Chapter 1

Executive Summary

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Chapter 1

Executive Summary

THE PRESIDENTIAL CHALLENGE

President Reagan's speech of March 23, 1983, renewed a national debate that had been intense in the late 1960s but much subdued since 1972. Wouldn't the United States be more secure attempting to defend its national territory against ballistic missiles while the Soviet Union did the same? Or would it be more secure attempting to keep such defenses largely banned by agreement with the Soviet Union?

The President posed the question,

> What if free people could live secure in the knowledge that their security did not rest upon the threat of instant retaliation to deter a Soviet attack, that we could intercept and destroy strategic ballistic missiles before they reached our own soil or that of our allies?[1]

Calling upon the U.S. scientific community . . . to give us the means of rendering these nuclear weapons impotent and obsolete, he announced that he was

> . . . directing a comprehensive and intensive effort to define a long-term research and development program to begin to achieve our ultimate goal of eliminating the threat posed by strategic nuclear missiles. This could pave the way for arms control measures to eliminate the weapons themselves.

After that speech the President ordered studies to explore further the promise of ballistic missile defense, and in 1984 the Department of Defense established an organization to expand and accelerate research in ballistic missile defense technologies. This research program was called the "Strategic Defense Initiative" (SDI).

If there were a national consensus on the role, if any, ballistic missile defense (BMD) should play in our national strategy, assessing the likelihood of attaining the necessary capabilities at an acceptable cost would be difficult enough. There is extensive controversy over the potential of various BMD technologies and the possibilities for applying them in affordable weapons systems that would be effective against a Soviet offensive threat which includes countermeasures to our defenses. But there is also extensive controversy over whether various levels of ballistic missile defense capability, if attainable, would be desirable. A fair assessment of the technological possibilities must weigh them against a range of strategic criteria which are themselves matters of controversy.

This report is intended to illuminate, rather than adjudicate, the BMD debate. It provides more questions than answers. But the questions will remain relevant in the years to come, because their answers will affect national policies with or without ballistic missile defense. For the short term, the important questions have to do with what kind of research the United States should conduct on BMD and with how future BMD technical possibilities affect current offensive force planning and diplomatic activities. For the longer term, the important questions have to do with what kind of BMD we could reasonably expect to deploy, whether we would want to, and what the consequences might be.

[1]Transcript of televised speech, Mar. 23, 1983. For text of relevant passages, see app. H.

THE BMD R&D DEBATE

The near-term debate over BMD research and development (as opposed to deployment) has focused on the following issues in particular:

1. What are (or should be) the central goals of the U.S. BMD research and development program;
2. The feasibility of reaching those goals;
3. The relationship between this research and arms control negotiations with the Soviet Union.

Participants in the debate over ballistic missile defense hold differing views on:

- Soviet motivations, intentions, and capabilities;
- Whether current U.S. nuclear strategy and nuclear forces are now, and will continue to be, adequate to deter Soviet threats and aggression;
- The past role and future prospects of arms control in contributing to U.S. national security;
- How optimistic or pessimistic one should be about the technical feasibility of rendering nuclear ballistic missiles "impotent and obsolete."

These differing views have shaped the debates both about BMD research and about BMD deployment.

Goals

Strategic Defense Initiative Goals

Few are comfortable with a situation in which U.S. security depends heavily on our threatening mass destruction with nuclear weapons. Fewer still are comfortable with the vulnerability of the U.S. population to Soviet nuclear attack. President Reagan's speech appeared to offer a way of eventually escaping this condition. Although some people have interpreted some of President Reagan's statements to mean that he envisions development of a virtually perfect defense of the U.S. population against all types of nuclear attack, pursuit of defenses able to protect the U.S. population and that of its allies in the face of a determined Soviet effort to overcome them does not appear to be a goal of the Strategic Defense Initiative program.[2]

Rather, some of the President's language and many subsequent policy statements indicate that the Administration envisions a more complex scenario that might eventually lead to deep reductions in the nuclear arsenals with which the United States and the Soviet Union now threaten one another. The steps in this scenario are:

1. A research program to seek ballistic missile defenses that would be cheaper to deploy than the offensive weapons needed to penetrate them.
2. A decision in the early or mid-1990s to develop such defenses for deployment near the end of the century.
3. Negotiations with the Soviet Union for agreed mutual deployment of defenses coupled with reductions in offensive weapons. In this transition stage, the threat of nuclear retaliation would play a still important, but presumably declining, role in deterring Soviet threats and aggression.
4. An ultimate stage in which ballistic missile defenses, air defenses, and negotiated reductions of offensive weapons to extremely low levels have eliminated the ability of the United States and the Soviet Union to destroy one another's societies with nuclear weapons.

Administration officials have stated, however, that negotiating with the Soviets does not mean giving the Soviets a veto over a U.S. decision to deploy BMD. In their view, if defenses become cheaper than the weapons they must intercept, the Soviets ought to see the rationality of the U.S. negotiating scenario. But if the Soviets refuse to negotiate,

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[2]According to the Department of Defense "Report to the Congress on the Strategic Defense Initiative, 1985":

> The goal of the SDI is to conduct a program of vigorous research focused on advanced defensive technologies that may lead to strategic defense options that could:
> - support a better basis for deterring aggression;
> - strengthen strategic stability;
> - increase the security of the United States and its allies; and
> - eliminate the threat posed by ballistic missiles.
>
> The SDI seeks, therefore, to exploit emerging technologies that may provide options for a broader-based deterrence by turning to a greater reliance on defensive systems.

U.S. security would increase anyway because (a) Soviet ballistic missiles would be less capable of achieving military objectives than they had been in the past; and (b) if the Soviets and the United States spent equal amounts on strategic forces, the assumed cost advantage of the defense would lead to a continuing decline in ability of the Soviet offensive forces to penetrate U.S. defenses.

Although the pursuit of this scenario appears to be the central purpose of the Strategic Defense Initiative, other goals have also been ascribed to it. These include:

- maintaining an ability to deploy U.S. ballistic missile defenses promptly in case the Soviets should "break out" of the ABM Treaty;
- hedging against Soviet unilateral development and deployment of advanced ballistic missile defense technologies by gaining an understanding of what is feasible (U.S. responses could include comparable defenses, more offensive weapons, offensive countermeasures, or all three);
- developing new technologies which may or may not be applied ultimately to BMD, but which could have other military and civilian applications.

Other Perspectives on Goals

The differing views of BMD debate participants cited above lead to support for differing research goals or different placements of research emphasis. Some approve of the SD I long-term goals but believe that there should be greater emphasis on moving toward near-term deployment of land-based and space-based BMD systems. Others question the SDI goals on strategic or technical grounds. They suggest that the United States should emphasize technology development and hedging against Soviet BMD potentials and that moving toward a deployment decision in the foreseeable future should not be a goal. Those who stress maintaining a base for quickly deploying BMD to deter or respond to a Soviet ABM Treaty break-out tend to favor research emphasis on "terminal" defenses, designed primarily (or, in some cases, exclusively) to protect U.S. ICBM silos and probably using nuclear warheads. A description of how various BMD research goals might present congressional choices for alternate research and development programs is presented in a later section.

Technical Feasibility

A second major focus of the debate over BMD is technical feasibility–the likelihood that the research will lead to the development of BMD systems that could achieve Administration goals. There are at least two layers of technical issues involved in this part of the debate. One is whether particular technology performance levels (for example, those of sensors, pointing and tracking systems, computers, chemical lasers or electromagnetic rail guns) could be scaled up and integrated into effective weapons systems. The second layer of technical issues is whether the weapons systems could operate effectively against determined Soviet efforts to counter them. Proponents of the SD I believe that the technologies are sufficiently promising to be worth intensive research. In addition, they point out that for many years the Soviets have been conducting research in advanced BMD-related technologies (such as lasers) and that the SDI as a research program would be justified if on no other grounds than hedging against possible Soviet progress in these areas.

Skeptics argue that offensive nuclear weapons are so likely-unless offenses are tightly constrained in number and quality-to continue to dominate defensive weapons that pursuing the SDI goals is not justifiable. They question whether Soviet research into advanced BMD-related technologies is likely to lead to actual defensive systems that U.S. missiles could not penetrate. They believe that the best hedge against such Soviet programs is continuing or accelerating work on U.S. offensive penetration aids. They may support continued U.S. research on BMD, but they are concerned about the potential consequences of certain SD I demonstration experiments.

Arms Control

Most BMD systems based on advanced technologies could not be developed, tested, or deployed under the ABM Treaty regime.[3] One issue is whether or not our program of BMD research will be compatible with the ABM Treaty. A more fundamental issue, however, is whether or not the ABM Treaty continues to be compatible with our national interest.

Differing views on the nature of the United States-Soviet strategic relationship come to the fore most strongly in debates over the interplay between the Strategic Defense Initiative and arms control.

Supporters of the SDI tend to argue from the following perspective:

- The Soviet Union has been relentless—and at least partly successful-in its pursuit of strategic nuclear superiority over the United States. In particular, the Soviets have obtained a "first strike' capability against U.S. land-based ICBMs. In the future, the Soviets might conceivably find means of detecting and destroying U.S. missile-launching submarines as well. The Soviets can be expected to exploit such advantages by attempting to intimidate the United States and its allies.
- Past arms control agreements have not successfully limited the Soviet offensive buildup. In particular, the ABM Treaty and the companion Interim Offensive Agreement, contrary to U.S. hopes, led to no significant Soviet offensive restraint. Instead, behaving as if nuclear war would be like other wars, only bigger, the Soviets have deployed far more weapons than they need for deterrence.
- The SDI has already caused the Soviets to return to arms control negotiations which they had previously walked out of.[4] The best prospect for future arms control agreements lies in persuading the Soviets that their "first strike" ICBMs will become obsolete in the face of U.S. defenses, and that the most promising way of adding to Soviet security is negotiating the reduction of both U.S. and Soviet offensive weapons while both sides emphasize defenses. Failing such persuasion, a competition in which defensive weapons had an economic advantage over offensive weapons would be more in the U.S. interest than the current situation because in the long run it should reduce net Soviet offensive capabilities.
- Given the asymmetries between the societies and the strategic objectives of the United States and Soviet Union, the arms control process as it has been conducted to date may never be to the net benefit of the United States. On the other hand, BMD may permit pursuit of a common interest in the "assured survival" of each society.

