bases in Europe, incuding perhaps the UK.

(Paras 41 - 55)

9. Political. The handling of the SDI issue with Americans is likely to become harder. It is a major election issue. There is a need to avoid gratuitous criticism of US efforts, while taking clear a position on substance. It will be important to use Congressional attitudes as a guideline.

(Paras 56 - 58)

10. Conclusions. There are good reasons to doubt that any comprehensive BMD system could be created, and equal grounds for scepticism that either comprehensive or partial BMD would be in British and Western interests. Alliance, financial, arms control and Trident interests could be damaged rather than furthered as a result. But there are some grounds for optimism in terms of the possibilities which exist for an arms control solution.

(Para 59)

11. Recommendations. Summarised in para 60, with suggested public line to take at Appendix 1.

12. Annex A: Responses to the SDI Political Background.
Annex B: Technical Aspects of BMD.
Annex C: Comparative US and Soviet BMD achievements and capabilities.
Annex D: Civil Uses of Outer Space.

BALLISTIC MISSILE DEFENCE (BMD): IMPLICATIONS FOR UK POLICY TOWARDS THE US STRATEGIC DEFENCE INITIATIVE (SDI)

INTERIM REPORT BY OFFICIALS

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BALLISTIC MISSILE DEFENCE (BMD): IMPLICATIONS FOR POLICY TOWARDS THE US STRATEGIC DEFENCE INITIATIVE (SDI)

INTERIM REPORT BY OFFICIALS

A. INTRODUCTION

1. In his "Star Wars" speech of 23 March 1983 President Reagan announced a long-term research and development programme for a system of Ballistic Missile Defence (BMD) aimed at the "ultimate goal of eliminating the threat posed by strategic nuclear missiles", in order to render them "impotent and obsolete". He emphasised the link between the vital interests of the US and its Allies, and stressed that it would be the intention to destroy missiles before they reached the territory of either. In a message to the Prime Minister, President Reagan denied any US intention of retreating into a Fortress America stance, of violating in any way the 1972 ABM Treaty, departing from commitments to Allies, or seeking a first-strike capability.

2. Work in the US to flesh out the bones of the R&D programme outlined by the President has continued and intensified, under the title of the Strategic Defence Initiative (SDI). The long-term programme has become a subject of political and technical controversy in the US and, to a lesser extent, in Western Europe and the current state of the debate is set out in Annex A. In summary, public debate within the US has been stimulated first by the publication, this spring, of officially commissioned studies on SDI prospects, and then by criticism of the SDI in the press, in Congress and among US scientists. This has contributed to changes in the Administration's own attitudes, including a move away from the idea of a comprehensive, leakproof defence system towards imperfect defence or defence of specific targets; an increasing emphasis on Soviet activities as a justification for the SDI; and, most recently, an acceptance of the need for dialogue with the Russians. Allied reactions have meanwhile been characterised by increasing concern at the strategic, political, arms control and cost implications of the SDI. This has been reflected in public criticism of the SDI by French and German Ministers, and by the French proposals to limit directed-energy weapons.

3. A team of US officials visited European capitals in February in order to brief them on the latest SDI developments; another briefing for NATO was conducted in July. A further round of discussion with closest Allies was held in Washington later that month. There have also been informal contacts, at Ministerial and official level, between US representatives and their Allies. Other contacts have included a UK non-paper (reviewed by Ministers) which was passed to the Americans last December and posed a series of basic questions.

4. The present Report gives an interim assessment of the developments in and implications of BMD as far as they can be determined and is intended to enable Ministers to take decisions on HMG policy. Because it appears that the crucial components of a BMD system would have to be space based, the issues covered in this paper are inevitably relevant to the long-term question of the militarization and perhaps eventual control of outer space. This paper does not, however, directly address the important related topic of Anti-Satellite Weapons (ASATs). These were the subject of another recent MOD/FCO paper, and although there is an important overlap between ASAT and BMD systems, and ASATs might, moreover, prove a serious offensive countermeasure to a BMD network, the timescales of the two subjects are very far apart. The Soviets already possess an operational ASAT and the US is rapidly catching up; by contrast, comprehensive BMD systems, if ever possible, are at least two to three decades away. Finally, in order to give a comprehensive treatment of space-related issues, a discussion of the predicted civil uses of space is attached at Annex D to this paper.

5. Throughout the paper, it is assumed that the Soviet Union will endeavour to keep pace with the US in whatever new programmes are developed.

B. THE COMPREHENSIVE BMD CONCEPT

GENERAL

6. Since the late 1950s the prevention of war between the super-powers has rested upon the threat of mutual destruction, the key to

which has been the assured survival of sufficient nuclear forces, even following an enemy first strike, to inflict a counter-attack of such destructive proportions as to make an initial attack worthless and irrational. This situation of potential Mutual Assured Destruction (MAD) has been recognised since the 1960s, and was crucial to the evolution of NATO's flexible response strategy, formally adopted by the Alliance in 1967. It was reflected in the 1972 ABM Treaty which placed severe restraints on defensive systems, on the grounds that these would cast doubt on the credibility of second-strike forces and thereby jeopardise strategic stability.

7. The recent development of new technologies has allowed, for the first time, consideration of the possibility of comprehensive or "leakproof" BMD, in distinction to the traditional "limited area" ABM defence systems covered by the 1972 ABM Treaty and now deployed round Moscow. Annex B sets out a summary of the technical aspects - including vulnerability to countermeasures - of the BMD concept which the Americans are now considering. Their studies envisage a multi-layered system of defence against ballistic missiles, comprising the following elements (See Annex B, Figure 1):

a. attack against ballistic missiles in their boost phase, when it would be desirable and probably essential to neutralise the overwhelming majority of Soviet offensive ballistic missiles;

b. interception of surviving warheads in the post-boost and mid-course phases, picking off those re-entry vehicles as or after they have separated from the dispensing vehicle;

c. elimination of the remaining warheads in their terminal phase of descent into or just outside the atmosphere on their way towards their targets.

Methods for achieving these various aims range from current intercept capabilities (nuclear or non-nuclear land-based missiles to be employed in the terminal phase), through conventional or nuclear warheads employed in space in the mid-course and post-boost phases; to advanced technology systems - directed energy weapons (DEWs) eg particle beam or laser - used to attack Soviet missiles in their crucial boost phase.

8. The President has directed that the US goal should be to eliminate the threat of ballistic missiles. Most of the present work is being devoted to the threat from the land-based, long-range version - the ICBM. There is no programme to eliminate the many forms of non-ballistic nuclear threats such as cruise missiles or strategic bombers (known as air-breathering systems). The Americans have suggested that technologies developed for advanced BMD might, at a later stage, be adopted to combat air-breathing systems. This paper does not consider the future vulnerability of air breathers.

ARGUMENTS EXPRESSED IN FAVOUR

9. Proponents of BMD argue that it would have the following positive features:

a. Ethical Merit
Successful BMD deployment would mean that weapons rather that people would be put under threat, populations could be defended rather than avenged, and the increasingly unpopular strategic posture deriving from Mutual Assured Destruction (MAD) could be replaced by one of Mutual Assured Survival;

b. Popularity with US Public
It is claimed that some US polls have shown up to 80% support for the BMD concept, and that this will inevitably translate into eventual political backing by leaders of both major parties. There is likely to be greater public willingness to spend huge sums of money on strategic defence rather than on new offensive systems to match the Soviet build-up. SDI may also attract support from those whose anxieties about nuclear war would otherwise lead them to favour calls for a freeze on the development and deployment of nuclear weapons;

c. Strengthening of the US Guarantee to Europe

American Presidents would no longer have to fear that strong military support for NATO Europe would, through escalation, risk the destruction of US cities by ICBMs. It is argued that this would add credibility to the US nuclear guarantee. In addition, the technical need to achieve interception of as many Soviet missiles as possible in their boost phase means that Europe's security would be enhanced, even if no dedicated terminal defences were built there: US BMD systems would have to attempt to destroy almost any ballistic missile launched by the Soviet Union before they could know where it was aimed;

d. New Crisis Management Options

As a deterrent to provocative behaviour in periods of tension, US Presidents could formally notify unfriendly states that the BMD system was being switched over to automatic, to achieve immediate interception and destruction of any missile launched from their territory;

e. Strengthening of Deterrence

A fully effective BMD system could nullify the risk of a disarming first strike by ICBMs, and thus remove the main incentive which has been put forward for a destabilizing nuclear move;

f. Damage Limitation if Deterrence Failed

If the increased strategic stability provided by BMD proved insufficient to avert a major East-West nuclear war, the number of casualties would be much reduced by eliminating large numbers of warheads. This might also prevent the nuclear winter climatic catastrophe which some experts predict would occur following an all-out nuclear exchange;

h. Incentives for Deep Cuts in Offensive Nuclear Systems

With effective BMD there would be no need to insure against a disarming first strike by accumulating large numbers of ICBMs so that as large a number as possible would survive. Thus the US and USSR could safely negotiate large reductions in ICBMs and warheads. In addition, the decreasing utility of non-penetrating missiles and warheads would logically encourage both sides to agree to reduce them, in theory to zero. There could be scope for greater concessions over verification since the consequences non-compliance would be less serious. Even the threat of US BMD deployment could provide leverage on the Soviet Union to reopen strategic arms limitation discussions;

i. <u>Nullifying the Risk of Accidental Missile Launch</u>
Were nuclear missiles to be launched accidently they could be destroyed in mid flight, with huge savings in human life and the reduction in risk of war. The importance of this might increase if less technologically competent states were to acquire nuclear ballistic missiles;

j. <u>Avoidance of Nuclear Threats by Small Nuclear Powers</u>
With a BMD system a superpower and its allies would not have to fear future nuclear blackmail by extremist states (eg Libya, Iran, Cuba) which managed to acquire a nuclear warhead and a ballistic missile (eg from an adapted satellite launcher);

k. <u>The Need for a Prudent Hedge Against Soviet ABM/BMD Efforts</u>
The Soviet Union has deployed round Moscow the world's only functioning ABM system and is known to be well advanced in DEWs and other research relevant to BMD. Although the Russians have not so far been assessed to have any immediate plans for evasion of or break-out from 1972 ABM Treaty limitations, this might rapidly change. It would be highly destabilising if the US were to fall behind in any race to deploy a BMD system as the Russians are well placed to take the immediate lead;

l. <u>Improved Monitoring and Verification of Soviet Compliance with the 1972 Agreement</u>
By carrying out BMD research the US would gain a better idea of which Soviet activities might indicate violation, or intention to violate the Treaty;

m. Comparative US Advantage in this Area of Military Competition
US superiority in high technology should mean that the Russians would have to divert a greater quantity of particularly scarce resources to compete in the BMD field. This would be likely to slow down the expansion of other Soviet military programmes and handicap the growth of their economy in general;

n. Achievement of a US Lead in 21st Century Weapon Systems and the Domination of Space
It would be historically unprecedented if, after 50 years of accelerating technical change, the nuclear tipped ballistic missile were to remain the single unchallengeable ultimate weapons into the early twenty first Century. BMD-relevant technology is likely to be crucial to the key weapons systems of the future, and the need to deploy it in space should give the US - and thus the West - an advantage in that increasingly important "High Frontier" area of military operations and economic competition. The alternative could be the inexorable attainment of a "Pax Sovietica", based on the domination of space, just as the "Pax Britannica" formerly rested on the control of the High Seas.