Many critics of the SDI have another perspective:

- Given the continuing mutual abilities of the United States and the Soviet Union to destroy one another's societies with several kinds of nuclear delivery vehicle (ICBM, SLBM, cruise missile, bomber), the Soviets do not have and cannot reasonably hope to obtain an exploitable strategic nuclear advantage. Even the narrower possibility of destroying most U.S. land-based ICBMs in their silos is so fraught with uncertainties that the Soviets would be irrational to try it. Moreover, there are other potential means,

[3] While laboratory research into any type of BMD system is permitted under the treaty, there are severe limitations on field testing and development of ABM systems. Only fixed, land-based systems can be developed or tested, and only one specified fixed, land-based system can be deployed. See app. A.

[4] The official position of both the United States and the Soviet Union is that the ongoing Geneva talks are new negotiations and do not represent a resumption of the previous ones.

such as mobile basing, to increase the survivability of the ICBM leg of the nuclear triad.

- While certain issues of Soviet compliance with past arms control agreements need to be resolved, by and large those agreements have kept Soviet offenses below the levels they might otherwise have reached. The ABM Treaty successfully limited Soviet deployment of anti-ballistic missile launchers and spared the United States the need to build countering offensive and defensive weapons. Abandonment of the Treaty could lead to a more costly and more dangerous arms race.
- Rather than having driven the Soviets back to the negotiating table, the SDI might instead have merely provided them a face-saving way to reverse their previous decision—which they now regret-to stay out of arms control talks until newly deployed nuclear weapons were removed from Europe. Even though negotiations have resumed, we should believe the Soviets when they say that U.S. BMD research and deployment would lead them to seek and deploy more offensive weapons and countermeasures rather than to agree to offensive reductions. Negotiations offer a better chance of reducing the net Soviet offensive threat to the United States than does ballistic missile defense. Whatever value SDI does have in encouraging arms control can best be realized if we agree to constraints on BMD technology development, for example by clarifying or extending provisions in the ABM Treaty, in exchange for Soviet agreement to deep cuts in offensive forces.
- Over the longer term, the best hope for avoiding nuclear war lies not in new kinds of military strategy or technology, but rather in maintaining a stable balance of invulnerable retaliatory forces until the political relationship between the two superpowers can be considerably improved.

ALTERNATIVE BMD RESEARCH PROGRAMS

The issues facing Congress in the near term concern the U.S. research program on technologies for strategic defense. There is general agreement that these technologies merit investigation. Support for BMD research, however, does not necessarily imply support for the Strategic Defense Initiative. Possible BMD research programs can differ greatly from the SDI in emphasis, direction, and level of effort. Moreover, research programs having different perceived and intended purposes—even if they have similar technical content—can have very different consequences.

Decisions to be made by Congress this year and in the years to come will have a major impact in either ratifying or re-directing major changes which have been initiated in the U.S. BMD research program and in U.S. arms control policy by President Reagan's Strategic Defense Initiative:

Urgency.—Research under the SDI is intended to proceed at a "technology-limited" pace to permit a decision to be made at the earliest possible date on whether to enter full-scale engineering development; entering such development would clearly be inconsistent with ABM Treaty constraints. The pre-SDI program had no such mandate for an early decision on maintaining or abandoning the ABM Treaty.

Visibility.--The SDI has much higher visibility and a much higher level of Presidential attention than the previous program of research in BMD-relevant technologies. The decision to spotlight BMD has already been made, and its consequences are already being felt. These consequences certainly include a decision by the Soviets to at least explore their options to respond to the increased probability of a U.S. BMD deployment.

Direction. -Under the SDI, emphasis has shifted away from fairly well-understood, or "mature," technologies, which generally include use of nuclear-armed interceptors, towards non-nuclear defenses which would use much more speculative but potentially more powerful technologies.

Budget. —Over the next decade, much more is to be spent on BMD research than would have been allocated in the absence of the SDI. In the proposed FY 1986 budget, the BMD funding level was more than twice its projected FY 1986 level under the pre-SDI program. Subsequent increases under SDI are to be even greater, and by FY 1990 are projected to be over eight times the FY 1984 funding level.

Arms Control Policy.–Instead of the pre-SDI approach of seeking deep reductions of offensive forces along with maintenance of the ABM Treaty ban on defenses against ballistic missiles, current arms control policy seeks "greatly reduced levels of nuclear arms *and an enhanced ability to deter war based on an increasing contribution of non-nuclear defenses against offensive nuclear arms.* "[b]

Different approaches that can be taken towards ballistic missile defense research proceed from different sets of basic assumptions about the value and feasibility of BMD, and from differing assessments of the consequences of pursuing BMD research. Three such approaches can be distinguished and are presented below. These approaches differ primarily in emphasis and urgency, rather than in which technologies are to be studied. Most BMD-relevant technologies would be investigated, at some level, in all three.

The first approach is the SDI as proposed by the Reagan Administration. The second approach would proceed to BMD deployment faster than the SDI would be able to, and the third approach would conduct BMD research and development at a slower rate than the SDI. Each of the last two approaches is further broken down into two suboptions which differ in the emphasis given to existing versus near-term technologies (in the second approach) or near-term versus far-term technologies (in the third). The five research suboptions are defined as follows:

1. SDI approach.–Vigorously investigate advanced BMD technologies with the intent to decide in the 1990s on whether or not to enter full-scale engineering development and subsequent deployment. This approach assumes that while technology now within the state of the art is not good enough to be worth deploying today, the potential of advanced BMD technologies is sufficiently promising that a technology-limited effort (i.e. a program limited by what is technologically feasible rather than by funding constraints) is warranted to develop that potential. It also assumes that if successfully developed, such technologies could make possible a national security regime (weapons systems and arms control) preferable to the current one.

2a. Early deployment approach.–Emphasize early and incremental deployment of currently available BMD technology. This approach places high strategic value on the modest levels of defensive capability which could probably be obtained today. Although the ABM Treaty permits the United States to defend some ICBMs with a single, highly constrained defensive deployment, most early deployment proposals go beyond these constraints and could not be pursued under the existing treaty regime.

2b. Intermediate deployment approach.–Emphasize research on BMD technologies advanced beyond those available today but which, un-

'Quoted from "The U.S. Strategic Concept, " enunciated by Ambassador Paul H. Nitze in an address before the International Institute for Strategic Studies, London, Mar. 28, 1985. (Emphasis added.)

like many SDI technologies, might be applicable to deployments in the early to mid-1990s. This approach assumes investigations of longer-run technologies should not delay deployments in the nearer term.

3a. Funding-limited approach.–Investigate advanced BMD technologies at a funding level well below that requested for the SDI and with a much-reduced sense of urgency. Like the SDI, this approach would focus on advanced technologies that may eventually make a highly capable defense possible. Unlike the SDI, however, it does not assume that we will know in a few years whether we can achieve that goal. The program would not aim towards facilitating a development decision at a particular time, nor would it include tests or demonstrations which might raise questions of compliance with the ABM Treaty.

3b. Combination approach.–Balance research in advanced BMD technologies with the development of near-term deployment options which would include "traditional" BMD technologies (nuclear-armed, radar-guided interceptors) of the sort specifically mentioned in the ABM Treaty. This program, conducted at a funding level well below that requested for the SDI, would aim to deter Soviet abandonment of the ABM treaty; to hedge against future Soviet BMD developments; to prevent technological surprise; and to investigate the long-term potential of advanced BMD technologies. Like the funding-limited approach, it would not include demonstrations or development work which might raise questions of compliance with the ABM Treaty.

Important issues that will be relevant to a decision among these alternative research approaches are discussed below. First, however, note is taken of Soviet BMD research.

SOVIET BMD RESEARCH AND COMPARISON WITH U.S. RESEARCH

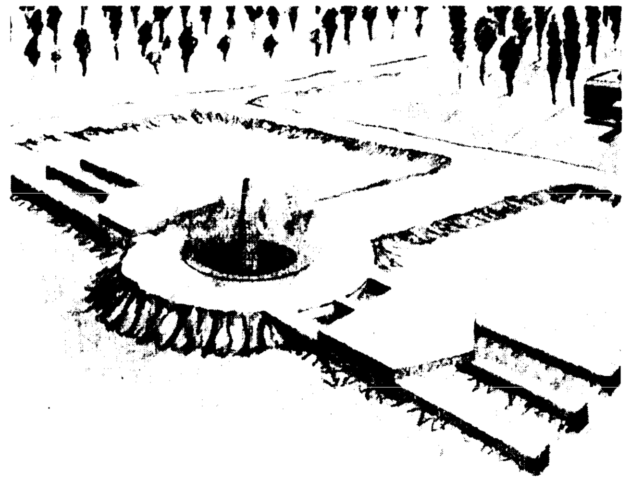
Both the United States and the Soviet Union have conducted research and development activities in BMD since before the ABM Treaty was signed. Both have acquired considerable experience with the "traditional" BMD technologies, such as nuclear-armed, radar-guided interceptors, of the sort specifically mentioned in the ABM Treaty. However, although the level of Soviet "traditional" BMD technology probably does not exceed our own, the Soviets, with a working BMD production base, are almost certainly better equipped in the near-term to deploy a large-scale, "traditional" BMD system than we are.