ARGUMENTS AGAINST

10. In opposition to BMD, critics have focussed on the following points:

a. The Enormous Technical Uncertainty of the Project
The sheer size and complexity of the research undertaking alone equals, in one official US estimate, 8 times that of the Manhattan Project, the original programme to build the atomic bomb. The need to ensure, if leakproof defence were to be achieved, confidence that it functioned perfectly first time (inevitably without ever undergoing a full system test) makes its eventual success not only highly dubious but the cost involved quite enormous. There is no evidence to suggest that, in the face of enemy countermeasures, the awesome technical problems can ever be overcome (Annex B);

b. The Relative Ease and Cheapness of Countermeasures

The attacker would have a number of options to complicate the defender's task. Again, these are discussed in detail in Annex B, but they would include new generation rockets with accelerated boost phases; increased use of chaff and decoys; thermal blinding of satellite sensors by nuclear explosions just before launch; insulation and rotation of rockets and re-entry vehicles to reduce DEW effects; direct ASAT attacks on orbiting BMD battlestations (including those by prepositioned orbiting "space mines", and from ground or space-based DEWs), and attacks on ground support systems, by saboteurs or by depressed-trajectory submarine-launched missiles. Even grouping ICBM sites in small areas would greatly increase the number of orbiting satellite battlestations needed to ensure that enough were over the launch sites at any one time to guarantee boost-phase intercept of the sufficient of the ICBMs from the site cluster. It seems likely that countermeasures could be both highly effective and cheaper for the attacker to develop and deploy than a BMD system;

c. The Risk of Saturation by Increased Numbers of Offensive Systems

A system designed to be near leakproof against, say, 6000 enemy warheads could be overwhelmed if the other side were to double its offensive inventory. A large increase of this kind, together with a vigorous countermeasures programme, would be one obvious Soviet response to US BMD deployment. Figure 2 of Annex B shows the estimated number of US urban fatalities which would occur with penetration of even small numbers of warheads. Unacceptable damage would thus almost certainly result from the minimal "leakage" of even a well-functioning BMD system;

d. Increased Dangers of Automatic Response Leading to War

The crucial ICBM boost phase lasts a maximum of a few minutes and potentially for a minimum of less than a minute. The most technically efficient comprehensive BMD system would therefore almost certainly have to incorporate a hair-trigger response, dependent upon automatic, computer-driven decisions. A limited provision for human override before defences were committed to action might be incorporated, but any resultant delay would be at the cost of reduced certainty of interception. At best, it would probably allow a rapid "yes or no" response on whether to fire from the BMD's military commander, rather than a considered decision by the political leadership. Although the primary consequences of a mistaken decision would be the targeting of enemy rockets rather than enemy cities and populations, there would be an risk that, to defeat predicted offensive countermeasures, the integrated defence plan would need to have programmed into it pre-emptive attacks at least on other enemy space systems. With enemy reactions, the sequence of automatically driven responses could widen into a general conflict;

e. The Danger of Strategic Destabilisation

Assuming both sides deployed similar BMD systems, the temptation would be heightened to indulge in a pre-emptive first strike at a time of crisis, both against the other side's BMD system itself and its anti-BMD weapons. A first strike against what are likely to be relatively soft targets associated with BMD systems, including satellites, could nullify the effect of the intended defences, whilst the aggressor remained confident that his own defence system would be able to deal with the surviving forces from the other side. Conceivably those might be the only circumstances under which such confidence could be achieved.

f. The Particular Dangers of Transition from Deterrence to Defence

Even if a comprehensive defence system proved technically feasible, the transition to achieving it and extending it to Western Europe would take decades. If this were a negotiated process, guaranteeing continuation of the central strategic balance, based on good faith and confidence between the superpowers, and starting in good time, the transition problems would theoretically be eased. More probably the transitional period would become an era of increasing international insecurity as one side periodically became concerned that the other was ahead in the race to achieve perfect BMD. With historically likely worst case assumptions governing the strategy of each, the temptation to threaten the use of offensive forces whilst they remained effective would be increased. The management of all major East/West crises in this period would accordingly tend to become more precarious;

g. <u>Improbability of Accidental Nuclear Release</u>

Accidental nuclear launches by established nuclear powers have not so far occurred and there is no reason to think that they will be more likely in the future;

h. <u>Low Likelihood of Ballistic Missile Attack by Future Nuclear States</u>

Future nuclear weapon states are unlikely to deploy sophisticated delivery systems such as ballistic missiles, at least in their first generation of weapons. Clandestine prepositioning of nuclear devices, or air delivery of primitive bombs, would probably be significantly greater threats, which would not be lessened by BMD;

i. <u>The Worldwide Nuclear Threat Itself Would Still Remain</u>

The superpowers could also resort to widespread clandestine pre-positioned nuclear devices in each others' territory. Furthermore, although not themselves capable of a first strike, air-breathing systems (nuclear-capable aircraft and cruise missiles) would remain largely unaffected by a BMD system. Aided by developments in Stealth Technology, they could fly low to avoid detection and remain effectively insulated from space-based DEWs by atmospheric absorption and turbulance. Ballistic missiles in depressed trajectories as well as nuclear-capable artillery could also continue to pose threats, depending on technological developments. A total elimination of the long-range ballistic missile threat could well lead to a massive increase in these other systems, with the concomitant need to develop defences against them. Huge air defence (AD) systems would be needed to counter these other threats and the Russians currently enjoy a clear lead in this area. It is not possible at this stage to predict whether the non-ballistic missile threat could ever be eliminated by leakproof AD or what the strategic implications of this would be. (Three probabilities, however, suggest themselves: AD of Europe would be more difficult than that of the US because of the shorter distances and reaction times; the transitional dangers of pre-emptive attack would be even greater if one side appeared to be achieving an imminent total defence against non-ballistic as well as ballistic missile nuclear threats; and, even if both sides were eventually able to deploy defences against all outside nuclear attacks, the risk of conventional war might thereby be increased);

j. Stimulation of a New Arms Race

It would plainly be unacceptable for the Soviet Union to enjoy a monopoly in research on any defensive or offensive system. But there is a concomitant risk of BMD efforts on both sides having a synergistic effect, compelling both to pursue an arms spiral which in the end leaves them no more secure and possibly less so than when they started;

k. Arms Control

The effects on present and future arms control arrangements are considered in Paras 30-39 below;

l. No Hard Evidence of Soviet Intention to Break Out of the 1972 ABM Treaty

Despite extensive Soviet research into DEWs, and US claims of Soviet breaches of the 1972 ABM Treaty, it is by no means obvious that the Soviets would themselves choose to precipitate all the problems considered above by breaking out of the 1972 Treaty;

SPECIFIC EUROPEAN CONCERNS

GEOGRAPHICAL COVERAGE OF BMD

11. The US Administration have continually insisted that any comprehensive BMD system would have to cover not only US territory and assets but the whole of NATO as well. (They would presumably also wish to include Japan and other countries dependent upon the US nuclear umbrella, which, given the Chinese threat, would be an additional complication). Were such a system not to extend with the same effectiveness beyond US territory, US Allies would be more exposed to a continuing ballistic missile threat, in addition to the other threats identified in para 10(i) above. This would be likely since the short flight-times of ballistic missiles targeted on Europe would make it difficult to deploy the full panoply of defences against them which might exist to protect the continental US.

EFFECT ON THE US STRATEGIC GUARANTEE

12. NATO's strategy of flexible response rests on three levels of response in any conflict: non-nuclear warfare, use of short and intermediate-range nuclear weapons, and strategic employment of nuclear weapons. Assuming an effective BMD system were in place, the ultimate deterrent threat would be limited to air-breathing (bomber, cruise missile) systems. What impact, strategic and political, would this have on the overall cohesion of the Alliance and the security of Europe?

13. US arguments that BMD would strengthen the US guarantee to Europe have been set out in para 9(c) above. But, on the other hand, whether or not leakproof defences against all ballistic missiles could ever be achieved, US cities would remain significantly at risk, primarily from air-breathing systems. The risk might be lower than at present, but there would have to be a very large reduction before it ceased to be considered unacceptable. It is not therefore obvious that the crucial willingness of a US President to risk unprecedented death and destruction to his homeland would be changed through deployment of a BMD system, whether perfect or partial. Assuming, as one must, rough superpower symmetry in BMD development, the technical improvements which progressively plugged potential BMD leaks, and thus somewhat reduced the millions of casualties which America could expect in a strategic nuclear exchange,

would, as they were matched by the Russians, simultaneously be undercutting the effectiveness of the US ballistic missile deterrent. To the extent that numbers of air-breathing systems were multiplied on both sides to compensate, the deterrent balance prevailing today would persist. In terms of the theoretical balance of strategic advantage, therefore, it can be argued that the security of the US guarantee to Europe would be neither enhanced nor undermined by BMD.

EUROPEAN REACTIONS AND EFFECTS ON ALLIANCE COHESION

14. But the response of European publics would not be dictated by cold reasoning of this kind. They would believe that the balance of nuclear risk within the Alliance had tilted heavily to favour the US. Europe would remain exposed to a range of Soviet nuclear threats (aircraft, nuclear artillery and nuclear-armed cruise and short-range ballistic missiles); whereas the US would be freed from its 30-year old vulnerability to Soviet ICBM attack. There would undoubtedly be widespread apprehensions, not necessarily logically justified or even internally consistent, that the topmost rungs of the escalatory ladder were being removed, thus making lower-level (conventional and theatre nuclear) conflict more likely in Europe. There might be a fear that the Russians would be less deterred than they are today from threatening or embarking upon a conflict, which they might have greater hopes would remain conventional, and which their numerical superiority at the conventional level would allow them to win, once the strategic deterrent was limited to air-breathing systems.

15. Paradoxically, Europeans might at the same time become more worried that the Americans, imagined to be safe behind their BMD walls, might be more likely to begin a nuclear exchange at the risk of the wholesale destruction of Europe. INF deployment was intended to reaffirm the credibility of extended US deterrence, since the Russians insist that use of INF would lead them to make a strategic response against the US homeland. If this were felt to be negated by BMD covering principally the US (whatever the continuing threat from air-breathing systems), fears could grow in Europe of a limited nuclear war, confined to European soil. The net result of all these factors could be to

exacerbate intra-Alliance tensions (probably to a greater extent than the INF decision, which at least developed from a European initiative)without real strategic gain, and at the cost of provoking increased anti-Americanism. In addition, the diversion of American resources into BMD would tend to reduce those available for programmes of more direct benefit to European security, such as US in-theatre conventional forces (see Paras 28 and 29 below).

SOVIET OPPORTUNITIES

16. This situation would present the Soviet Union with many propaganda options. They would certainly intensify their campaign of allegations that the Americans planned to wage limited nuclear war in Europe while maintaining their own homeland as a sanctuary. They might even enhance the effect by openly offering the US an arrangement whereby Soviet offensive systems would not be used against America itself provided that US forward-based systems in Europe were not fired at targets in the USSR. Even if such a proposal were vigorously rejected by the US, doubts could linger in European minds about future US dependability.

EFFECT ON INDEPENDENT NUCLEAR POWERS

17. Even if comprehensive BMD against superpower-sized ballistic missile attacks proves in practice to be unattainable, the sheer size of the resources which might eventually be deployed on continental scales in pursuit of this goal would be likely to undermine the credibility of small independent national deterrents based on ballistic missiles (ie those of the UK, France and China). In the medium term, if the extreme American proponents of SDI were to be proven correct in their optimism over the speed and effectiveness with which BMD technologies could be introduced, and if such a pace could also be achieved by the Soviet Union, there could be significant implications for the UK's Trident programme. However for the reasons discussed in Para 10a and b above, and in Annex B, it is probably more realistic to assume that, if necessary at the cost of an extensive countermeasures programme, UK Trident's ability to penetrate Soviet defences could be maintained for the duration of its planned operational life. (This issue is more fully discussed in Paras 45 - 48 below). By that stage other delivery systems,

such as air-breathing cruise missiles, may offer alternative prospects for the next generation of independent national nuclear deterrent.

C. PARTIAL BMD SYSTEMS

INTRODUCTION

18. Given the very large technical uncertainties overhanging the comprehensive BMD concept, most of its proponents would concede that perfect "leakproof" defence is unattainable, but argue that there would still be merit in deploying a partial BMD system. Possible systems offering partial BMD divide into two categories:

a. Less-Than-Perfect Defence, allowing significant predicted leakage of attacking warheads;

b. Point (or Limited Area) Defence ie an extensive interception capability against the terminal phase of ballistic missiles targeted on high value sites - missile silos, other military bases, key command/ communications facilities etc - but perhaps leaving cities unprotected. Multiple point defence systems of this type would exceed the limits of the 1972 ABM Treaty.

LESS-THAN-PERFECT DEFENCE

POSSIBLE ADVANTAGES

19. Proponents of this variant use many of the same arguments as for comprehensive BMD, with some differences. They claim that such a defence system would enhance deterrence by reducing, though not eliminating, the certainty in the mind of the aggressor that his missiles would reach their targets. It would also inhibit the temptation to indulge in pre-emptive or limited nuclear strikes; it would contribute to saving human lives; it would help to shape a possible arms control agreement; it would provide protection against small accidental missile launches and the forces of minor nuclear powers; and it would be an essential reaction to current Soviet efforts in this field.

DISADVANTAGES

20. Most of the criticism detailed in paras 11 and 14-18 above applies equally to a less-than-perfect defence. The nuclear threat would remain; there would be dangers of decoupling Europe from the US nuclear umbrella; there would be a risk of reduced political control over decisions which could set off a conflict; the credibility of the UK national deterrent would be reduced (or, at least, an potentially expensive countermeasures programme might be required); and the temptation to launch a disarming first strike, though lessened, would remain a factor in Soviet strategic thinking.

21. In addition:

a. Proliferation of Offensive Systems
The incentives to increase offensive forces to overwhelm the defences by raising the volume of incoming warheads would increase as defences were perceived to be less than fully effective. Far from contributing to arms control, less-than-perfect defences are much more likely to lead to a proliferation of offensive systems. Indeeed in his report to Congress in April, Defence Secretary Weinberger explicitly acknowledged that "the immediate response" of the Russians would be "to press ahead with the further expansion and modernisation of their offence systems";

b. Switch to Counter-Value Targeting
Faced with fairly effective defences of military and other government targets, the Soviet Union could well switch more of its targeting to urban centres. If only between 10 and 50% of their warheads aimed at military targets such as missile silos were to penetrate US ballistic missile defence this could leave a larger number of US missiles intact on the ground than could be the case at present. But if 10-50% of Soviet warheads aimed against cities were to get through, this would remain a devastating action in war and therefore an effective threat in peacetime. According to official US projections, and depending upon the yield of warhead used, a 5% leak in US defences against a 10,000 warhead Soviet attack targeted on cities

could leave between 30 and 50% (40-60 million) of the US urban population dead (See Figure 2 of Annex B);

c. Facilitation of Offensive Countermeasures
Gaps in the defences could be increasingly exploited by effective countermeasures, whose technology would be developed at an equal or greater pace than the defences themselves.

POINT (OR LIMITED AREA) DEFENCE

GENERAL

22. Point (or Limited Area) Defence would be a major expansion of the terminal-phase defence already developed in the 1960s beyond the right codified in the ABM Treaty to a single such system. It is strictly speaking a separate issue from the sort of defences largely based in space which are under consideration in the context of the SDI, but it seems desirable, for the sake of completeness, to set out briefly the advantages and disadvantages of this concept.

POSSIBLE ADVANTAGES

23. Effective systems of this kind, covering US land-based ICBMs, would certainly protect them against a Soviet ballistic missile first strike. It might also be extended to protect US military targets and improve the survivability of Command, Communication and Control (C3) elements.

DISADVANTAGES

24. Civilian targets such as cities could not be safeguarded in this way against superpower attack and Point Defence by one side of even some of its missiles and key military facilities might be perceived by the other as an attempt to preserve a decisive capability for nuclear attack. This could heighten concern that the side deploying Point Defence might be less deterred from launching a first strike, secure in the knowledge that any of the other side's offensive forces which might survive the first strike would be incapable of mounting a credible retaliatory threat against the

attacker's remaining offensive forces inside their defence areas. These fears might in turn cause the Russians to try to forestall the creation of such US defences by fomenting a political crisis in Europe, or even to consider a pre-emptive first strike themselves. In addition, powerful arguments against pursuing the deployment of Poi t or Limited Area Defence include the likely growth in the number of offensive missiles; increased counter-value targeting; the remaining irreducible threat to C3; the political implications of exposure of European military targets to Soviet threat while the threat to similar US targets was being reduced; the impact on the credibility of small national deterrents (see paras 45-48 for the effect on UK Trident), with the consequent effect upon public support for their maintenance in the countries concerned; and the inevitable reopening of the ABM Treaty. Moreover, this first step towards full-scale BMD would increase the temptation, as the strategic risks detailed above grew, to move into the next stage of less-than-perfect defence.

D. COSTS

UNCERTAINTY AND OVERALL SCALE

25. Many of the components of a potential BMD system are only at the earliest stages of research; in most cases they have not left the drawing board. It will be many years, if ever, before they can be seen to be effective. This makes an assessment of the eventual cost more than usually difficult. Estimates provided to the US Congress range from $200 billion using current technologies (with a $50 billion annual maintenance cost), to $1,000 billion. The final cost might well be very much more than this. In fact, it is perhaps harder to estimate in 1984 the total cost of a complete ABM system of the sort originally envisaged by the President than it would have been in 1945 to estimate the current cost of the US nuclear weapon programme and forces. The variables - types and numbers of systems, supporting equipment, ancillary technology, etc - are so wide as to make meaningful assessments at this stage unrealistic. The only point on which there is a general consensus is that a complete defence system would be prodigiously expensive, requiring hundreds of billions of dollars; and that it would inevitably

effect the Western ability to support defence expenditure on other areas.

26. The present Administration proposals for the SDI envisage expenditure of $26 billion over Fiscal Years 1985-89; FY 1984 funding came to $1.2 billion. They are seeking $2.0 billion for FY 1985, an increase of 25% over previous projection, but this figure is subject to proposed cuts by Congress. For FY 1986 they envisage $3.7 billion. They have not made available figures for the later years, but it seems inevitable that by the end of this decade at least $10 billion annually will be required. It can be argued than an average expenditure of some $5 billion over each of the next five years is not an excessive amount in order to demonstrate whether a real defensive system is feasible. Such expenditure would certainly be within the scope of the present trend of US defence budgets without exerting damaging pressure on other areas. However, the longer-term implications of this trend are also important.

LIKELIHOOD OF RESOURCES BEING FOUND

27. The history of US defence spending suggests that once programmes have been launched, albeit with minor funding, successive Congresses and Administrations have found it very difficult to cancel them. Given the investment that would have been made by the end of this decade, including the increased involvement of US industry, it cannot be assumed that funding for a continued SDI programme could then be radically reduced, even if this appeared to be the sensible course in the light of the results of the R&D programme. On the other hand both the scale and political visibility of the SDI programme will be unprecedented. These factors, together with its long gestation period, could therefore put it at risk of cancellation or deferment, despite the historical record of lesser projects, as a result of Presidential or Congressional reconsideration of either its technical feasibility or intrinsic politico-strategic desirability: it would have to survive around 8 presidencies and over 30 Congressional budget debates before completion. (The Soviet capacity to afford deployment of a comparable BMD system is considered in Annex C).

EFFECT ON OTHER US DEFENCE PROGRAMMES

28. Nevertheless, even if the projected cost of a complete defence system were to run into hundreds of billions of dollars, there is little doubt that, given sufficiently prolonged and consistent political will, the US would be able to supply the necessary funding. (Even if it were to total $1000 billion, this must be seen in the context of the current annual US Defence Budget of $300 billion and a likely timescale of around 30 years.) The key issue is the impact which such diversion of funds would have on other (especially conventional) areas of defence spending; and in particular on the US ability to maintain its present level of support for European defence. At a time when there are increasing strains on defence budgets throughout the Western world in order to provide for enhanced defence at the conventional level, and when these pressures are affecting national budget deficits especially in the US, there can be little doubt that an American decision to move substantially into SDI development will have a much wider impact on the defence of the West.

29. Throughout the transitional period towards the goal of leak-proof BMD, the US would need to keep its nuclear offensive forces in being; indeed, the requirement to develop the nuclear triad would increase. But the costs of these forces are considerably less than those of conventional forces. In the inevitable competition for resources, nuclear forces (which amount only to about 20% of the current US Defence Budget) could escape largely unscathed since they represent the highest US strategic priority. Cuts in conventional forces might then be needed to accommodate the new SDI demands and the existing resource competition would become even harder to resolve. Current attitudes in Congress towards the US military presence in Europe suggest NATO programmes are likely to bear at least a significant proportion of any cuts. (Notwithstanding present Congressional reservations about BMD, this tendency to question the conventional force commitment to Europe could paradoxically increase if Congress began to judge European attitudes towards the SDI as unjustifiably hostile.) This point is already recognised in Washington, particularly by the Joint Chiefs, whose reservations about space defences stem partly from their impact on other parts of Pentagon spending: the Chiefs continue to press for all SDI funding to be governed by a separate non-DOD budget.

30. Three other points are relevant:

a. to the cost of any BMD scheme, whether perfect or less than perfect, would be added the cost of the anti-BMD systems which would tend to be developed. A radical increase in the numbers of ballistic missiles against which the defences were ranged would not, so far as can be predicted at this stage, be enormously costly, and should certainly be cheaper than the BMD system itself. Any move away from the current emphasis on ballistic missiles towards more air-breathing systems, such as bombers and cruise missiles, with corresponding air defences, would carry new costs of its own. These would all produce an additional burden on defence spending;

b. were the Americans and/or the Russians to go for relatively simple Point or (Limited Area) Defences of their own strategic forces, the costs would be correspondingly less. Defence systems based on present capabilities eg land-based interceptors with ancillary radars, communications etc, would not prove an excessive burden. But as soon as defences incorporated advanced technology, especially in terms of space-based systems, there would be a quantum jump in the funding required;

c. Any development which led to a significant increase in Soviet ABM capability could generate considerable costs for the UK in maintaining the long-term credibility of Trident. This is discussed more fully in paras 45-48 below.

E. <u>ARMS CONTROL FACTORS</u>

<u>CURRENT TREATY ARRANGEMENTS</u>

31. At present military activities in outer space and defences elsewhere against ballistic missiles are constrained by four major treaties:

a. the 1972 Anti-Ballistic Missile US-Soviet Treaty (as amended) which allows the deployment around a national capital or at one missile site of a maximum of 100 interceptors, together with associated control radars. Only the Russians now exploit this allowance, by deploying an ABM system around Moscow;

b. the 1967 Outer Space Treaty which bans the deployment in space of nuclear and other mass destruction weapons;

c. the 1963 Partial Test Ban Treaty which prohibits nuclear testing in space; and

d. the SALT agreements which ban interference with satellites designed to monitor compliance with arms control agreements.

32. A full defensive system such as originally envisaged under the SDI would spell the end of this treaty regime. A Point (or Limited Area) Defence system, ie an extension of the present arrangements allowed under the ABM Treaty, need not be so damaging to the present corpus of international arrangements. Even so it would require substantial changes in the Treaty itself and might prove unnegotiable with the Russians, resulting in the collapse of the Treaty.

SIGNIFICANCE OF THE 1972 TREATY

33. The ABM Treaty is significant in two major respects. It codified the de facto acceptance by both sides of the principle of mutual deterrence: ie that they would live with the threat against themselves which stemmed from the negotiated limits on both offensive and defensive systems; and that they would not seek radically to shift the competition into defensive systems. Secondly, the ABM Treaty represents a significant political achievement in terms of East-West arms control. Decisions that required the abrogation or a major amendment of this keystone could have far-reaching political consequences in terms of future prospects for East/West relations. The ABM Treaty is subject to regular review but, unlike the SALT agreement it will last indefinitely unless terminated by one of the two parties.

EFFECT OF SDI ON OTHER ARMS CONTROL ARRANGEMENTS

34. There could also be direct consequences for other areas of arms control. Development of BMD systems which led to increases rather than reductions in offensive forces would destroy the basis not only of the present strategic arms constraints (SALT I etc), but also damage the prospects for further limitations. The likely political turbulence in Europe (discussed in Paras 11-16 above) which could result from BMD deployment might also complicate the already intractable problems in achieving some agreement with the Russians on INF.

35. The chances of preserving the Non-Proliferation Treaty (NPT) arrangements into the next decade and beyond would be jeopardized, with non-nuclear Parties less and less convinced of the good faith of the nuclear Parties to fulfil their commitment under the Treaty to reduce nuclear arms. The temptation to the near-nuclear states, particularly those not Parties to the Treaty, to use this excuse to take a domestically popular decision to acquire nuclear weapons, could become increasingly irresistible.

CONTROL OF THE OVERALL NUCLEAR BALANCE

36. In announcing the SDI President Reagan made no direct reference to a complementary arms control approach, which appears not to have been considered at the time. Arguably, the creation of a perfect BMD system - the President's declared objective - would in any case render limits on such systems via a negotiated agreement not only unnecessary but undesirable. However, (as noted in Para 9(h) above), SDI supporters do claim that defences will contribute to arms control by making existing high levels of offensive ballistic missiles redundant and thereby disposable. Pentagon projections foresee the SDI producing a better climate for arms control in some 15-20 years. The counter-arguments - that BMD/SDI will make arms control harder, not easier, by increasing the levels of offensive systems on both sides - were spelled out in Paras 10(c) and 21(a) above. Meanwhile, US statements continue to stress that the SDI is being conducted in compliance with the ABM Treaty and that there is no present intention of breaking or altering it. But there are increasing hints that, in the event of the SDI showing promise, the Treaty will have to be amended before long.

37. At the same time, US officials have argued that until such time as there is a clearer picture of the systems at issue, any attempt to construct a potential arms control regime would be premature and indeed fruitless. They also indicate that they intend to decide on options for development of hardware before tackling the possible arms control options which could then apply to that hardware. This would not be consistent with the increasingly emphasised public rationale that US SDI efforts are needed to counter Soviet activity. In that case, US interests would a priori be better served by early attempts to close off the prospective spiral of competition stimulated and led by the Russians, rather than to chase after them.

38. The further danger remains, as the history of arms control efforts demonstrates, that systems are developed in isolation and that the task of controlling them at a later stage is made immeasurably harder. The deployment in the 1970s of multiple, independently-targetted re-entry vehicles (MIRVs) is a case in point. US reluctance in 1969-70 to go for constraints, at a time when they led the Russians in the technology, eventually rebounded on them as the latter eventually overtook them and established the present threat to US ICBMs. There is now a general consensus (which includes Dr Kissinger) that the short-sighted US approach a decade ago, which made no provision for an arms control solution until it was almost too late, proved counter-productive. Given the variables involved, it is not easy to foresee how best an arms control regime could be constructed. For that reason further consideration of the current French proposal for a five-year renewable ban on SDI-capable weapons would seem desirable. An agreement of this kind would act as an interim measure while the longer-term picture cleared, and would prevent irrevocable steps. What is known of attitudes in Moscow (see Annex A, paras 9-13) continues to indicate that the Russians take seriously the possibility of new controls on defensive systems, and may well be prepared to negotiate in ernest with the US in this area.

LINKAGE BETWEEN OFFENSIVE AND DEFENSIVE CONTROLS

39. Despite current Soviet unwillingness to resume any negotiation similar to the START or INF talks, exchanges on defensive systems would inevitably, and within a short space of time, need to address the

concomitant problems of offensive nuclear forces. The catalyst necessary to resolve the present impasse in the nuclear negotiations could thereby be created. (Dr Kissinger has suggested privately that the SDI could have a certain value with the Russians in negotiating terms). An extension of this thesis, which has already won some acceptance among academics and US officials, is that space talks could be expanded not only to allow nuclear talks to be resumed but to provide the broader strategic setting in which agreement on asymmetries in both areas could eventually be reached. In other words, trade-offs could emerge between Soviet nuclear forces and future US technological superiority in BMD. The danger in pursuing such a linkage is that progress in each area could easily become dependent (or conditioned by either side) on the other. Opponents of negotiated results in one area would be able to block useful outcomes in the other, or could use the other side's alleged intransigence in the first field to justify their own in the second.