The Soviets have deployed and maintained an ABM system around Moscow utilizing "traditional" BMD technologies. They have also extensively upgraded and modernized that system. Ever since the United States decided that its own, similar system was not effective enough to justify maintaining it, the Moscow ABM has been the world's only operational ABM system. According to the Department of Defense publication *Soviet Military Power, 1985,* the Soviets are "developing a rapidly deployable ABM system to protect important target areas in the U. S.S.R.. " That report concludes that "the aggregate of [their] ABM and ABM-related activities suggests that the U.S.S.R. may be preparing an ABM defense of its national territory. "[6] Officials of the CIA, however, have said that they do not judge it likely that the Soviets would in fact move to such a deployment in the near term.[7] These officials point out that while the Soviets could expand their presently limited ABM system by the early 1990s,

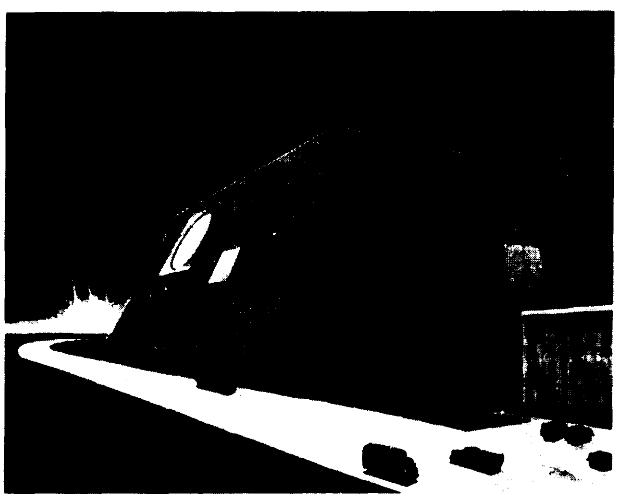
> In contemplating such a deployment . . . [they] will have to weigh the military advan-

[6]Both quotations from Department of Defense, Soviet *Military Power,* 1985, p. 48.

[7]Unclassified testimony of National Intelligence Officer Lawrence K. Gershwin before a joint session of the Subcommittee on Strategic and Theater Nuclear forces of the Senate Armed Services Committee and the Defense Subcommittee of the Senate Committee on Appropriations, June 26, 1985.



Moscow Ballistic Missile Defense



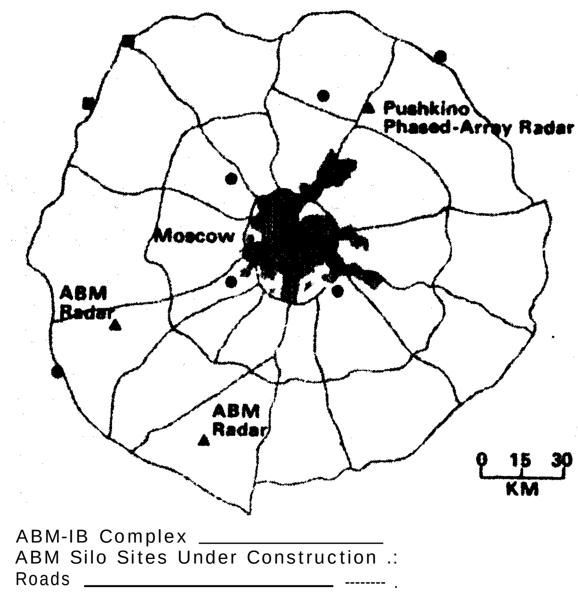


Photo credit: U.S. Department of Defense

M w m map at right include the Pushkino ABM radar, above, Galosh
m new silo-based high-acceleration interceptors, top right.

tages they would see in such defenses against the disadvantages they would see in such a move, particularly the responses by the United States and its allies.

One of the functions of a U.S. BMD research program is to deter or respond to a near-term Soviet ABM Treaty breakout. A U.S. response to such a situation would most likely consist of deployment of a near-term U.S. defense, deployment of offensive countermeasures that would ensure that our strategic forces could penetrate Soviet defenses, or some combination of the two. Should a defensive response be desired, a research approach which prepared options for near-term deployment would be needed.

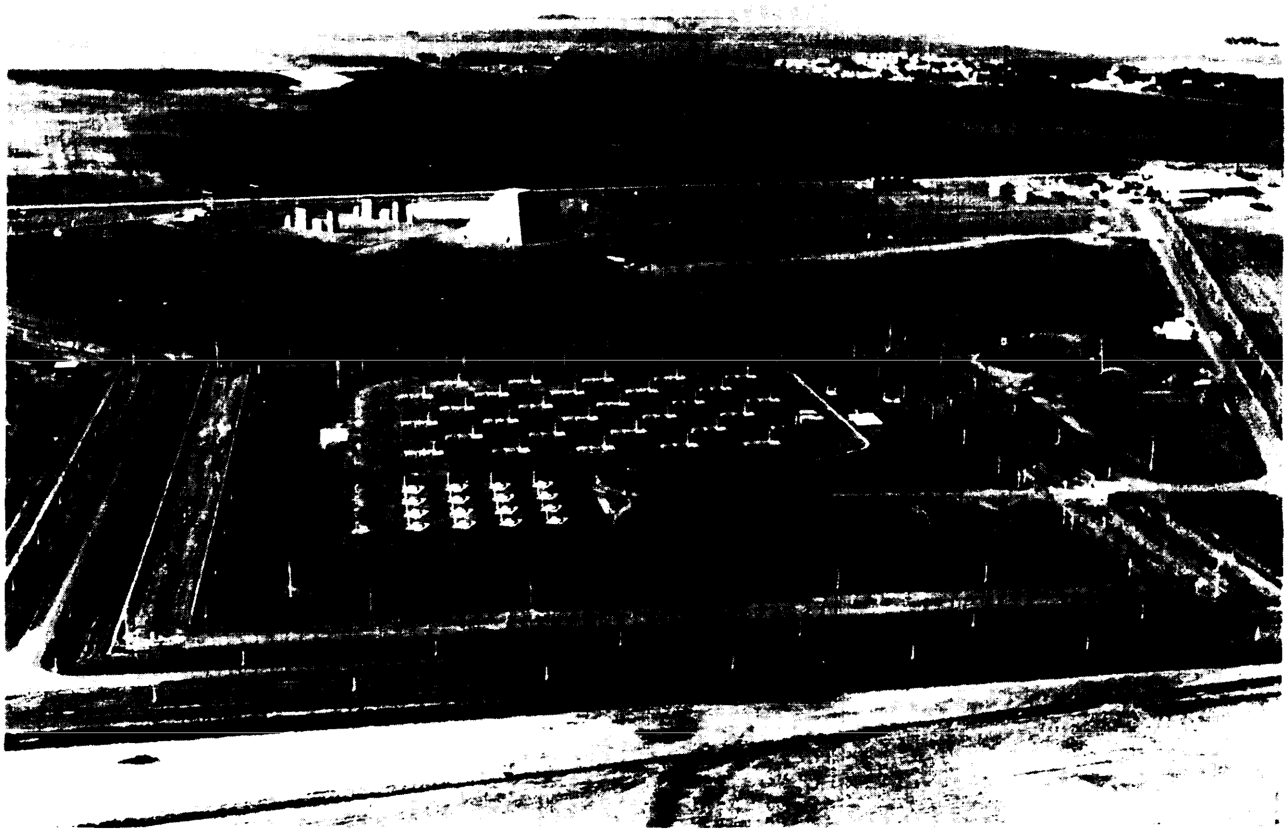


Photo credit: U.S. Army

The Missile Site Radar (background) of the Safeguard ABM System was designed to refine the data received from the long-range Perimeter Acquisition Radar, track the attacking ICBM reentry vehicles, and fire Sprint and Spartan interceptor missiles (in cells, foreground), to intercept them. Though this site was permitted under the 1972 ABM Treaty and its 1974 protocol, the United States decided that its limited capabilities did not justify the cost and deactivated the system in 1976.

Offensive countermeasures intended to penetrate, counter, or evade the Soviet defense are at least as important in deterring or responding to a Soviet defensive deployment as U.S. defensive options are. Offensive countermeasure research would accompany any of the BMD research options above. In addition to providing capability against Soviet defenses, an offensive countermeasures research program must be an integral portion of any research and technology development program studying BMD so that possible counters to U.S. defenses can be anticipated.

The Soviets are also vigorously developing advanced technologies potentially applicable to BMD,[8] in addition to modernizing the "traditional" system they have deployed around Moscow. However, the quality of that work is difficult to determine, and its significance is therefore highly controversial. It has been estimated that the total Soviet effort in directed energy research is larger than that in the United States. However, in terms of basic technological capabilities, the United States

[8] *Soviet Military Power,* 1985, op. cit., pp. 43-44.

clearly remains ahead of the Soviet Union in key areas required for advanced BMD systems, including sensors, signal processing, optics, microelectronics, computers and software. The United States is roughly equivalent to the Soviets in other relevant areas such as directed energy and power sources. The Soviet Union does not surpass the United States in any of the 20 "basic technologies that have the greatest potential for significantly improving military capabilities in the next 10 to 20 years" which were surveyed by the Under Secretary of Defense for Research and Engineering.[9]

[9] *The FY 1986 Department of Defense Program for Research, Development, and Acquisition,* Statement by the Under Secretary of Defense, Research, and Engineering, 99th Cong., 1st sess., 1985, p. II-4.

ISSUES FOR R&D PROGRAMS

1. Maintenance of the ABM Treaty

The five research options cited above each have different implications for the ABM Treaty. Administration policy is that the SDI approach is intended to remain within Treaty bounds until a decision is made to develop BMD systems for deployment. However, proposed technology experiments raise technical questions concerning compliance with Treaty constraints on BMD development and testing.[10] Moreover, the sense of urgency and the high visibility imparted to the SDI also raise political questions concerning the degree to which the United States is committed to maintaining the ABM Treaty regime. Early or Intermediate deployment would probably imply abandonment of the Treaty, though intermediate deployment might allow time for attempts at reaching agreement with the Soviet Union on Treaty revisions to permit limited deployments. The funding-limited and combination approaches would relax the urgency of BMD research, easing the political questions; to the extent that technology demonstrations were de-emphasized, the technical questions of treaty compliance would be relaxed as well. Advocates of these approaches would strive not to damage the Treaty regime before we had identified a preferable alternative which we had confidence could be attained.