40. The Americans have not been slow to see the relevance of this link, in their response to the Soviet 29 June proposal. They have suggested in turn that the September talks in Vienna could deal not only with space issues but with ways in which the nuclear negotiations could be resumed. The immediate Soviet counter-reaction has been negative. But the link will be potentially important.

F. SPECIAL UK INTERESTS

THE UK AND STRATEGIC NUCLEAR DEFENCE: HISTORICAL BACKGROUND

41. The defence of the UK against any but the most limited nuclear attack by the Soviet Union has not been a practical proposition since the mid-1950s. Since then our defence polcy has been based on the deterrent effect of NATO's ability to pose a strategic threat to the Soviet Union, coupled with the ability of the UK's national strategic force also to pose a credible last-resort deterrent.

42. The credibility of Britain's national strategic deterrent against Soviet defensive and offensive systems has thus been an issue of major importance for the UK since the inception of the UK's strategic deterrent in the 1950s. Our perception of the decreasing capability of the V bomber force to penetrate Soviet air defences, coupled with the increasing vulnerability of a UK land-based strategic

deterrent, and the US cancellation of the Skybolt Air-Launched Ballistic Missile, led to the decision in 1962 to acquire Polaris, as the most affordable and efficient way of providing a credible deterrent with the prospect of a reasonable in-service life.

43. Both the US and USSR devoted considerable resources to ABM development during the early 60s, leading to clear indications of Soviet intentions to deploy such a system in 1966. The 1972 ABM Treaty clarified the extent of the problem which Soviet defences round Moscow would pose to the credibility of the UK's Polaris force. Work already underway on improving Polaris' capability to penetrate such defences was accordingly accelerated, and subsequently developed into the Chevaline project. This improved capability became operational in 1982.

44. By the end of the 1970s studies were underway on the replacement for Polaris. The continued importance of being able to threaten Moscow as the central feature of the UK's deterrence criteria was confirmed. Gradual improvements in the capability of Moscow's ABM system, and related technological developments giving the prospect of significant further enhancements to them during the life of the successor system were significant factors in the decision in 1980 to acquire Trident, and have remained major considerations in the recent Ministerial decisions on the missile numbers and warhead configuration to be adopted.

IMPLICATIONS FOR TRIDENT

45. The size of the UK Trident force in terms of the number of submarines, missiles and warheads will be dictated by HMG's concept of minimum credible deterrence and the concomitant requirement that UK national deterrence criteria be met by one SSBN-load of missiles. Thus, on current assumptions, 16 UK Trident D5 missiles each capable of deploying a number of independently targetable re-entry vehicles, will be able to threaten a prescribed level of damage to the Soviet homeland in the face of ground-based ABM defences deployed within the limits of the 1972 ABM Treaty. Our continuing ability to meet the criteria is however contingent on there being no break-out from the ABM Treaty which resulted in a significant increase in the number of ground-based ABMs especially around Moscow. Thus

small nuclear powers such as the UK would be affected not only by eventual deployment of Soviet space-based BMD but, in the nearer term, by enlargement of current ABM defences, or early and limited development and application of new technologies such as ground-based DEWs.

46. The emergence, during the lifetime of the UK Trident force (1995-2020), of a Soviet space-based BMD system able to destroy incoming missiles during their boost phase, before re-entry vehicles had been dispersed, and deployed on a scale necessary to match the full weight of the American strategic ballistic missile inventory would unarguably have serious implications for UK Trident. A force as small as our own, acting independently in defence of wholly national interests, would represent a small fraction of that necessary either to swamp Soviet defences or to exploit effectively any inherent "leak" in the system. Opponents of the decision to acquire Trident have already begun to argue that it will be rendered obsolete by Soviet BMD developments (See Annex A, Para 19). The extreme and loudly voiced technical optimism of certain US SDI proponents about the rapid attainability of capable BMD systems may provide ready arguments for such critics. Whether these views are justified or not they are likely, therefore, to form an important focus of domestic political opposition to the UK Trident programme.

47. But given the uncertainty surrounding the development of comprehensive BMD systems and their likely timescales, Trident is likely to remain the most robust solution to the problem of providing a successor to the present UK deterrent force. In this context the JIC recently concluded (JIC(84)2) that "for the moment, the best assessment that can be made is that it is unlikely that exotic ABM defence will threaten the credibility of a Trident based deterrent over the next two or three decades and it may never do so."
It is worth noting that submarine-launched ballistic missiles (SLBMs) have distinct advantages over ground-launched systems. The launch platform is immune to pre-emptive attack; furthermore, the exact point of launch (and hence the precise missile trajectory during the boost phase) cannot be determined in advance by the defences. The time from the first SLBM launch to the last missile completing the boost phase could be as little as 5 minutes, which would compound the problem of timely detection and effective reaction by the defences.

48. A missile with the range and throw-weight capacity of Trident D5 offers considerable scope for the introduction of additional countermeasures such as penetrating decoys or manoeuvering re-entry vehicles. Such countermeasures could be expensive, even though their costs would be insignificant relative to the scale of investment needed for an even moderately effective space-based BMD system. The cost to the UK of a countermeasures programme would depend largely upon the degree to which the US was prepared to embark upon such a project to maintain the effectiveness of its own much greater Trident force, and to share the results of its work with the UK. On the other hand if it were felt by the Americans that we were opposing crucial US interests (among which SDI might come to rank) continued cooperation over Trident for which we are already critically dependent on the US, might be jeopardised.

IMPLICATIONS FOR UK INTELLIGENCE CAPABILITIES

49. Although research into SDI might not have immediate arms control implications, any actual deployment of SDI systems in space would be incompatible with a future Treaty banning ASATs, since weapons capable of destroying ICBMs would necessarily themselves have a high intrinsic anti-satellite capability. In consequence it is very likely that Soviet countermeasures to SDI would include improved ASATs to attack the SDI components in orbit, and that such ASATs could attack other Western satellites as well, including perhaps those in high or geosynchronous orbits. Intelligence gathering satellites, on which the West relies to a greater extent than the Soviet Union, may therefore become more vulnerable than at present as a result of SDI, though they would presumably remain intact and available during the critical warning period leading up to hostilities.

50. As has been stressed in the recent MOD/FCO paper on ASATs, the UK is largely dependent on the US for space-derived intelligence and a wide range of technical support. The same factors affecting US/UK cooperation on Trident could come to influence the extent of the information flow in the intelligence field. The resultant impact on our military capability might be serious, and it will thus be doubly important to minimise the probability of any such UK/US rift by careful handling of any approach to the Americans on SDI.

IMPLICATIONS FOR THE UK ECONOMY

51. If the US developed and deployed a full BMD system the sheer scale of the enterprise (see paras 10(a) and 25-26 above) would be likely to have significant worldwide economic implications. Its huge cost would tend to compound the problem of the US budgetary deficit. Industrially, on the other hand, if, as seems likely, the SDI remained an almost exclusively American project, it might give a huge boost to US technology, especially in the data-processing and certain weapons fields. Together with various spin-offs in the civilian sector, this could leave US corporations as the sole suppliers of some of the key weapons of the next century, thus increasing the disparity in production of ultra high value-added systems within NATO and accentuating intra-Alliance economic strains. For the UK economy major uncertainties about the scale, nature and timing of the SDI procurement programme and the degree of involvement by the UK mean that only the broadest speculations are possible.

52. If the US went ahead with this programme on its own but allowed foreign participation, UK firms could expect to be involved at best only as sub-contractors. The extent to which they should attempt to do this would primarily be a matter for their commerical judgement. Our technology base would probably allow us to act as additional suppliers in a number of areas: eg C^3, sensors, software, components and support for space and ground segments. The prize of a share in eventual production could be great but would be likely to be preceded by a lengthy phase when only research and feasibility studies were on offer. Firms would also need to weigh the risks to their technology lead in areas where they were ahead of the US.

53. From a UK economic standpoint there would be conflicting considerations. We would eventually stand to gain the benefits of additional sales to USA, and though the quality and quantity of work would be largely controlled by US security and industrial interests, it would nonetheless be likely to contribute to UK industry's expertise and competitiveness in technologies of key future military importance. On the other hand the programme would divert research assets from other programmes, and in particular those manpower skills in software and micro-electronics which are

already in seriously short supply in relation to our present military and civil programmes. Some advantages from spin-off to the civil economy might be gained, but overall the effect would be to increase the percentage of the UK's highest technology industrial capacity devoted to military work. This is already higher for the UK than for most of our Allies.

54. If HMG were to become a partner, either with the US or European countries, to any significant extent in a BMD programme, as certain lobbyists have began to propose, a much greater scale of UK investment especially in R & D would almost certainly be needed. This would tend to increase the size of the UK's total research efforts and tilt its balance even further towards defence and away from civil projects. Our share of the high-technology end of BMD business might be greater (though it would be unlikely to include the most lucrative and far-reaching components), but the drain on scarce resources and skills would be correspondingly higher. The adverse effects on both other military programmes and the development of the civil economy would seem likely to outweigh any benefits from spin-off.

POSSIBLE REQUIREMENT FOR BMD BASES IN THE UK

55. Dr Keyworth, the President's Scientific Adviser and a prominent SDI advocate, said in a recent interview that any BMD system 'is likely to require some bases in Europe'. It is unclear what he meant by this statement but the main alternatives would seem to be tracking stations, communications centres or terminal defence systems such as interceptor rockets or DEWs. Such a proposal, if it were in due course made formally by the US Government, could raise political difficulties for HMG. Much would depend upon the prevailing public attitude to the US BMD programme and to US policies generally. The type of facility would also be important in the extent to which it might be thought likely to attract Soviet attack in an attempt to knock out the support systems for the overall BMD network.

G. POLITICAL HANDLING

56. The politics of the SDI will probably become more tangled.

The issue is likely to be the subject of sharp US debate especially during the election campaign. Were a Democrat President to be elected this November, present US plans would be radically altered. But if President Reagan is re-elected, he may remain personally committed to the project. Our close links with the US require that we tread delicately in any criticism of their proposals. For political reasons we must be cautious about treating the project, whatever the US Administration in power, in a negative and unconstructive way, without ideas of our own to offer. We must also encourage our European partners to steer clear of the same trap.

57. Apart from the near-term problems that would arise if the Europeans were seen to be taking sides on a major campaign issue, there is a continuing risk that the US will counter European criticisms with the following arguments:

(a) for years the intra-Alliance debate on extended deterrence has cast doubt on the credibility of the US nuclear umbrella;

(b) with the SDI the US is honestly trying to enhance the apparent credibility of its commitment to Europe;

(c) the Europeans are still keeping their heads in the sand and insisting on a dangerous status quo.

There are, of course, reasonable answers to all these accusations, as shown in the analysis above. But if Europeans were drawn into pursuing the debate in too crude or generalised a way, and in particular bringing their doubt about the US nuclear guarantee too much into the open the effects could be destructive and could provide an unwelcome encouragement to neo-isolationist sentiment in the US.

58. It will therefore be important that the European Allies should not in future seek to express concerns or criticisms in terms stronger (or less rational or sophisticated) than those voiced by Congress, the US media or informed opinion. In the SDI debate, as in the 1960s over ABM, the role of Congress will be crucial to the future of the programme. European views should be made clear to the Congress at the same time as consultations continue with successive

Administrations. We should continue to study the scope for practical and realistic UK proposals.

H. CONCLUSIONS

59. From the above analysis a number of conclusions can be drawn; even though the UK is not in a position to make definitive technical and political judgements:

(a) President Reagan's proposal for SDI has raised important and potentially divisive issues for the Alliance, Western Europe and in particular the UK. These will have to be addressed in the short term whether or not SDI is ever implemented;

(b) there is very little chance that, in the face of likely Soviet countermeasures, a reliable system of leakproof defence against ballistic missiles, as envisaged in President Reagan's March 1983 speech, can be created;

(c) even if this were possible, the transition period between the present situation and total BMD would be a time of potentially grave instability. Nor would such a defence provide protection against non-ballistic missiles threats;

(d) BMD systems offering less-than-perfect protection would be open to the above and other objections, and would encourage the proliferation of offensive systems and increased counter-city targeting;

(e) the balance of advantage in Point (or Limited Area) Defence systems, which strictly speaking are separate from SDI, would require further analysis should the US or the Soviet Union move towards their deployment;

(f) the likelihood of a large-scale Air Defence programme to achieve a concomitant leakproof defence against non-ballistic missile threats lies beyond the scope of this Paper, but may be affected by BMD developments;

(g) after prodigious expenditure and periods of transitional strategic instability, development of BMD could well leave the fundamental nuclear balance between the US and Soviet Union unchanged. In theory there might thus be no effect on the major incentives influencing a US President to risk US cities in support of America's overseas Allies and interests;

(h) for Europe, on the other hand, the effect of US BMD deployment might, in the worst case, have far-reaching consequences for the continued cohesion of the Alliance and no strategic benefit;

(i) the enormous and increasing cost of BMD over a period of years is likely to have adverse effects on other US defence programmes, especially for conventional forces, of more direct importance to UK security concerns;

(j) dramatic expansion of the SDI programme would challenge a fundamental aspect of US-Soviet relations, with dangerous consequences in both the arms control field and for East/West relations generally, not least because of the inevitable impact on the ABM Treaty;

(k) conversely, early exploration of the arms control possibilities relevant to defensive systems could provide a way of breaking an expensive spiral of technological competition and provide a platform for improving US relations with the Soviet Union, as the ABM Treaty did in 1972. Conceivably it could also create an inducement for the Soviet Union to end the present impasse in negotiations on offensive nuclear forces;

(l) BMD developments could, in the longer term, have serious implications for the UK national deterrent. In military terms the effects on UK Trident might be sustainable but the necessary countermeasures could be expensive. In any event, political opposition in the UK to the preservation of this essential element in UK national defence could well be strengthened;

(m) opportunities for British industry to obtain BMD-related work are likely to be few. They would in any case be concentrated in a few already overloaded high-technology sectors. But a massive US BMD programme could give a competitive advantage to US industry in some key military and possibly civil technologies of the next century;

(n) because of our particular dependence on the US for our Trident programme and for satellite-derived intelligence, any approach to the Americans on the SDI must be careful to minimise the possibility of a rift which could have an impact on our wider military capability. On the other hand Soviet countermeasures against space-based US BMD could well mean that all satellites would eventually be put at greater risk;

(o) the SDI has caused friction within the Alliance, and is subject to growing scepticism in the US. Congressional sentiment appears to be moving against its implementation, and financial doubts among the US uniformed services seem to be be growing;

(p) despite the above, the US needs to maintain, in the form of a continued research programme, a prudent hedge against future Soviet BMD developments.

I. RECOMMENDATIONS

60. Ministers are invited:

(a) to take note of current US plans and intentions and what is known of Soviet programmes;

(b) to note the arguments expressed for and against continued development of BMD systems by the superpowers, and at the same time the particular grounds for UK reservations about such development;

(c) to note the positions already adopted by most of our European partners, notably the French and Germans;

(d) to agree that serious attention should be devoted to the apparent balance of advantage to be gained from practical measures of arms control in the BMD field;

(e) to agree to consider further the ways in which the above reservations could be suitably expressed and arms control measures further examined, taking care to distinguish between possible private approaches to the Americans and other Allies, and potential public positions to be adopted by HMG;

(f) to encourage the US Administration in the meantime to continue detailed consultations with their Allies, including further bilateral exchanges with the UK.

RESPONSES TO THE US SDI

GENERAL

1. President Reagan's March 1983 speech came as a bomb-shell for the international community and almost all his own senior advisers, not least in the Pentagon. At one stroke, without any consultation of the Allies and with virtually none within the Administration, he had called for a radical change in strategic planning and doctrine. He had overturned the politico-military assumptions which had governed international strategy and Western defence structures since the early 1960s. Such a dramatic step was partly the result of the arguments put to the President by a small group of US scientists, predicting that in the distant future systems providing for the sort of defence he advocated might indeed be feasible. More important, the President himself on reviewing in January the recommendations from the Joint Chiefs of Staff for enhancing further the destructive power of US nuclear forces appears to have recoiled from the seemingly endless spiral of offensive technology. Added to this factor was his understandable reluctance to allow the survival of the United States and of the Western world to depend ultimately on the rationality of a group of Communist leaders in the Kremlin; and perhaps the innate attraction in the United States of an apparently desirable technological fix, to dissipate increasingly burdensome political problems.

THE DEBATE IN THE US

2. The President's March statement led to immediate critical comment from Europe, and in large measure from within the United States. Doubts were expressed about the technical feasibility of the SDI; its effect upon strategic stability; the financial implications; and, in Europe, the implications for the Alliance. (It has been a notable feature of the US domestic debate since then that the effects of SDI on the Allies have been largely ignored). Two weeks later the prestigious and bipartisan Scowcroft

Commission released its Report on Strategic Forces which included the judgement that "no ABM technologies appear to combine practicality, survivability, low cost and technical effectiveness sufficiently to justify proceeding beyond the stage of technology developments". Criticism was quick to die down, partly because the INF deployments dominated the strategic scene for the rest of 1983, and partly because many people still tended to dismiss the SDI as the "Star Wars" fantasy it had been labelled. As US officials set out their own aims in a non-paper passed to the UK: " we seek to minimize near-term negative reaction to SDI by keeping US discussion of the programme low key and by providing concerned audiences with information about Soviet activity in this area". The Administration commissioned two major studies on SDI prospects; the strategic implications (Hoffman Report) and the defence technologies available (Fletcher Report).

3. With the publication of these two Reports, the debate revived, stimulated by a spate of renewed criticism from non-official sources and leaks from within the Administration that the whole SDI concept was being re-thought. Two major reports, from the Union of Concerned Scientists and the Congressional Office of Technology Assessment (which the DOD are seeking to have withdrawn on the grounds of alleged technical inaccuracies), argued that the entire initiative was technically doomed, apart from the strategic drawbacks. While the creation of an SDI Task Force under General Abrahamson in the Pentagon in March 1984 underlined the determination of Secretary Weinberger and at least some of his senior colleagues that the initiative should be taken seriously, scepticism began to be more strongly reflected in the attitude taken within Congress.

4. At this stage Congressional doubts about the SDI are concentrated on the technical, strategic and financial aspects; little has so far been heard from the Hill about the impact on the Alliance. In contrast to its role during the strategic arguments of the late 1970s, Congress can now occupy a key position in the SDI debate. In the case of the former, the systems concerned were largely already developed and deployed, with the result that the chief leverage of Congress - control of the purse strings - was not effective. However in the case of the SDI, as with the MX development, Congress can exert a potent influence, possessing the ability to control the pace at which the Administration move down the development road, if at all. In other words, Congress

can now replay, in terms of influence, the role it adopted during the previous ABM debate which began in the mid-1960s; and Dr Henry Kissinger recently told the Foreign Secretary that in his view Congress would most probably kill the SDI.

5. These cross-currents of debate over the past 18 months have produced changes in the Administration's own attitudes, and public statements about the SDI. One point has, however, remained unaltered: the President's insistence that the SDI represents only a research and development effort, and that no decisions can or will be taken on the next stages until some years have passed. Meanwhile whatever is done will continue to be fully consistent with US obligations under the 1972 ABM Treaty.

6. In his speech the President acknowledged that "it may never be possible to achieve these aims" (of perfect defence). The major change has been in a wider acceptance within his Administration that a totally leak-proof system of defences may never be achievable. As the technical obstacles to approaching this goal, let alone achieving it, have become clearer, US officials have begun to talk in terms of the SDI producing a partial defence of US targets against Soviet ballistic missiles. The argument has begun to shift away from the implications of total defence towards the traditional arguments, widely debated in the 1960s, about the impact of partial defences (eg for missile silos) on strategic stability.

7. Another change in the Administrations's approach is reflected in the increasing emphasis on Soviet efforts in this field as the justification for the US enhanced research programme. It is striking that at the time of his March speech, which was largely devoted to criticism of increased Soviet military efforts, the President made no mention of Soviet work on BMD. This argument to justify the SDI only began to be developed in the autumn of 1983, as the Administration came under increasing criticism for pursuing their own programme. By February 1984 US officials were emphasizing that Soviet efforts alone were sufficient justification for the US continuing to pursue the SDI. The position is to some extent accepted even by their critics, who believe in the light of what is known about the Soviet programmes that the US cannot

sensibly refrain from pursuing some sort of efforts of their own as a prudent hedge against a sudden Soviet breakthrough. Within the Administration, however, there is little disposition to accept that just such an argument could be advanced with equal justification by proponents in Moscow of defence systems. The advantages of the "prudent hedge" are so far seen as applicable to the US alone.

8. A further twist in the political debate in Washington has been the increasingly willingness, (albeit grudging on the part of some officials) of the Administration to accept that some sort of dialogue with the Russians on this area can be pursued. Shortly after the March 1983 speech the Russians had privately offered talks between scientists on BMD research. The US had accepted these, provided these were held on a government-to-governement basis. But it was not until May 1984 (in a speech by Secretary Shultz) that the Administration went on the record as prepared to conduct such a dialogue. The 31 May NATO communique recorded (largely as a result of FRG insistence) the welcome given by the Allies to this "willingness of the United States to discuss with the Soviet Union research programmes on strategic defence". However, they continued to resist the long-standing Soviet proposals for formal negotiations on a treaty to ban the use of force in outer space and especially anti-satellite systems (ASATs), until they gave a swift and positive response to the Soviet proposal of 29 June for discussions in Vienna in September to cover all issues of militarisation of space, including both ASATs and anti-missile defences. The stage is now set for the next move in this hesitant dialogue, despite lingering doubts among some in Washington about the desirability of such a process.

SOVIET RESPONSES

9. In their public position the Russians have come a long way from 1967 when Mr Kosygin stated that "the defensive systems which prevent attack are not the cause of the arms race but constitute a factor preventing the death of people - maybe an anti-missile system is more expensive than an offensive system, but it is designed not to kill people but to preserve human lives." (This statement is close to the position now being advocated by some in Washington, but disavowed by official US statements). Despite having closed the ABM race in 1972 with a single deployment

of systems around Moscow, the Russians have continued research (as permitted) into defensive technology. In recent briefings for the Allies, US officials have hinted at far-reaching Soviet gains. UK assessments are less conclusive, and the evidence for US claims has yet to be fully established. The extent of Soviet progress in this field is more fully assessed in Annex C.

10. Expressions of Soviet concern at the increasing military competition in space has however become more vocal. As the Foreign Secretary said on his return from Moscow in July, it is possible to "detect in their minds a real anxiety about arms in outer space ... and an element of seriousness in what they say". Their own crude ASAT capability will shortly be outstripped by a more sophisticated US system. The history of the development of both civil and military capabilities in space suggests that in any technology-based competition there must be a risk that they will be outstripped by the Americans. It will not however be a race in the classic sense, just as the development of nuclear arms reflects competition and confrontation but not a race. In neither case is there likely to be an ultimate winner who, on reaching the finishing line, will have nullified all the efforts of his opponents. In the case of space systems, as nuclear arms, even if the Russians were to lag behind the Americans it is inconceivable that they would drop out of the competition altogether. And the history of MIRV development suggests that the technological edge of the US may well turn out to be less decisive than originally supposed.

11. Given these concerns it is not surprising that for the past three years the Russians have actively pressed for negotiations on new agreements limiting military deployments in space. These have been heavily slanted in the direction of Soviet interests, designed to rest upon unverifiable declarations and to foreclose military options which the Russians have either developed themselves already (in the case of ASATs) or in areas where they fear US superiority (as in the case of the Shuttle). The Soviet draft Treaties in 1981 and 1983, proposing severe restraints on anti-satellite systems and wider provisions for banning the use of force in space, have been the basis for the Soviet public platform. In recent months President Chernenko and a host of Soviet senior officials and commentators have harped upon the need to avoid the

militarisation of outer space, and have found an international response to this theme. The 29 June proposal is the latest and most comprehensive offer to seek ways to close off the military competition in space. The Soviet leaders no doubt see the SDI as a readily available and attractive propaganda stick with which to beat Washington; this became evident during the Foreign Secretary's visit to Moscow in July. But they may have misjudged its potential, and their ability to exploit it in the face of a skilful US response.

12. This approach need not on the other hand conceal genuine anxieties felt by Soviet leaders, on the grounds of self-interest alone, about the ultimate outcome of current US efforts. A Soviet study passed privately to UK officials last October set out in considerable detail the concerns, ostensibly felt by Soviet scientists, at the strategic, political and financial implications of the SDI.

13. For the Russians, the SDI represents a major challenge. At worst it could strike at the heart of their only real claim to superpower status. It would challenge their ability to find the necessary resources to maintain their status. The Russians will do what is necessary, but at great cost given the relative sizes of the two economies and the less well developed Soviet technological base. It is also a severe challenge to a central aspect of US/Soviet relations enshrined in the 1972 Mutual Relations Agreement: "The prerequisites for maintaining and strengthening peaceful relations between the USSR and USA are the recognition of the security interests of the parties based on the principle of equality and the renunciation of the use or threat of force."

WESTERN EUROPE

14. The initial reaction in Western Europe to the President's March 1983 statement was irritation at the failure even to attempt consultation before launching such a dramatic and far-reaching initiative and some incredulity that the Administration could seriously intend to move down this path. Since then, reaction to the President's plans throughout the rest of NATO has become increasingly critical and vocal. The FRG Government, with Woerner and Genscher in the lead, have made no secret either in private

or in public of their antagonism to the SDI. The French have also opposed US plans. They launched publicly (and without prior consultation) in June at the Geneva Conference on Disarmament (CD) a range of proposals for outer space arms control which included a renewable five-year ban on the development, testing and deployment of any directed energy weapons.