[10] In app. A of this report, OTA points out that if one accepts the Defense Department's current interpretation of key terms of the ABM Treaty, one may also reasonably accept the conclusion that the current SDI program will be Treaty compliant; however, applying a different interpretation to key Treaty terms could lead to the opposite conclusion,

The United States can plan for revision of or withdrawal from the ABM Treaty, or it can attempt to make the Treaty more effective. The middle course–trying to bolster the effectiveness of the ABM Treaty in the short run (thereby preventing short-term Soviet BMD testing and deployment) while explicitly and publicly preparing to decide whether to abandon it in the future-maybe the most difficult to implement. If we choose to maintain the Treaty in the near term, an important issue for Congress to consider is how we can carry out our BMD research program so that it does not either prematurely compromise the ABM Treaty by encouraging Soviet exploitation of technical ambiguities, or stimulate the Soviets to begin deploying BMD and enhanced offensive forces at a time more advantageous to them than to us. If we were to allow the ABM Treaty regime to erode, and then find at the end of our BMD research program that the new BMD technologies did not fulfill expectations, we could end up with the worst of both worlds: no arms control to limit BMD, Soviet BMD deployment, no effective U.S. BMD, and, quite possibly, augmented Soviet offensive forces intended to overcome an anticipated U.S. BMD.

At the same time, current issues of Soviet non-compliance with the Treaty must be addressed as well. If they cannot be satisfactorily resolved, the United States in effect would have adopted stricter standards of compliance than those observed by the Soviets, which might put us at a competitive disadvantage.

Congress may wish to review the standards and the procedures by which U.S. activities are judged to comply with existing treaty commitments-perhaps by establishing an independent and nonpartisan commission to review Soviet BMD activities and to advise Congress and the President on compliance questions associated with BMD activities pro posed by the U.S. Department of Defense.

2. Requirements for Arms Control

In addition to their differing effects on the ABM Treaty, the alternate BMD research approaches pose different requirements for arms control.

The role of arms control under the SDI approach would be to facilitate a safe transition to a state of highly constrained offenses coupled with highly effective defenses. Such a transition agreement would have to be negotiated before actual deployments began. And it might need to take effect during the research and development stages, in order to regulate offensive and defensive developments. The negotiability of any such agreement is very much in question. Nobody has yet suggested how the problems of measuring, comparing, and monitoring disparate strategic forces—problems which have plagued past arms control negotiations—could be satisfactorily resolved in the far more difficult situation where both offensive and defensive forces must be included.

By deploying BMD in excess of ABM Treaty limits without waiting for the establishment of a replacement arms control regime, most early deployment approaches imply abandonment not only of the ABM Treaty but of the entire arms control process. Not content with the condition of strategic parity prerequisite to arms control (or, alternatively, believing that the Soviets are not willing to settle for such a state) supporters of these approaches would instead attempt to attain and maintain a lead over the Soviets in strategic forces.

Supporters of the intermediate deployment approach might see the possibility of negotiating with the Soviets over a transition not to "defense dominance, " but to agreed force postures with an increased role for defenses relative to offenses. On balance, however, if such an agreement could not be reached, they would probably see uncoordinated deployments by the two sides as being more in the U.S. interest than the current ABM Treaty regime.

Under the funding-limited and combination approaches, negotiations with the Soviets which attempted to establish the boundaries between permitted and proscribed BMD research would be desirable for the purpose of clarifying activities on both sides. If the prospect of the United States' developing advanced technologies under the SDI approach sufficiently concerns the Soviets, Soviet desires for limitations which would have the effect of constraining U.S. research and technology development might give the United States considerable bargaining leverage. Such an agreement would almost certainly have to permit laboratory research, which would be extremely difficult to ban verifiably, but it might constrain more observable activities such as demonstrations of ABM "sub-components" and other field experiments which the Department of Defense argues are currently not prohibited by the ABM Treaty. Although it might be difficult to construct a verifiable and equitable agreement of this sort, the task might be easier than reaching agreement on the mutual introduction of strategic defenses.

3. Anti-Satellite Weapon Arms Control

At the Spring 1985 U.S.-Soviet arms control negotiations in Geneva, the Soviets emphasized the importance they attach to limiting weapons deployed in or directed at space. As the companion OTA report, *Anti-Satellite Weapons, Countermeasures, and Arms Control,* indicates, anti-satellite weapon technologies and BMD weapon technologies are closely related. Therefore, those favoring uninhibited research on BMD would find arms control measures limiting antisatellite weapon testing highly constrictive. Indeed, to attempt to remain compliant with the ABM Treaty, some technology demonstrations now planned under the SD I would be conducted as anti-satellite tests. On the other hand, those interested in strengthening the testing limitations in the ABM Treaty would find anti-satellite weapon test restrictions a useful tool in further constraining BMD development.

4. R&D/Deployment Coupling

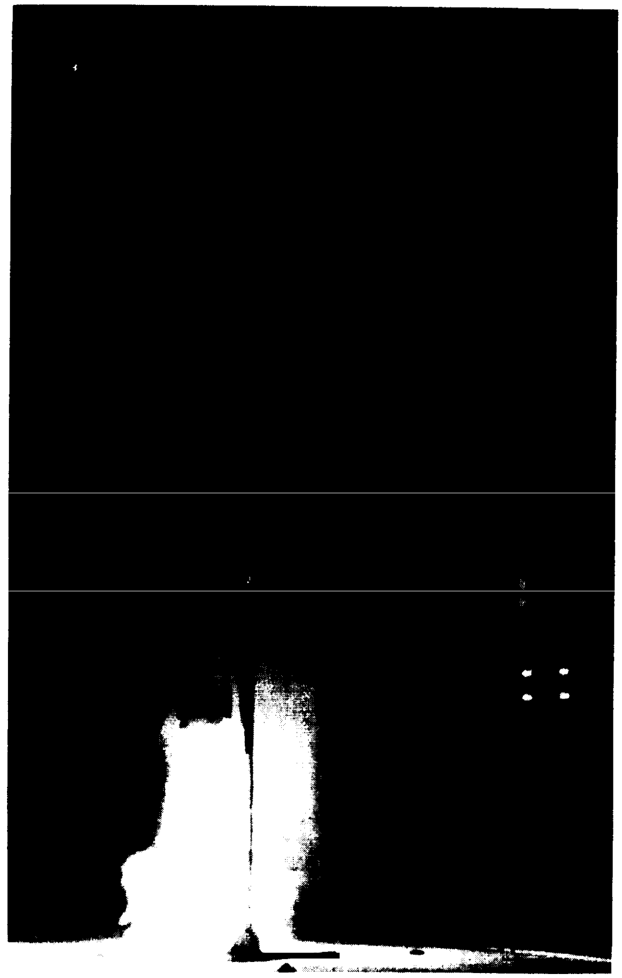
There is an inherent conflict between seeking the ability to make deployment decisions in the near term and seeking to keep control over whether and when such a deployment might be made. Vigorous U.S. R&D programs could lead the Soviets to infer an intent to deploy, and might stimulate them to preempt such a deployment. Therefore, proposals for a vigorous R&D program should demonstrate the ability to cope with a Soviet defensive breakout and associated Soviet offensive actions in a timely way. Offensive countermeasures would probably contribute more than defensive actions towards our ability to respond to Soviet defensive breakout.

If our research program is not to be presumed to be a prelude to deployment, there must be a clearly perceived threshold which requires a positive decision—not merely the lack of a negative one—to cross. The limitations posed by the ABM Treaty provide such a threshold.

Also required, however, is a clear set of decision criteria that must be met before BMD development continues past the point requiring ABM Treaty renegotiation or abrogation. As the level of effort devoted to BMD research increases, a momentum or constituency will be created that will favor continuing and enlarging the research effort and then moving from research to demonstrations to deployment. For this reason, it would be easier to establish decision criteria before a few more years of BMD research growth had occurred and before the time comes to make the actual decision.

5. Technology Experiments

Technology demonstration experiments are the most expensive and one of the most controversial aspects of a BMD research program.



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Demonst at ons may be usefu to gauge tech nical p ogress o to p o de public ev dence ha the techno ogy effo n gene al s suc eeding Mo eo e demons a ons will be needed soone o ate o dete mine whethe some sys em omponen s are feas b e On he o he hand ad anc ng ou unde s anding of bas c p nc ples and technologies may be p efe ab e to demonst ating the existing state of the ar The e s a risk that demonst at ons may ock n sub opt mal evels of techno ogy and dive esou ces which would othe wise go owards de e oping imp o ed op ons

Photo credit U S Department of Defense

Homing Overlay Experiment—Kinetic Kill: Video recording of telescopic view of impact of homing vehicle on reentry vehicle target. Debris resulting from collision is spreading out from center of rectangle.

Demonstrations of BMD technology are also complicated by ABM Treaty constraints on developing and testing ABM components or systems. Experiments that raise treaty compliance questions run the risk of provoking a Soviet reaction that could eliminate the option of deferring BMD deployment until technology had advanced further. One possible way to assess whether this risk is worth taking might be to require that before such experiments are approved there should be developed both (1) a plausible system architecture which would use the particular technologies to be demonstrated and (2) a corresponding arms control approach. Congress may wish to satisfy itself beforehand that, if the technologies are proven feasible, such an architecture and arms control regime appear likely to meet satisfactorily whatever criteria are established for proceeding with BMD.

6. Research and Development of Offensive Forces

In the absence of an agreement to forgo or drastically reduce them, there will be a role for U.S. strategic offensive nuclear forces for the foreseeable future. To ensure their effectiveness in the event that the Soviets deploy defenses, the United States will need to continue its development of penetration aids and other offensive countermeasures. By minimizing the potential effectiveness of Soviet defense, the existence of such countermeasures would help deter the Soviets from abrogating the ABM Treaty or any subsequent agreement limiting defenses.

However, prudence dictates we assume that any offensive countermeasure that can be developed by the United States could also be available to the Soviets, and we therefore must consider what such countermeasures would do if deployed against our defenses. Development by either side of powerful offensive countermeasures conflicts with the long-term goal of minimizing the role for offenses—a problem which will be exacerbated if *defensive* technologies have applications in *offensive* roles (e.g. attacking satellites or aircraft, or, particularly, attacking enemy defenses).

7. Relations With Allies

Beyond its effects on the ABM Treaty, the U.S. BMD research program can have other foreign policy consequences which should be taken into account in evaluating options. Most of our allies support United States BMD research as a counter to Soviet research, and some have inquired how they can participate in this research. However, for the most part they generally have deep reservations about the wisdom of deploying a strategic defense. Whether the U.S. BMD research program now, and any deployment in the future, can be conducted so as to avoid endangering the cohesion of our alliances is an important issue.

8. Technology Transfer

The ABM Treaty prohibits the "transfer to other states" of "ABM systems or their components, " or of "technical descriptions or blue prints" worked out for their construction. These provisions prohibit the signatory nations from using their allies to circumvent ABM Treaty constraints. As a result, allied participation in a treaty-compliant research program would have to be limited to research which had not reached the “system” or “component” level. More of a problem for research at this stage would be restrictions which the United States itself might impose, as it does now, on the transfer of military technology to its allies for fear that such technologies may eventually reach the Soviet Union.

In some discussions of BMD research or deployment approaches it has been suggested that the United States might intentionally transfer BMD technologies to the Soviet Union to prove that the United States did not seek military superiority. Any such transfer would raise two very significant issues: If BMD plans or devices are transferred, potential adversaries might be able to study them to discover vulnerabilities, enabling them to circumvent or destroy our own such components. If technological capability is transferred, rather than specific devices, the American advantage which had enabled us to develop that technology first would necessarily be compromised. Furthermore, many BMD-relevant technologies have applications in other military areas that we may not want to help the Soviets develop. Approaches towards BMD which assume that we can and should maintain technological supremacy over the Soviets would not be consistent with transfer of U.S. BMD technology to them.

DEPLOYMENT ISSUES

Decisions about BMD should be made in the light of their overall impact on U.S. national security. National security depends on more than military capability. It is also affected by such factors as Soviet perceptions and actions, arms control, the cohesion of our alliances, national unity and resolve, and economic strength. It is beyond the scope of this report to attempt to define or measure national security or to explore the merits of alternative approaches to enhancing it. Instead, we address the narrower question of how a decision to deploy BMD might affect our national security. One way to approach this question is to establish a set of criteria that BMD deployment would have to meet to some degree in order to produce net benefits for national security.

Most participants in the current debate would probably agree on what criteria to apply in making a U.S. decision about whether to deploy BMD. But there is considerable disagreement over how stringent each of these criteria should be and what relative weights should be assigned to each. There are also strong disagreements about both the strategic and the technical prospects for satisfying them.

We label the criteria:

1. Potential Role in U.S. Nuclear Strategy
2. Crisis Stability Effects
3. Arms Race Stability Effects
4. Diplomatic Stability Effects
5. Feasibility
6. Cost

The national debate over BMD in the years to come is likely to center on the application of these criteria. It is possible that the Soviets, who maintain a vigorous BMD research and development program, will choose to “break out” or “creep out” from the ABM Treaty before the United States has decided whether to deploy BMD itself. Soviet judgments about the relation of their BMD deployments to the above criteria could be quite different from U.S. judgments. But a U.S. decision about how to respond to Soviet BMD deployments would still need to take these criteria into account.

Criterion 1: Potential Role in U.S. Nuclear Strategy

BMD should enhance the effectiveness of current U.S. national strategy or permit the adoption of a new and better one. And things should not get much worse before they get better: the transition to an improved strategy should not make the world significantly more dangerous than it is now. On the other hand, if one believes that current strategy in the absence of BMD is likely to lead to a worse situation for the United States, then one might settle for a BMD deployment which simply kept things from getting as bad as they might otherwise have. In addition, the BMD deployment should be no more costly or risky than alternative means, if they exist, of achieving the same strategic goals.

For analytic purposes, OTA has postulated five levels of ballistic missile defense capabilities (including none at all) and, where appropriate, of air defenses. In this part of the discussion we do not consider the feasibility or cost of obtaining and sustaining those levels of protection against Soviet offensive weapons (these are discussed in this summary under Criteria 5 and 6). Rather, we simply attempt to explore some of the strategic implications of those levels if we and the Soviets could both achieve and sustain them. (Analysis in chapter 5 of this report also addresses asymmetrical situations—cases in which one side or the other has a higher level of defense capability. For the most part, however, we assume that, in accordance with stated U.S. policy, the United States does not seek superiority over the Soviets and will not permit Soviet superiority over the United States.)

These postulated levels are:

No Additional Strategic Defense.–No defenses against ballistic missiles beyond those permitted by the ABM Treaty; passive and air defenses comparable to current levels.

Level 1: Protection of Some ICBMs.–Defenses able to assure the survival of a useful fraction of U.S. land-based ICBMS, but which would offer little or no protection to cities.

Level 2: Either/Or.–Defenses–including BMD and air defense—able to ensure the survival of most land-based ICBMs or a high degree of urban survival against a follow-on (or simultaneous attack), but not both.

Level 3: Most ICBMs, Some Cities.—Defenses that could intercept enough Soviet missile and and air-breathing weapons to deny the Soviets the ability to destroy most U.S. land-based ICBMs in their silos but could not deny them the ability to destroy many U.S. cities if all their offenses were concentrated on cities.

Level 4: Extremely Capable.–Defenses which would permit the Soviets to destroy, by any means, few if any targets in the United States. They could not be confident that they could destroy any U.S. cities.

The Soviets might, of course, have comparable levels of defensive capabilities. The combination of U.S. and Soviet capabilities would determine what nuclear strategies were available to the United States.

The stated goal of the Administration's Strategic Defense Initiative is that the early stages of BMD deployment should make the existing U.S. deterrent strategy more effective, while later stages would allow us to move to a different strategy.

The following discussion summarizes the potential implications for U.S. nuclear strategy of each of the five BMD capability levels postulated above.

No Additional Strategic Defense

Some argue that in the absence of ballistic missile defenses, U.S. nuclear forces will be less and less able to support current U.S. nuclear strategy, which has been called a "countervailing strategy. " It attempts to deter the Soviet Union from nuclear attack or threat of attack on the United States or its allies by persuading the Soviets that U.S. nuclear counterattacks would, primarily, lead to unacceptable damage to valued Soviet assets (punishment), and, secondarily, would cause such Soviet attacks to fail in their gee-political objectives (denial). Although the United States would first attempt to repel a Soviet non-nuclear attack with conventional forces, it holds out the possibility to the Soviets that their aggression could escalate into a nuclear conflict. Thus the United States seeks not only to deter a nuclear attack on itself, but to obtain "extended deterrence" by making the Soviets fear that other kinds of aggression could lead to nuclear escalation.

In 1985, the Department of Defense estimated that the Soviet SS-18 ICBMs could destroy 80 percent of the U.S. Minuteman ICBMs in their protective silos.[11] Some argue that this vulnerability of the U.S. land-based missile force could, under some conditions, offer the Soviets an incentive to launch a preemptive nuclear strike against the United States. Even if the Soviets did not wish to launch a preemptive attack, however, they might believe that their ability to destroy a high proportion of U.S. land-based intercontinental missiles gave them a basis for nuclear blackmail against the United States or its allies.

Others argue that the Soviets are highly likely to remain deterred from such strikes by the threat of retaliation from thousands of U.S. nuclear weapons deployed on alerted bombers and submarine-launched ballistic missiles. Moreover, they argue, the probability of success of a necessarily high-precision attack on the U.S. Minuteman force is subject to many uncertainties, including the possibility that the U.S. might launch its missiles before Soviet missiles could reach them.

Level 1: Defense of Some ICBMs

To the extent that the Soviets have confidence in the success of an attack on U.S. land-based missiles, on U.S. command and control facilities, and on some other military targets, even relatively modest levels of BMD performance could reduce that confidence and thereby enhance U.S. deterrence.

At the same time, given the kinds of offensive missile forces the Soviet Union and the United States now have, modest levels of Soviet BMD performance would reduce the net number of ballistic missile warheads reaching the Soviet Union in a U.S. retaliatory attack. (See chapter 5 of this report for a detailed explanation.) This reduction in the total effective size of the U.S. retaliatory force may be thought worthwhile when weighed against the advantages of preserving at least some land-based ICBMs in addition to the SLBMs and bomber weapons and of having a partly protected command and control system.

On the other hand, in the view of those who think that the probability of Soviet success in a disarming first strike is already sufficiently uncertain, the uncertainty that BMD could add to Soviet military planning would do little or nothing to enhance deterrence. In addition, if the survivability of land-based ICBMs and command and control facilities were the only goal of U.S. defenses, then there might be other, less costly, means of achieving that goal, such as making the ICBMs mobile (and thus difficult for the Soviets to target) and increasing the redundancy and mobility of communications nodes and command centers.