15. Other Allies have adopted much the same approach, criticising defence systems as potentially decoupling, destabilising, destructive of previous and still valid arms control agreements, and financially crippling. There seems to be a growing sentiment within the Ten that the Community as such should establish its own position towards arms control in outer space; by implication, this would differ from the present US approach. The French are also talking (despite the obvious difficulties this would raise for Alliance cohesion) about a revived WEU adopting space issues as one of the major subjects for its new range of discussions. Only the Japanese have been relatively equivocal in their attitude towards the US plans, an approach dictated perhaps by an interest in the industrial possibilities which a fully developed SDI may produce for Japanese industry, but perhaps more by a reluctance to oppose the Americans on a key security issue.

16. Despite US commitment to consultation within the Alliance and two briefings given to NATO, this has until recently been sparse and unsatisfactory. Prior to the ABM Treaty, senior UK and US officials held wide-ranging formal discussions in the mid-1960s about BMD issues. (The records of these exchanges are available if required; they indicate the wide range of subjects covered, the depth of UK concerns, and the similarity between the issues under debate twenty years ago and at present.) There has until now been no similar offer from the US side this time, but the Administration are apparently beginning to recognize the need to take at least their closest Allies into their confidence. The latest discussions, in Washington on 17/18 July, showed signs of developing into the sort of continuing dialogue which the Allies are seeking.

17. In the rest of the world, the space debate has yet to make much impact. At the Geneva CD and at the UN the Russians and the

radical non-aligned have won a number of easy but unimportant propaganda victories. At the 1983 General Assembly, 126 countries voted for a resolution calling for negotiations on space arms control, including ASATs; the only country to vote against was the US, and the only one to abstain (for reasons of solidarity with the US) was the UK. The non-aligned, insofar as they participate in the debate, favour a radical approach, namely the entire demilitarisation of outer space, a position they (and the Russians) advocate both in disarmament talks and in the UN meetings on the peaceful use of space. So far they have not been prepared to accept that this is totally unrealistic approach. In any case, their contribution to the real debate, as in the past, is unlikely to be substantial.

THE UNITED KINGDOM

18. HMG has welcomed in the NATO ministerial communique of May 1984 US-Soviet contacts on strategic defence and later the US acceptance of the Soviet proposal of 29 June on outer space arms control talks. HMG have not provided detailed comments in public on the SDI. Ministers have underlined our wish to conduct a serious study of all the issues; and on 28 June this year the Prime Minister confirmed in a Written Answer that "we remain anxious to prevent an arms race in outer space". The Foreign Secretary has welcomed the US response to the Soviet proposal for talks in Vienna, and urged the need for these to begin. In a speech at the Guildhall on 11 July, the Prime Minister spoke of "the new and urgent challenge of arms control in outer space" and the need to prevent space becoming a "new and terrible theatre of war" through "negotiation and mutual restraint".

19. The public debate in the UK has followed lines similar to that in Western Europe. The general approach in the media has echoed the words of the "Daily Telegraph" (21 June): "The SDI is an irresponsible and wasteful chimera which, as an answer to the dilemma of nuclear vulnerability, is on a par with the solution offered by the unilateral disarmers". Most informed opinion in this country, political and scientific, tends to dispute official US claims and arguments. There is growing interest in the range of issues within Parliament, with a number of MPs on both sides

of the House questioning US intentions. The Select Committee on Defence, in its Report on the 1984 White Paper, drew attention to the potential ability of a defence system to negate the UK deterrent based on Trident; other MPs have expressed similar disquiet. The Report expressed a preference for further international agreements in this area to replace superpower competition; and it urged the Government to make their concern known before the US Administration took any irrevocable decisions. Opposition parties, like the Democrats in the US, are committed to seeking "an end to the arms race in outer space" and are against the deployment of BMD.

ANNEX B

BALLISTIC MISSILE DEFENCE (BMD) - TECHNICAL ASPECTS

A. INTRODUCTION

1. In the past there have been no wholly affective technical means of defending against a strategic ballistic missile attack and strategic deterrence concepts have been based on the overwhelming advantages of an attacker and the concept of mutual assured destruction. ABM systems such as that currently deployed around Moscow would have some effectiveness against a limited attack but would almost certainly be very "leaky" and, in any case, unable to cope with the massive attack which could be mounted by a superpower. Although improved defences can be obtained by moving to layered defences (exemplified by the development of a two-layer defence around Moscow) to increase the number of opportunities for intercepting an incoming warhead and hence reduced "leakiness", or by increasing the number of ABMs (which would breach the existing ABM Treaty) the attacker could readily restore his advantage by the application of existing or feasible technolgies to provide improved penetration, and also by increasing the sheer number of warheads.

B. NEW DEVELOPMENTS

2. In recent years there have been marked advances in the development of directed energy devices such as lasers, particularly in power levels, which have moved them on from being merely interesting and useful devices in science and technology to the potential for forming the basis of weapon systems - so-called directed energy weapons (DEWs) - for use in all theatres of war including space. In principle it is now feasible to consider seriously the use of DEWs to destroy or disable strategic ballistic missiles or their dispersed re-entry vehicles at very long ranges, perhaps up to several thousand kilometres. The totally different characteristics of DEWs compared to those of "traditional" ABMs have allowed a fresh look at the problem of providing effective defence against strategic ballistic missiles and the "Star Wars" speech by President Reagan on 23 March 1983 has served to intensify studies in this area. A number of quite detailed technical

studies, official and unofficial have been carried out in the US and the essential arguments and conclusions have been published openly. Figure 1 shows schematically the type of comprehensive BMD system which seems to be emerging as feasible.

C. CONTINUING LIMITATIONS OF BMD

3. It should however be emphasised that, while the new technologies considered below may now begin to bring defences against ICBMs to the verge of feasibility, other nuclear delivery means such as air-breathing systems (cruise missiles and bombers), depressed-trajectory ballistic missiles, and nuclear artillery will remain difficult or impossible to counter with certainty. This is because of factors like short flight time, atmospheric attenuation of DEW effects, and new "stealth" technologies. Nor could a fully functioning SDI system provide protection against possible low-technology nuclear blackmail through devices hidden in embassies, terrorist safe houses, or ships in harbour.

DIRECTED ENERGY WEAPONS (DEW)

4. A directed energy weapon essentially consists of a narrow, nearly parallel, beam of pulsed or continuous electromagnetic radiation or atomic particles which can deliver concentrated and damaging energy to a target over long ranges in space at or near the velocity of light (300,000 km/sec). The effective range is limited by the inevitable divergence of the beam causing energy concentration to fall off with distance. Within the atmosphere effects of attentuation and distortion markedly reduce DEW performance.

5. Three main types of DEW have potential application to BMD.

a. A laser provides an intense focussed beam of electromagnetic radiation in the form of ultraviolet, visible or infra-red light. Laser beams can damage boosters in two ways, either by applying power for sufficient time to burn through the missile skin or by hitting the target with a very high energy pulse to cause shock damage. A special case is the x-ray laser, now in its infancy, which uses the concept of generating from a nuclear explosion a directed single pulse which could be very damaging by means of the impulse imparted at the target.

b. A particle beam is formed by accelerating charged particles to velocities approaching the velocity of light by means of high voltage fields. Charged particle beams have unsatisfactory characteristics for direct use as damage weapons because of charge repulsion (causing divergence) and bending by the Earth's magnetic field. However by "charge stripping" a charged particle beam can be converted to a neutral particle beam having the required characteristics. A special case is an electron beam which, although charged, does have some potential for a short-range DEW eg for ground-based terminal defence. Particle beam weapons would cause damage to the target by a variety of mechanisms ranging from disruption of electronic components at lower levels of energy deposition to melting of structures at high levels.

c. In a radiofrequency weapon the power from a microwave source would be directed on to the target by a large radar-like antenna. However, the energy cannot be concentrated to the same extent as with lasers and particle beams, and would only be of use for damaging electronic systems. This, though, might in itself be an effective means of disabling a ballistic missile.

KINETIC ENERGY WEAPONS (KEWs)

6. The high-velocity kinetic energy projectile, a well proven concept, is capable of development to even higher velocities, say up to 200 km/sec by means of electric rail guns. This velocity is still relatively slow compared to that of light, and KEWs would therefore have a restricted range of interception for the boost phase (see para 8 below for the importance of this). KEWs may, however, have greater potential for mid-course intercept if fired from satellites. Some form of terminal guidance would probably be required and this could be provided only for relatively large and therefore slow projectiles. A direct KEW impact would produce an almost certain kill whatever the size of projectile.

OVERALL CONCEPT

7. The SDI goal is to eliminate the threat posed by nuclear ballistic missiles. It has been generally accepted that this could not be achieved by relying on interceptions during only one of the four phases of flight (see Figure 1). An effective defence would need to be based on interception during several phases with leakage being cumulatively reduced at each stage. Thus an integrated BMD system could well involve a combination of space and ground-based DEWs and more traditional ABMs. For example, during the boost phase, while the missile was in the upper atmosphere and entering the space environment, space-based DEWs could be used to attack it (Stage 1 in Figure 1). DEWs or missiles could then be used for post-boost or mid-course interception in space of the missile "bus" or any of its re-entry vehicles which had already been dispersed (Stage 2 and 3 in Figure 1). Later ground-based DEWs or ABMs could be used to attack re-entry vehicles or other threat bodies in the upper atmosphere, or lower down as last moment Point Defence of selected targets, eg missile launchers (Stage 4 in Figure 1). There would be a minimum height (a few kilometres) of useful intercept for protecting "soft" targets such as cities because incoming Re-entry Vehicles (RVs) might be "salvaged fused" so that their warheads would detonate on interception.

IMPORTANCE OF BOOST-PHASE INTERCEPT

8. The greatest potential for effective defence is in the destruction of the missile during the boost phase as this would, at one interception, remove all the nuclear-armed RVs and associated penetration aids which at later stages in the flight could constitute up to hundreds of credible threats each warranting separate interception. The Infra-Red signature of the rocket boosters also provides an exceptionally clear target for the BMD sensors to pick up. Preliminary research for the SDI has therefore highlighted the importance of DEWs as the only weapons realistically capable of achieving boost-phase interception.

D. ELEMENTS OF A BOOST-PHASE INTERCEPT SYSTEM

9. For boost-phase interception it is clear that the defensive system must be stationed in space in order to have a line-of-sight to the ballistic missile during the early stage of flight and to be capable of rapid response. It follows that the defensive system would need to use satellites, of which a sufficient number would have to be arranged to provide an adequate potential intercept capability over ballistic missile launch sites at all times. The number of satellite battle stations thus required would depend on the effective range of their DEWs. At the extreme, a small number of geostationary satellites could be used but these would necessarily involve a minimum range of about 36,000 kilometres - probably much too great for effective DEWs. It has also been suggested that it might be possible to station laser beam weapon generators on the ground, and redirect their beams on to their targets by mirrors in space. This, though, would introduce additional problems caused by atmospheric effects on beam propagation, and would still require a large part of the system, eg sensors, re-directing mirrors and control mechanisms, to be satellite-mounted.

10. Other key elements of a defensive system include the following:

a. Surveillance and target sensing/acquisition/tracking. The basis for the detection of the launch of a strategic ballistic missile could be sensing of the very hot rocket exhausts. However, much more precise methods would be required to define the missile positions sufficiently accurately to intercept with a DEW. Surveillance monitors could be stationed independently of the DEW satellites and might be mounted in geostationary satellites.

b. Aiming and Pointing the DEW. The DEW beam must be exceptionally stable if there is to be successful interception. Furthermore, even for a beam travelling at the speed of light, the missile target would move a significant distance during the time of passage of the beam, so the beam would need to be pointed at the correct distance ahead of the target and to be kept on target by "panning", eg about 10 metres at a range of 1000 km, at the correct angular velocity for sufficient time to inflict lethal damage. It would also be necessary to incorporate means of correcting errors in aiming and pointing. The accuracy and stability requirements represent a most severe technical challenge, particularly if, as is likely, the DEW would need to be capable of switching rapidly from one target to the next.

c. Confirmation of Kill. It could be a very difficult problem to detect to what extent, if any, the target missile had been "wounded" and whether the damage was lethal, at least until it was too late to re-attack during the boost phase. This could be an important aspect where the damage could be too subtle, eg to internal electronics, to be readily observable from outside.

d. Power Sources. All SDI concepts involve the rapid generation of chemical, electrical or nuclear energy on command. The very large amounts of directed energy required, often by relatively inefficient conversion processes, could lead to correspondingly large power sources (including fuel requirements of several tons), probably much heavier than any single satellite that has yet been launched.

e. Reliability. Most of the defensive system, especially those elements based in space, would need to be passive, perhaps for many years, and yet able to move immediately into action on demand. This situation presents enormous problems of reliability and its assurance.

f. Survivability. The defensive system would need to be survivable in face of possible pre-emptive attacks by an enemy. Given the range of threats, including the use of anti-satellite weapons, it could be extremely difficult or impossible to provide assurance of survivability.

g. Battle Management. Automated management would have to ensure effective functioning of a enormously complex defensive system involving a multiplicity of sensors, weapons, targets, decoys, threats, and communication channels. It would have to provide complete confidence, in advance, that it would operate effectively when needed "for real" even though no full "dress rehearsal" would ever have been possible. This unparalleled software generation and validation task presents perhaps the greatest obstacle to the achievement of an effective operational system.

E. COUNTERMEASURES

11. In considering the potential of new technologies to provide improved BMD systems it is necessary to give equal attention to potential technologies available for providing effective countermeasures.