Another goal might be to deter Soviet limited nuclear strikes against various kinds of military targets in the United States or a theater of war abroad, particularly in Europe. Depending on how they were configured, low to moderate levels of BMD might offer some protection to such targets. But, unlike multiple, relatively hard-to-destroy targets like missile silos, these other military targets would, as a whole set, still be highly vulnerable to a determined Soviet attack using many hundreds of nuclear weapons. The presence of BMD would force the Soviets to use more missiles than otherwise would be necessary, thus raising the threshold of violence and perhaps increasing the Soviet perception of risk of large scale nuclear retaliation from the United States. At the same time, the presence of Soviet BMD would similarly narrow the range of U.S. limited options for using nuclear ballistic missiles.

[11] The Soviets have other accurate missiles that might raise that estimate, and as they add still more accurate missiles to their arsenal, the estimate could go up further. U.S. Department of Defense, *Soviet Military Power, 1985,* p. 30.

Modest levels of nationwide ballistic missile defense might protect the United States and the Soviet Union against relatively small missile attacks from other nuclear missile powers. On the other hand, small nuclear powers interested in nuclear weapons as instruments of terrorism may not rely on ballistic missiles as delivery vehicles, but might use, for example, small aircraft or boats to smuggle their weapons into superpower territory. For the near future, however, it is the Soviets, not we, who face Chinese, French, and British nuclear missiles. From the point of view of U.S. allies Britain and France, Soviet BMD could degrade the credibility of their own nuclear deterrent forces. If, on the other hand, the United States were able to provide them with effective missile defenses of their own, they might or might not consider that to be a fair trade.

Yet another benefit of even limited nationwide BMD capabilities would be the probable interception of accidental or unauthorized launches of very few ballistic missiles.

Level 2: Either/Or

(Defenses–including BMD and air defense —able to ensure the survival of most land-based ICBMs or a high degree of urban survival against a follow-on or simultaneous attack, but not both.) If the United States and the Soviet Union both had this level of defense capability, both Soviet and U.S. strategic planners would face still greater uncertainties. For example, in planning a first strike on the United States, the Soviets would have to consider not only how the U.S. ICBM silos might be defended, but also how U.S. defenses might be allocated between silo (and other military target) defense and city defense. They would have to be careful to retain sufficient offensive capability to threaten many U.S. cities after they had attacked U.S. silos.

A Soviet first strike followed by a U.S. retaliation could have a wide range of outcomes. The Soviets would have little ability to determine in advance what the actual outcome would be. Depending on how the United States had allocated its defenses and how the Soviets allocated their offenses, the Soviet strike might destroy nearly all, some, or virtually none of the U.S. land-based ICBM force. As a result, a U.S. retaliatory attack, on the other hand, might or might not be large and well-coordinated enough to penetrate Soviet defenses. Depending on how one measures ‘‘success’ in a nuclear strike, the Soviets might emerge “better” or “worse” off than they would have been if neither side had had defenses. However, at this level, a significant and extremely dangerous possibility is that the Soviets might calculate that a first strike against U.S. retaliatory forces combined with Soviet defenses could keep damage from a U.S. retaliatory strike to a relatively low level. If the Soviets similarly calculated that the United States could strike first and defend successfully against their retaliation, that would be an additional incentive for the Soviets to attack preemptively.

The very wide range of possible outcomes of a strategic nuclear war under these circumstances, and the difficulty of predicting which might occur, should reinforce military conservatism on both sides. But, particularly during a crisis, as the uncertainties of striking first go up, so do the potential gains, in terms of reducing the other side’s ability to retaliate. And, perhaps more important, the potential risks of waiting for the other side to go first also increase.

Level 3: Defense of Most ICBMs, Plus Some Cities

(Ballistic missile and air defenses that could unconditionally deny the Soviets the ability to destroy most U.S. land-based ICBMs in their silos but could not deny them the ability to destroy many U.S. cities if all their offenses were concentrated on cities). At this level of defense capability on both sides, neither the Soviets nor the United States could have confidence in almost any plausible plan for attacking military targets, no matter how they allocated their warheads.[12] Both sides

[12]Some might argue, though, that several hundred or a thousand nuclear weapons reaching key strategic command and con-

would still be able to do considerable damage to many "soft" civilian or military targets (though perhaps markedly less than if neither had defenses"), but each would have to expect comparable retaliatory destruction imposed by the other. Soviet decisions to challenge U.S. interests would not be reinforced by any possibility that the Soviets could improve their military position by a preemptive strike on U.S. offensive forces.

At this high level of defense capability, both sides would also want very capable air defense systems, in order to deny any attempts to accomplish significant military ends with nuclear weapons delivered by bomber or cruise missile. Substantial civil defense capabilities might further reduce the level of casualties predicted.

At a such high level of BMD capability on both sides, the Soviets might also perceive a reduced risk that conventional or tactical nuclear war would escalate to strategic nuclear war. Insofar as the risk of escalation to nuclear war had discouraged the Soviets from aggressive acts, they might now be more tempted to use or threaten to use military force. On the other hand, U.S. leaders might be more willing to commit conventional or tactical nuclear forces to block Soviet aggression if they believed that escalation to a war that would damage U.S. territory were unlikely. "

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trol nodes would be a plausible military accomplishment. But if sufficient survivability measures had been incorporated in the command and control system, weapons penetrating the BMD system might not accomplish much.

[13]Some might argue, though, that several hundred nuclear weapons reaching cities would be comparable in horror to several thousand.

lt should be noted that some policy analysts believe that the United States relies too much on the extended deterrence thought to be provided by nuclear weapons. In their view, more emphasis should be placed on conventional forces adequate to repel aggression as the primary means of deterring threats or aggression. Some holding this view believe that nuclear weapons should be used only to deter the use of nuclear weapons by threatening punishment. In this latter view, any nuclear first-strike attack by either the Soviet Union or the United State, assuming either current levels of nuclear delivery capability or much lower levels, would be irrational because the cost would be out of proportion to any conceivable gain. In other words–again, in this view—there is already little or no military utility to nuclear weapons, and ideas of "nuclear war-fighting" are unrealistic. Thus BMD deployment at "Level 3" would have no significant value for U.S. national security.

Level 4: Extremely Capable

(Defenses that would permit the Soviets to destroy few or no U.S. targets; they might be able destroy some U.S. cities, but their military planners could not have confidence in their ability to do so). The previous hypothesized levels of defense capability all retain a key element–many say the key element–of today's situation: the threat of massive nuclear destruction should the Soviets attack us. At this high level of capability, however, denial of Soviet ability to inflict damage on the United States would supplant retaliation as the key element of U.S. security. The survival of U.S. society as a whole would no longer depend on the *rationality* of Soviet decisions, but on the *inability* of the Soviet Union to inflict mortal damage upon us. If we believed that the Soviets had virtually no chance of delivering any nuclear weapons at all on U.S. cities or those of our allies, we might do away altogether with threats of retaliation. If, on the other hand, we believed that there was at least some risk of their being able and willing to do so, we might want to retain some residual (albeit low-confidence) retaliatory capability.

In either case, the threat of nuclear retaliation would play a much smaller role in U.S. security policy than it does today. As the Administration's long-range scenario for the Strategic Defense Initiative implies, this level of protection could probably only be reached by a combination of defense deployments and negotiated deep reductions of offenses. The principle of "extended deterrence" would have been abandoned, but in an international climate in which the superpowers had negotiated vast reductions in their nuclear offensive capabilities toward one another, they might also be able to negotiate reductions in the conventional and nuclear threats to U.S. allies. We return below to the question of BMD and arms control negotiations, as well as to questions of technical feasibility and cost.

Criterion 2: Crisis Stability

The deployment of BMD should not increase incentives to launch a strategic nuclear first strike in a crisis situation. Preferably, such incentives should be decreased. The motive for a Soviet decision to escalate a crisis to a central nuclear war might not be to gain a clear political or military objective: instead, it may be to reduce what they fear could be a severe loss.[15] In time of crisis we would not want the Soviet leadership to calculate that its least bad option was to start a nuclear war. We would not want our own force posture to lead them to believe either that they could gain in some way by striking first or that the United States would be likely to preempt. (The issue is not whether U.S. policy would actually allow a preemptive U.S. attack, but whether the Soviets might fear that possibility.)

No Additional Strategic Defense.—Those who believe that vulnerability of the U.S. land-based ICBM force and U.S. command and control facilities might offer the Soviets an incentive to launch a preemptive nuclear attack see this vulnerability as crisis-destabilizing. It is also possible that the growing accuracy of U.S. missile warheads that could attack Soviet missiles might induce the Soviets to believe they must "use or lose' their vulnerable weapons under some circumstances.

Others argue that current crisis stability is relatively high and likely to remain so as long as both sides continue to maintain thousands of relatively survivable warheads on submarines and bombers.

Level 1: Some ICBMs.–Insofar as ICBM vulnerability is a destabilizing factor, the ability on both sides to defend some ICBMs should be crisis-stabilizing. Again, if protection of retaliatory capabilities were the only goal for a BMD system, it should be compared in cost-effectiveness to other means of achieving the same end. On the other hand, those who see crisis stability as high and likely to remain so are likely to view defense of ICBMs as unnecessary for that purpose.

Level 2: Either/Or.–(Defenses–including BMD and air defense—able to ensure the survival of most land-based ICBMs or a high degree of urban survival against a follow-on (or simultaneous attack), but not both.)

As indicated above, there would be a far more serious potential for crisis instability if both sides had a "Level 2" strategic defense capability. That the Soviets would be less certain that an attack on U.S. ICBMs would succeed ought to be a stabilizing factor. On the other hand, at "Level 2" there would be at least the possibility-not previously available—that a first strike combined with defenses could keep damage from a retaliatory strike to a relatively low level. Worst of all, it is possible that both sides could arrive at a highly unstable situation in which each might perceive a chance of assuring its own survival by striking first, and only by striking first.

Level 3: Most ICBMs, Some Cities.—If both sides had ballistic missile and air defenses that could unconditionally deny the other side the ability to destroy most U.S. land-based ICBMs in their silos, but could not deny them the ability to destroy many of one's cities if all the offenses were concentrated on cities, *crisis* stability should be quite high. The advantages of attacking first should be marginal, the threat of retaliatory destruction still substantial.