ACTIVE COUNTERMEASURES

12. These would involve direct attacks on the BMD system itself. Satellites are very vulnerable to attack and, in general, any space-based BMD sub-system would be difficult to protect against ASATs, especially as they would have to include inherently soft elements such as sensors and mirrors. Pre-emptive nuclear bursts in space could produce widespread damage to sensors and communications. Ground-based elements would be vulnerable to attack by sabotage and by non-ICBM strategic delivery systems, eg cruise missiles and submarine-launched ballistic missiles (SLBMs) on depressed trajectories.

PASSIVE COUNTERMEASURES

13. A number of methods already exist within the capacity of existing technology, eg completion of boost phase within the atmosphere (to shorten the time available for BMD interception during this phase and to use the atmosphere as a shield against DEWs); rotation of the launch missile (to spread the deposited energy of the DEW beam and lower its effect on any point on the structure), provision of protective coatings to absorb DEW energy without damage to underlying structure, and deployment of decoys, including hot flares.

14. Changes to ICBM launch site locations (by construction of new fixed sites or concerted movements of mobile launchers) could

also be used to increase the scale of the defender's problems. Non-geosychronous satellites necessarily move round the whole of the earth's surface and cannot sit stationary over a single point such as an ICBM site. At any given moment, therefore a continuously circling network of orbiting battlestations would be need to provide DEW coverage of all potential launch sites, including the oceans with their SLBM threat. Regrouping ICBM launchers into a relatively dense cluster would mean that they would all have to be countered by the few satellites within range. The DEW firepower of the rest of the satellite network would become unavailable at the crucial moment (in technical terms, the "absentee ratio" would have worsened). The defence would thus need a large increase in satellite numbers or the capabilities of individual satellites to prevent the numbers of ICBMs being launched simultaneously from the ICBM cluster overwhelming the BMD system's boost-phase intercept capability.

FEASIBILITY

15. The feasibility of deploying operational BMD systems to meet the objectives of the SDI depends not on the scientific concepts themselves, which are founded on well-established physical principles, but on overcoming the enormous technology gaps which exist in critical areas, and the further "reactive" problems posed by likely anti-BMD countermeasures.

16. To achieve perfect or near-perfect defence against present levels of deployment of ICBMs alone a BMD system might need to comprise several hundred satellites, a large proportion carrying a DEW and associated power supply weighing possibly several hundred tons. Other satellites would have to carry pointing and tracking optical systems each of which would need to be larger, more stable and more accurately fabricated than the most powerful land-based astronomical telescopes now in existence. Additionally there would need to be deployed potentially hundreds of thousands of non-nuclear ABMs and up to a hundred ground-based large radars. It is unlikely that a fully integrated and functioning system of this kind could be deployed for another 30-40 years. However, taking into account the inherent vulnerability of a space-based system to ASATs which, together with all the other possible anti-

BMD countermeasures would also have had 4 decades to mature, it seems probable that even then the goal of perfect ballistic missile defence would remain unobtainable.

Figure 1 Schematic Representation of Multi-layered Ballistic Missile Defence System

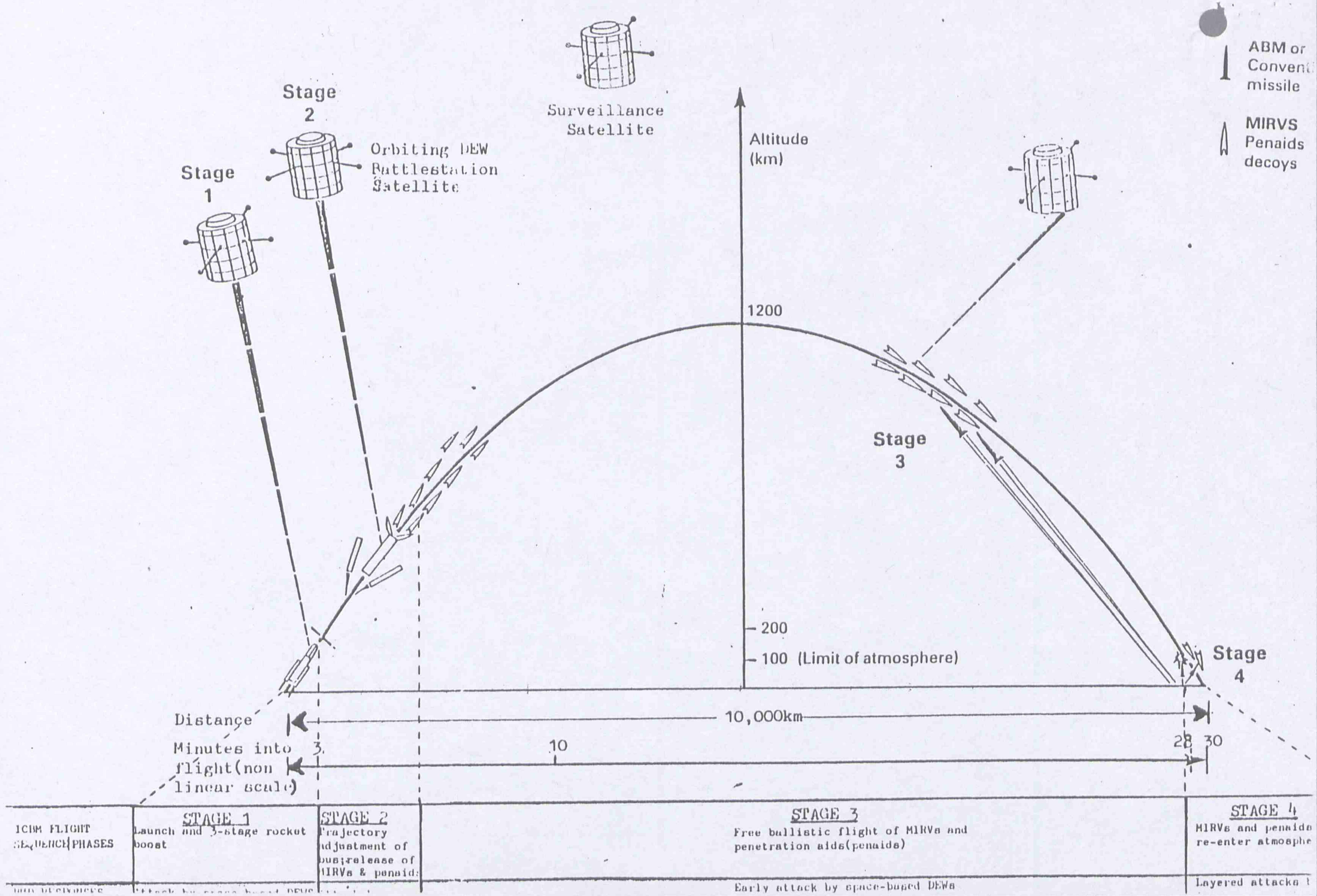
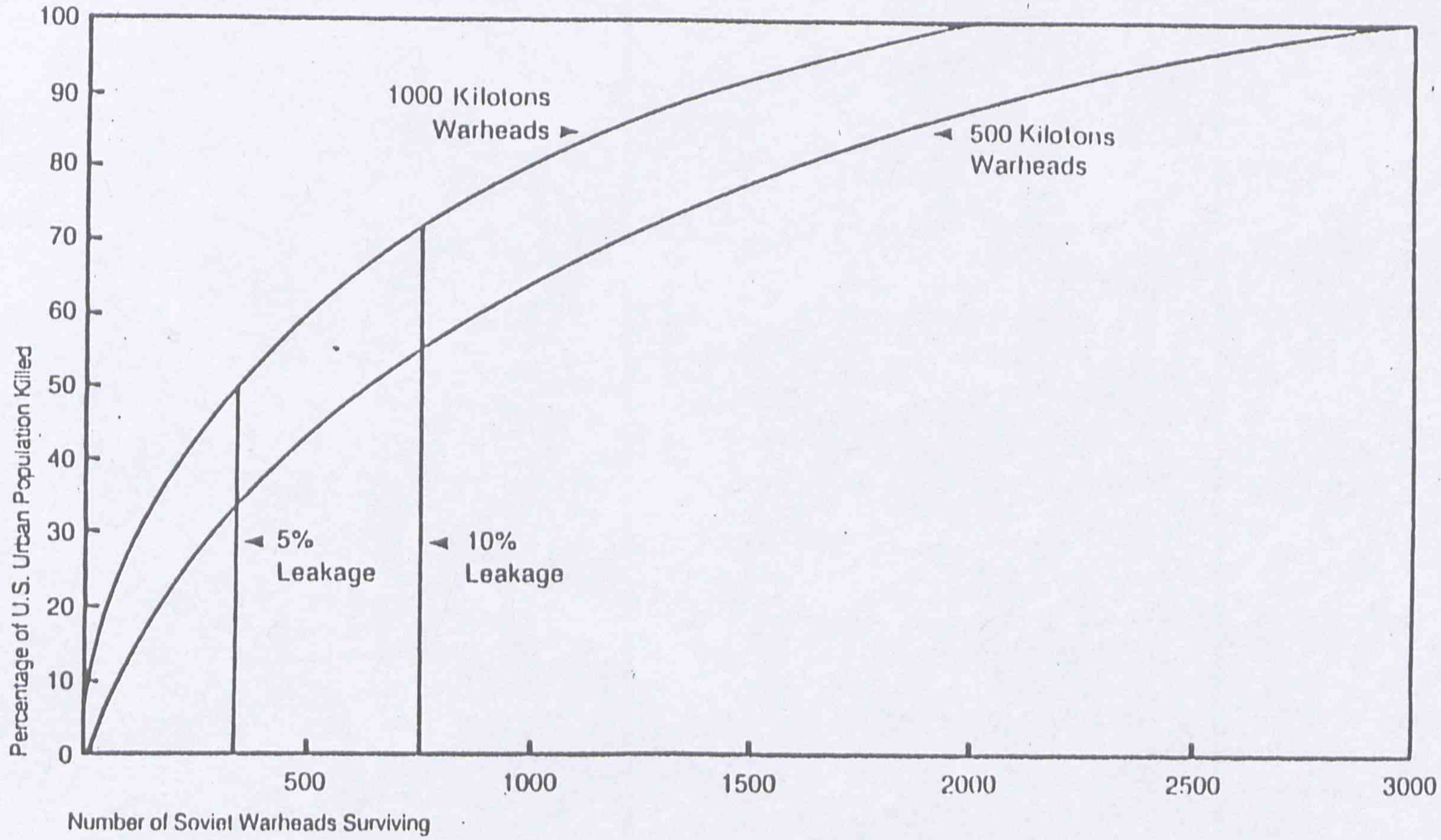


FIGURE 2

Effect of BMD Leakage on U.S. Urban Fatalities



Source: Adapted from Arms Control and Disarmament Agency, *U.S. Urban Population Vulnerability* (ACDA, 1979), quoted in Carter and Schwartz, eds., *Ballistic Missile Defense* (Brookings, 1984).

Note: Aimpoints chosen to maximize prompt human fatalities. Assumes current Soviet ICBM and SLBM warhead total of approx. 7500. Assumes U.S. urban population of 131 million, as in 1970 census.

ANNEX C

COMPARATIVE US AND SOVIET BMD ATTAINMENTS AND CAPABILITIES

A THE USA

ABM

1. The 1972 ABM Treaty allowed both the US and USSR each to deploy up to 100 ABM interceptors either round the national capital or an ICBM field. The Americans chose to defend the ICBMs at Grand Forks, North Dakota and built up an ABM complex there based upon the Safeguard system. This was, however, deactivated on grounds of cost effectiveness, soon after becoming operational in 1975, with the perimeter acquisition radar remaining in use as an early warning system. Research nevertheless continued throughout the 1970s and early 1980s on ABM-related technologies. By early 1983 before the Presidential launching of the SDI, Department of Defence and Department of Energy (DOE) expenditure of $1.75 billion was already being proposed for FY 1985 in areas such as:

a Infrared (IR) sensors for improved tactical warning of ICBM attack under the USAF's advanced warning system programme.

b Space-based IR sensor developments under the USAF's space-based surveillance system programme.

c The Defence Advanced Research Projects Agency (DARPA)'s Talon Gold programme: a space-based experiment to demonstrate pointing and tracking for space-based DEW concepts.

d Airborne optical system development as part of the US Army's BMD programme.

e The Army's Homing Overlay Experiment (HOE) for homing non-nuclear mid-course interceptors.

f The White Horse neutral particle beam test bed at Los Alamos.

g DARPA's ALPHA programme to demonstrate, initially on the ground, a megawatt-class chemical IR laser.

h DOE analyses of x-ray laser feasibility.

SDI

WORK TO DATE

2. President Reagan's speech of March 1983 led a further impetus to this work, which was brought together in the integrated Strategic Defence Initiative. Two studies on Strategy and Policy (the Hoffman Report) and Defensive Technologies (the Fletcher Report), were submitted to the President in October 1983. The Defensive Technologies study identified critical technical issues which would have to be resolved before a decision to move to full-scale development could be made. These were:

a Boost-Phase and Post-Boost-Phase Vehicle Intercept. (DEWs were identified as the most promising technology for this crucial task and the determination of their lethality against 'responsive' targets, which had been specifically designed to counter them, was given the highest priority of all.)

b Discrimination and tracking of numerous re-entry vehicles, decoys, and other material during midcourse and high re-entry.

c Survivability of space-based defensive assets when threatened with nuclear or "mirror-image" weapons.

d Inexpensive interceptors for non-nuclear midcourse and early re-entry kill.

e Automated preparation and testing of battle management software.