Level 4: Extremely Capable.–At a level of defense at which few or no military targets and few or no cities could be destroyed, a strategic nuclear crisis would seem to be out of the question. An aggressor calculating that he might in some way deliver a few weapons on enemy territory would have to contend with the risk that the victim could retaliate on a similar level. Nor could a first strike do anything to reduce such residual retaliatory capabilities.

Importance to Crisis Stability of BMD System Survivability

One criterion for a BMD system which many Administration officials have cited is system survivability-the ability of the sys-

[15]Many factors would go into a decision to escalate a crisis to strategic nuclear war. Calculations about the likelihood that the other side might launch a preemptive attack and about the disadvantages of waiting for it to do so would be only one set of such decision factors. In this report we treat only the even more limited question of how BMD (or its absence) might affect such calculations.

tern to perform at desired levels despite direct attack on its components. We may take it for granted that neither side would bother to deploy a BMD system which could obviously be rendered ineffective by enemy attack. Rather, the question would be about the degrees of confidence on each side regarding the continuing survivability of its own and the other side's defensive systems.

If one side or the other had a BMD system that was itself vulnerable, preemption would leave the attacked side defenseless and the attacker at least partially defended against retaliation-even if the victim of attack launched ICBMs before they could be destroyed.

If both sides had vulnerable BMD systems, the net result of simultaneous successful attacks on both systems could be to leave the two sides in an offensive stand-off similar to the one existing now. However, an extremely unstable situation would arise if each sides's space-based BMD system were vulnerable to attack, but only from the other's BMD system. Each would have powerful incentives to "use or lose" his system, to attack before the other side did. The one that struck first might substantially disarm the other side.

Criterion 3: Arms Race Stability and Arms Control

Related to, but separate from, the issue of crisis stability is the issue of arms race stability. What incentives would BMD deployment by one side offer the other to agree to negotiate arms control measures limiting or reducing those forces? On the other hand, what incentives would BMD deployment by one side offer to the other side to increase its offensive or defensive forces in a way which would induce the first side to further increase its own forces?

There is a degree of paradox associated with the uncertainties that BMD deployment could introduce in the calculations of the two sides. On the one hand, increased uncertainty about the likelihood of successful attacks could increase crisis stability by making the aggressor less willing to gamble on a favorable outcome from a first strike. On the other hand, in the face of growing uncertainty about the effectiveness of its military forces, each side will have an incentive to try to reduce that uncertainty by deploying additional offensive and defensive weapons and countermeasures.

BMD deployments at any level would be much less likely to destabilize the strategic nuclear competition if they could be coordinated in advance by explicit agreement between the United States and the Soviet Union. If the Soviets could be persuaded that U.S. defenses hold the potential for rendering offenses obsolescent by making them less and less able to reach their targets, then the Soviets might have an increased incentive to try to negotiate mutual reduction of U.S. and Soviet offenses. Moreover, if both sides could agree for other reasons on the desirability of reducing offenses and increasing defenses, then the incentive of a favorable "cost-exchange ratio" of defenses over offenses would not be necessary. Or, to put it another way, a favorable ratio could be negotiated: decreasing offenses would make defenses more effective. A "race" between offenses and defenses would be circumvented.

An arms control agreement for phasing in BMD would have to establish acceptable levels and types of offensive and defensive capabilities for each side and means for verifying them adequately. It would have to specify offensive system limitations that prevented either side from obtaining a superior capability to penetrate the other's defenses. It would have to specify the BMD system designs for each side that would not exceed the BMD capabilities agreed to. It is important to note, however, that no one has as yet specified in any detail just how such an arms control agreement could be formulated.

Without such an agreement, as the United States and the Soviet Union began to deploy BMD, each might easily suspect the other of attempting to gain military advantage by seeking the ability to destroy most of the opponent's land-based missiles and then use defenses to keep retaliatory damage to a very low level. If either side feared that its retaliatory capabilities were about to be lost or greatly reduced relative to those of the other side, there would be an incentive to add offensive capabilities and defensive capabilities at the same time. Those additions, in turn, could look to the other side like the pursuit of a "first-strike capability" and stimulate further reactive offensive and defensive deployments. The potential interactions could be extremely complex, depending as they would on the actual deployments made by each side, the effectiveness of those deployments as perceived by the other side, and the future deployments each side anticipated that the other would make. Land-based ICBMs, sea-based SCBMs, bombers, cruise missiles, and air defenses would all affect strategic stability—positively or negatively.

We do not yet know at what point the Soviets might decide that their best chance of avoiding military inferiority was to abandon their offense and stress defense. Would they do so after calculating in *advance* that offensive responses would be economically futile, or only after a considerable acceleration of the strategic arms competition had *proved* the fact through experience? Thus far, they have repeatedly declared that their reaction to the SDI will be to augment their offensive forces and pursue countermeasures. Most observers seem to believe that these (along with Soviet BMD deployments) are the most likely initial Soviet reaction to possible U.S. BMD deployments. [16]

But there is much disagreement about when, if ever, the Soviets might reverse their decision and agree to deep offensive reductions. Some argue, for example, that even if increments of offense were more expensive than corresponding increments of defense, the Soviets would still add offenses. In the long run, of course, if the United States stayed in such an arms race, the Soviets would find themselves with declining offensive capabilities. But, for the near term before any BMD deployment, if the Soviets perceive the likelihood of U.S. BMD deployment later on, then they are likely to remain unwilling to agree to offensive arms reductions.

Criterion 4: Diplomatic Stability

Relations with other nations benefit from a degree of mutual understanding of each other's intentions and from some predictability of action. While it is clear that many kinds of military deployments will affect our international relationships, we would do well to try to introduce changes in ways that minimize adverse effects on our overall relations with foreign nations.

The deployment of BMD would have significant effects, positive or negative, on our relations with our allies, with our adversaries, and possibly with other countries. Moreover, the *manner* in which we carried out a deployment decision could also affect our diplomatic relations. As Presidential arms control advisor Paul Nitze pointed out in a speech in London in March 1985,

> President Reagan has made clear that any future decision to deploy new defenses against ballistic missiles would be a matter for negotiation.
>
> This does not mean a Soviet veto over our defense programs; rather, our commitment to negotiation reflects a recognition that we should seek to move forward in a cooperative manner with the Soviets . . .
>
> Before negotiating such a cooperative transition with the Soviet Union, we would consult fully with our allies. "

"Some believe that the Soviets would actually deploy countermeasures to BMD such as penetration aids before increasing already planned levels of offensive weapons. Others believe that in any case the rate of growth of Soviet offensive forces is already so high that prospective US. BMI) deployments would have little effect on that rate. Yet another argument is that since the Soviets have heavily emphasized other forms of strategic defense (e.g., air defense and passiive defenses), they may be more willing than they admit to shift to an emphasis on ballistic missile defenses.

[17]Speech before International Institute for Strategic Studies, op. cit.

The Administration has made a frequently restated commitment to develop defenses that would defend U.S. allies as well as U.S. territory.

Proponents of BMD argue that deployment could enhance U.S. diplomatic relations in at least two ways. First, if U.S. deterrence of a Soviet nuclear attack on the United States were enhanced, our allies should feel more secure about our commitment to fight if they are attacked since it might be less dangerous for us to do so. Second, if their territory were also protected against Soviet missiles, our allies should feel directly more secure from the Soviet threat. This might be especially true if the deployment of BMD led to mutual deep reductions of offensive nuclear forces. Some would argue, however, that even defense of NATO military targets against Soviet missiles would strengthen allied feelings of security by enhancing deterrence of Soviet attack. Third, a new strategic relationship with the Soviets, in which we had negotiated a transition to a "defense dominant" world, might lead to a healthier relationship both between the United States and its allies and between the Western allies and the Soviet bloc. As Paul Nitze put it,

> Clearly, were we able to move cooperatively with the Soviet Union toward a nuclear-free world, that would presuppose a more cooperative overall relationship than exists at present–one in which efforts to establish a conventional balance at lower levels should be fruitful.[18]

On the other hand, skeptics about the diplomatic promise of BMD make the following sorts of predictions:

- The likely Soviet response to U.S. BMD deployment, prospective and actual, would be to add offense rather than negotiate offensive reductions; thus, the idea of a negotiated transition to a safer world or indeed of any offensive arms reductions at all in the context of BMD deployments is probably unrealistic.
- If a "defense dominant" situation had made escalation of conflict to nuclear war between the United States and the Soviet Union much less likely, most of the effects of U.S. "extended deterrence" would be lost. Either the likelihood of Soviet conventional aggression might increase, or large additions to Western conventional forces might be necessary, or both.
- European allies of the United States may correctly believe that BMD cannot protect them as well as it could the United States, particularly in view of their proximity to Warsaw Pact territory and the variety of shorter-range nuclear delivery means available to the Soviets; thus, they may see U.S. and Soviet BMD as tending to decouple their defense from that of the United States and, conceivably, make Europe a "safer" sphere of conflict for the Soviets.
- Soviet BMD might render the British and French nuclear deterrent forces ineffective, thus leading those allies to oppose the U.S. initiative in upsetting the strategic equation.
- Many national leaders see the ABM Treaty as the keystone of East-West arms control; if the United States leads the way to abandonment of that Treaty regime, U.S. allies may question whether the United States is serious about arms control and may seek to distance themselves from the United States. In addition, signatories to the 1970 Nuclear Non-Proliferation Treaty may also see U.S. and Soviet abandonment of the ABM Treaty as abandonment of the arms control process (a process the nuclear powers committed themselves to in the 1970 treaty) and be more inclined to develop their own nuclear weapons.

Criterion 5: Feasibility

There are two important levels of technical feasibility. First, it must be feasible to apply the technologies under consideration in working components of a BMD system. Second, it must be feasible to make the components work together effectively as an operational *system* in the face of attempts of the adversary to overcome that system.