The study also emphasised that to discourage proliferation of offensive systems as a 'cheap' counter, the cost of destroying a warhead would have to be lower than corresponding offensive system costs, and that this problem was closely tied to the ability to discriminate between targets and decoys in all phases.

FUTURE WORK AND TIMESCALE

3. The US Government suggests that the implementation of the SDI should be seen in terms of a progressive evolution away from today's sole dependence for deterrence on nuclear retaliation, in the following notional stages, for which the timescales, due to the huge technical uncertanties involved, are necessarily vague:

a The research phase: The period from the President's March 23 1983 speech to the early 1990s when a decision on whether to enter systems development could be made.

b The systems development (or full-scale engineering development) phase: assuming a decision to go ahead beginning in the early 1990s when prototypes of actual defensive system components are designed, built, and tested. It would be at this point (early to mid 1990s) that the US would have finally to abrogate the 1972 ABM Treaty (provided it had not already collapsed) if they were to begin testing the new technologies.

c The transition phase: of incremental, sequential deployment of defensive systems. The US intend that each added increment, in conjunction with effective and survivable offensive systems, should increase deterrence, and reduce the risk of nuclear war. During this period, as the US and USSR deploy defences against ballistic missiles that progressively reduce the value of such missiles, significant reductions in nuclear ballistic missiles might be negotiated and implemented.

d The final phase: during which deployments of highly effective multi-phased defensive systems are completed and during which ballistic missile force levels reach their negotiated nadir. This is the goal proposed in the President's March 23, 1983 speech, but seems unlikely to be reached before the first decade of the next century, if ever.

B THE SOVIET UNION

CURRENT ABM SYSTEM

4. The ABM treaty permits each side to deploy up to 100 launchers in defence of an ICBM field or the national capital. The Soviet Union currently possesses 16 above-ground launchers and 16 silo launchers as part of the Galosh ABM system around Moscow. Of these only the above-ground launchers are assessed to be operational. The Galosh system, now 20 years old, was designed to counter only simple threats (ie those without penetration aids such as chaff or decoys) and, in response to the development of more sophisticated weapons, the Soviet Union is developing and deploying the High Acceleration Vehicle (HAV) designed to counter missiles well inside the atmosphere. 66 HAV launchers are under construction and preparation is in hand to start another 2. Deployment of the HAV will thus give the Soviet Union a total of 100 HAV and Galosh launchers by 1989 thus giving a limited two-layer defence system around Moscow. These developments remain within the confines of the 1972 ABM Treaty and there is no hard evidence of a Soviet intention to abrogate this Treaty.

OVERALL R & D EFFORT

5. The Soviet Union appears to be following an extensive research and development programme which covers many of the elements required for more advanced multi-layered BMD systems, including possible space-based elements. However, there is no evidence of an intention to deploy an SDI system as such, nor of work on further ground-based BMD using existing technology. But the United States estimates that the Soviet Union is spending in the order of $1 billion a year on BMD-related directed-energy research alone. In addition, R & D on space continues at a very high level and essential developments such as large space booster and a re-usable orbiter are well advanced. R & D on the systems required to produce a new generation of BMD is, however, in general at such an early stage so highly vulnerable to the development of countermeasures, and so subject to unforeseeable technological development, that it is impossible to predict its outcome.

SPACE-BASED BMD DEVELOPMENTS

6. The Soviet Union has tested three types of laser considered suitable for space-borne BMD i.e. gas dynamic, chemical and iodine lasers. Research programmes exist on megawatt chemical lasers and power systems for electrically-driven gas lasers. Work on an x-ray laser based on the radiation from a nuclear explosion is probably at a much earlier stage. The Soviet Union is well advanced in particle beam research; work on an accelerator began in the 1960s. But while there is some evidence of testing an evaluation of a particle beam weapon concept, there is no indication that the problems of beam steering and control have been solved. The Soviets have also been working for many years on producing the very high powers needed for radiofrequency (RF) weapons, as a natural extension of the development of powerful radars and jamming equipment. There is however only limited knowledge of Soviet progress in this field and the importance they attach to the development of such weapons.

7. The effective use of DEWs as BMD weapons depends on very high accuracy target tracking and precision pointing of the beam. The required accuracy of at least 1 microradian (i.e. within a metre at a range of 1000 kms) is at least 10 times better than the best thought to be achieved by current Soviet ground-based systems. At present the Soviet Union makes use of research in the German Democratic Republic on target tracking in space where the performance achieved is comparable to that in the West. Soviet research has concentrated on laser design and mirror technology (for the beam directing mirror). The pointing and tracking experiments carried out so far in the SALYUT 7 spacecraft are, however, far too crude for the requirements of lasers. Together with the problems of compact power supplies and the miniaturization of command and control systems we believe it will take 20-30 years to produce an operational system, using existing technologies.

8. The Soviet Union has several operational space launch vehicles but none large enough to put a DEW system in space. However new large space boosters are under development with the payload capacity

adequate to support a laser weapon programme. One of these is assessed to have the ability to lift possibly up to 200 tonnes into low Earth orbit. A re-usable manned orbiter similar to the US Shuttle is also under development and should be operational by the late 1980s while a re-usable small space plane has been tested. The large dimensions and mass of space based BMD weapons imply fabrication in space. The Soviet Union has considerable experience from its manned space programme, but a vast amount of additional work would be required to reach a level of expertise adequate for assembling and maintaining space-based BMD.

GROUND-BASED BMD DEVELOPMENTS

9. The Soviets may be working on ground-based lasers for BMD. A project which started in the mid 1960's involves an iodine laser believed to be intended for use against re-entry vehicles in the terminal phase. Trials on the laser are carried out regularly at the weapons development centre at Sary Shagan. Particle Beam Weapons would not be effective as ground-based BMD weapons because of atmospheric absorption.

C. COMPARISON OF US AND SOVIET BMD CAPABILITIES AND POTENTIAL

TECHNICAL PROGRESS

10. It is impossible to be precise about the relative status of the Soviet and United States directed energy weapons programmes because of the wide range of potential weapons, the long lead times associated with the larger systems, the early stages reached in research for space-based BMD applications and, not least, the different approach to the problem taken by the two sides. In broad terms, the Soviet Union appears to be ahead in the development of high-power lasers, with the notable exception of chemical lasers, while the US is more advanced in the development of pointing and tracking and mirror technologies. In space-based systems neither country is advanced beyond R&D, but at this early stage the US has probably progressed further.

C CAPACITY TO AFFORD DEPLOYMENT

11. American ability to afford deployment of a comprehensive BMD system is discussed in Paras 25-30 of the main paper.

12. For the Russians, their BMD R&D programme must already be extremely expensive in both human and financial resources. Two leading research establishments are believed to be involved in the development of space-based lasers and their heavy-lift launch vehicles, both received massive investment during the late 1970's and early 1980's. R&D accounts for 20 per cent of Soviet military expenditure and was increasing at an average annual rate of 5 per cent between 1970 and 1982, making it the fastest growing category of military expenditure; it is not, however, possible to isolate the cost of individual programmes within the overall R&D budget.

13. The Soviet Union is unlikely to allow cost to restrain its development of SDI if it perceives the need to match the US programme. Such a decision would be based on strategic rather than financial considerations and the Russians, by their construction of an unparalleled air defence and ABM system have already proved their willingness to divert very considerable resources to limit the damage which might be inflicted on their homeland, and have consistently demonstrated the ability and willingness to match US developments in other fields.

14. A greater restraint than cost alone is likely to be the demands that a BMD system would place on certain key industries such as electronics where the United States still enjoys a considerable advantage over the Soviet Union. There is no doubt, however, that the Soviet Union is placing great emphasis on advanced technology and in developing its industrial base, particularly in the electronics industry.

15. While the pace and degree of success in these directions will be critical to the development of Soviet BMD, there are already indications that considerable resources are being allocated to space systems development, particularly large launch vehicles and large orbital platforms, and associated infrastructure.

In parallel with this effort work has begun on development of DEW components. Thus the indications are that technical and industrial resources for a BMD system would be found, although it is unclear what long-term effect the concentration of resources on this area may have on other parts of the defence sector. There is no doubt about the damaging effects that having to devote an even larger slice of the national economy to defence will have but equally no doubt that the leadership would consider this the lesser of the two evils if the choice were between disappointing consumer expectations and keeping up in an arms race in space with the US. Once begun, however, Soviet work on a full-scale counterpart to the American SDI would probably be much less subject to internal political change and turbulence than in the US.

CIVIL USES OF OUTER SPACE

1. The main current and future civil uses of outer space are:

   a. Telecommunications.
   b. Broadcasting (direct television broadcasting by satellite).
   c. Remote sensing of the earth and atmosphere.
   d. Scientific research, especially astronomical observation.
   e. Navigational satellites/search and rescue.
   f. Possible near-term future industrial uses making use of the microgravity/vacuum environment in orbit.
   g. Speculative longer-term prospects for solar power generation, space mining operations etc.

A. Telecommunications

2. Satellites, especially in geosynchronous orbit, have been used increasingly to provide a relatively cheap and flexible means of communications for telephone, telegraph, data transfer, and point-to-point television transmissions. Much international telephone traffic is now routed through the International Telecommunications Satellite Organisation (Intelsat) system and through the Soviet Bloc's Intersputnik equivalent. Intelsat capacity is also used for domestic communications especially in sparsely populated areas, and there are also domestic telecommunications satellites (eg in US, Indonesia) and regional ones (Europe); they are being used increasingly for shorter-distance communications.

3. Satellites are, and are expected to remain, largely complementary with submarine cables. Cables are expected to have much increased capacities with the introduction of fibre optics, but it is expected that the growth in civil telecommunications traffic will be such that there will be increased use of both satellite and cable in years to come.

4. Satellites are also used for ship-to-shore telecommunications, the International Maritime Satellite Organisation (Inmarsat) system. And there is the prospect of increased use of satellites for mobile

communications eg aircraft and possibly land mobiles (lorries).

B. Broadcasting

5. Although sound radio broadcasts can, by using the right frequencies, cover quite large areas of the globe, television broadcasts of reasonable quality need to be transmitted at a frequency which requires almost line-of-sight between transmitter and receiving aerial. Direct broadcasting by satellite, in which the signals are beamed up to a satellite in geosynchronous orbit, and then retransmitted to the selected area on earth, can provide good coverage without many repeater stations, though the viewer or cable-head receiver needs a special dish aerial. This use is just starting but may be expected to grow over the next 10 to 15 years.

C. Remote Sensing of the Earth and Atmosphere

6. By using sensors working on different frequencies of electromagnetic radiation (not just visible light), remote sensing of the earth from space (often from lower orbit) can, with suitable computer analysis of the results, give a wide variety of information ranging from meteorological cloud cover, sea state etc to indications of the natural resources in a region, including geological formations, the likely presence of certain minerals and the state of crops.

D. Scientific Uses

7. Many astronomical observations can be carried out much better in space than on the surface of the earth since the atmosphere is opaque to certain frequencies of radiation and distorts others. The UK has for example been involved in an astronomical satellite which scans the heavens in the infra-red. Scientific studies are also carried out, from various orbits, of the earth and its atmosphere, including upper atmosphere conditions. Missions to the Moon, the other planets and Halley's Comet are also of great interest, and There are also scientific uses which exploit the microgravity environment.

E. Navigational satellites

8. There are already many civil uses of US military navigational satellites, and ideas has been proposed for separate civil navigational systems. There is widespread use of such satellites by ships, and aircraft will increasingly benefit from them.

9. Small packages already exist on some satellites for picking up radio distress calls, with further possible uses of satellites in the search and rescue role.

F. Possible Near-Term Future Industrial Uses

10. The microgravity and vacuum environment encountered in orbit cannot be created on earth except for short periods of time. It allows the ultra high purification of certain high-value materials and the manufacture of composite materials with very interesting properties. Such uses of space have not been proved categorically to be economic, but proponents of the US Manned Space Station programme point to interest by several US firms in the idea. The Soviet Union has conducted a great deal of work in this field.

G. Longer-Term Prospects

11. As with all radical new technologies, it is particularly difficult to guess the longer-term prospects. In less than two decades, satellite communications have become an everyday fact of life. The US manned space station (planned for 1992) will open new possibilities in space, as may the European Columbus programme. The capacity to carry out sustained operations in space, with men present to make decisions and operate apparatus, and the availability of high power (over 100 KW) are likely to foster new scientific and industrial activities (see above). A space station will also enable the refuelling and repair of spacecraft, as well as the construction in space of large devices made up from individual launcher payloads.

12. Even further into the future, much more ambitious activities may be possible: for example the construction of very large solar power satellites converting the sun's rays into electrical energy

and beaming it down by microwave transmissions to receptors on earth, or the capture and mining of asteroids for rare minerals. The potential of space in the very long term is obviously enormous, but equally the eventual feasibility of such proposals is at present impossible to assess.