[18] 1 bid., p. 6.

General Issues

Whether new ballistic missile defense technologies could lead to the kind of defense we would want depends both on the potential of the technologies and on the kind of defense we would want.

- Levels of BMD performance intended to enhance deterrence by increasing the uncertainty of the Soviets as they calculate the risks and benefits of a strike on U.S. ICBM silos and command and control facilities might be attained with technologies now fairly well-understood.
- Levels of BMD performance intended to assure complete denial of military objectives (such as destruction of most U.S. missile silos) to Soviet ballistic missiles would require major technological advances.
- Levels of BMD performance intended to offer substantial protection to U.S. cities and other "soft" targets against nuclear attack would require still more extensive advances. These higher levels of BMD capability (such as clearly denying military utility to ballistic missiles or substantially protecting cities) will almost surely require a multi-layered, multi-weapon BMD system. Therefore, lower levels of BMD capability might be attained if a few technical developments prove fruitful, while higher levels will require that more key technologies become available together.
- A strategic defense which could assure the survival of all or nearly all U.S. cities in the face of unconstrained Soviet nuclear offensive forces (missiles, bombers, cruise missiles, other means of attack) does not appear feasible. As we have seen, current Administration policy envisages pursing the goal of assured survival through a combination of defensive weapons and negotiated deep reduction of Soviet and U.S. offensive weapons.

A wide variety of technologies could, in principle, be developed to produce components for a multi-tiered ballistic missile defense system. Candidate technologies for kill mechanisms include various types of lasers, kinetic energy vehicles (self-propelled or projectile), and particle beams. No known physical law stands in the way of developing such components and assembling them into a layered system intended to intercept ballistic missiles and their warheads in the boost-phase, the post-boost (reentry vehicle separation) phase, the midcourse, and the reentry phase. Physical laws do limit the potential performance of some kinds of components, however. For example, neutral particle beams cannot penetrate the atmosphere, and thus could not intercept missiles while they were still in the atmosphere.

For most of the new ballistic missile defense technologies, much research is still necessary to determine whether the physical principles involved can be affordably applied in working weapon systems. Many of the technologies being considered for BMD still require improvements in performance of orders of magnitude (factors of ten) before they can be used in weapons. Systems for boost phase, post-boost phase, and midcourse BMD are likely to require many satellites in orbit, satellites which must be highly reliable while relatively inaccessible to maintenance.[19]

Massive improvements in computer speed, reliability, durability in a hostile environment, and software capabilities would be required. Current research gives cause for some optimism about meeting the hardware requirements, though most analysts agree that generating the necessary software would be a monumental task.

Space-based BMD systems would require a much more capable space transportation system than the United States now has, and would probably require a substantial lowering of space launch costs. This requirement would be less stringent, however, in the case of systems employing ground-based lasers.

Another issue is the susceptibility of sensors to defeat by various countermeasures. Their

[19] However, some system designs might require fewer than others. For example, those using ground-based lasers, or those using weapons "popped up" from the ground, would require fewer satellites than those using entirely space-based weapons.

sensitive nature, necessary for long distance detection, makes them vulnerable to various kinds of temporary or permanent blinding. They would have to be designed to operate against a background of nuclear explosions. Making decoys look like targets and making targets look like decoys may spoof sensor systems. Space-basing makes the the sensors potentially vulnerable to antisatellite weapon attack.

For all space-based BMD system components, survivability against directed energy, nuclear, or kinetic energy weapon attack is a major issue. For example, space mines might be planted to tail sensor satellites or battle stations. As the companion OTA report, *Anti-Satellite Weapons, Countermeasures, and Arms Control*, indicates, there are many potentially effective means of interfering with or destroying space systems, as well as many potential countermeasures for dealing with those means. Whether the means of protecting satellites will be adequate to ensure the survivability of particular space-based BMD systems will depend in part on the kind of system deployed[20] and in part on future Soviet antisatellite capabilities. Insufficient information is now available to resolve the survivability question.

The Soviet Union will have about as long to develop offensive countermeasures to defensive systems as the United States does to develop the defensive systems, and vice-versa. No one can confidently predict today whether defensive technologies will dominate offensive delivery technologies in the future. It is clear that a U.S. BMD research program should devote considerable effort to exploring BMD countermeasures, both to determine whether defense at the desired level of effectiveness is feasible and affordable, and to hedge against Soviet BMD advances.

‘For example, many sensors, redundantly distributed among numerous satellites in a variety of orbits, could increase overall system survivability.

Components and Systems

In the absence of officially proposed BMD architectures (system designs) and in the absence of specific weapon designs, it is impossible to estimate BMD feasibility and costs. The Strategic Defense Initiative Program is charged with doing research to find out whether current technologies can be scaled up to the necessary performance levels and then whether they can be applied in engineering effective, reliable, and affordable weapons. How much Congress will choose to invest in this research program will depend in part on its judgment about the benefits and risks considered in this report and on its beliefs in the premises and predictions of differing policy advocates.

It is possible, however, to give a general conception of the likely ultimate feasibility and costs by conveying a feeling for the requisite scale of a highly capable, multi-layered BMD system. OTA has postulated a BMD system architecture purely as an illustration of the kinds of tasks involved in deploying a very ambitious BMD system. We definitely do not predict that the example we have hypothesized will ever be proposed or built, nor do we assert that the technologies assumed for it are more or less promising than any others. The example is given (see table l-l) to illustrate that deploying a large-scale, multi-tiered BMD system would be a formidable, complex, and expensive job.

A highly capable BMD system designed along the lines of our postulated example would pose the following challenging requirements:

- A boost-phase defensive layer effective in the face of proliferation and countermeasures. The boost phase interception of ballistic missiles must be highly effective to keep the tasks of the succeeding defensive layers manageable. Soviet deployment of many additional rocket boosters appears possible in the very near term. Rocket boosters which finish burning very quickly and upper stages which dispense their separate reentry vehicles very rapidly appear feasible to deploy in significantly less

Table 1-1.—Hypothetical Multi-Layered BMD System

System level	System elements	Description	Comments
Level 1 Terminal Defense (defense of hardened sites using endoatmospherlc rockets to Intercept reentry vehicles (RVs) as they approach their targets)	Early warning satellites, ground-based radar: airborne optical sensors ground-based battle management computers. fast endoatmospheric Interceptors.	Warning of launch provided by high-orbit satellites RVs detected and tracked in region of ground targets by ground radar and airborne sensors, ground computers assign Interceptors to RVs, kill assessment permits reassignment of defense interceptors; atmospheric Interception used, air effects used to discriminate between RVs and decoys	Homing either infrared (IR) or radar, interceptors should be relatively inexpensive, since many needed, may be nuclear or nonnuclear
Level 2 Light Midcourse and Terminal Defense (addltlonal layer added with some interceptlon capability in midcourse and some ability to discriminate RVs from decoys in space to reduce burden on terminal layer, some area defense)	Level 1 plus exoatmospheric homing Interceptors, range hundreds of km; pop-up[b] IR sensors (possibly satellite-based Instead), self-defense capability for space assets.	As in level 1 for terminal defenses: longer range Interceptors added which can Intercept some RVs above atmosphere, providing some area defense, this requires some discrimination capability, furnished by passive IR pop-up sensors, launched towards cloud of decoys and attacking RVs; the new layer reduces the burden on the terminal layer	Passive IR sensors used for crude discrimination and possibly kill assessment: data base of Soviet RV and decoy signatures needed, sensors must be able to function in a hostile nuclear environment.
Level 3 Heavier Midcourse Layer (effective midcourse layer added, giving realistic two-layer system, with each layer highly effective)	Level 2 plus' ultraviolet laser radar (ladar) imaging on satellites; highly capable space-based battle management system; space-based kinetic energy weapons, effective self-defense in space: significant space-based power.	Satellite-based ultraviolet laser radar (ladar) used to image objects; discrimination provided by comparing images with data base of Soviet RV and decoy characteristics, RVs attacked by in-orbit kinetic-energy weapons, which also defend all space-based components of system; this level has fully developed terminal and midcourse layers, but no boost or post-boost phase defense.	Ladar imaging rapid with resolution good to 1 meter or less for adequate discrimination and birth-to-death tracking of RVs, kinetic weapon homing capability good to less than a meter
Level 4 Boost-Phase Plus Previous Layers (boost-phase Intercept added to kill boosters or post-boost vehicles before RVs and decoys dispersed)	Level 3 plus: ground-based high-tntensity lasers (either excimer or free electron); space-based mirrors for relay and aim; high resolution tracking and Imaging in boost phase; self-defense for all phases	This level adds a boost- and post-boost-phase layer, consisting of very bright ground-based laser beams directed to their targets by orbiting mirrors; sensing by infrared sensors, imaging by ultra-violet ladar: battle management to handle all layers doinq discrimination, kill-assessment, and target assignments and reassignments. Boost- and post-boost-phase layers may be combined, since post-boost phase could be shortened to 10 seconds or so.	Extremely capable battle management system needed; kill assessment required for boost phase as well as midcourse
Level 5 Extremely Effective Layer (Level 4 with better capability; meant to permit only minimal penetration to targets by enemy RVs)	Level 4 plus: more terminal and exoatmospheric interceptors; electromagnetic launchers for midcourse and boost-phase intercepts: large capacity space-based power; all systems extremely reliable.	More interceptors are added in terminal and midcourse layers; electromagnetic launchers used for boost, post-boost and midcourse intercepts; high capacity space power needed; all systems, including battle management must be extremely reliable.	Essentially same as Level 4, but more of it and higher reliability; newer technologies used as they become available.

[a]Kill assessment refers to the process of determining whether a struck target has been effectively disabled
[b]pop-up components are ground-based assets which are launched into space for action upon warning of an enemy attack

SOURCE: Office of Technology Assessment.

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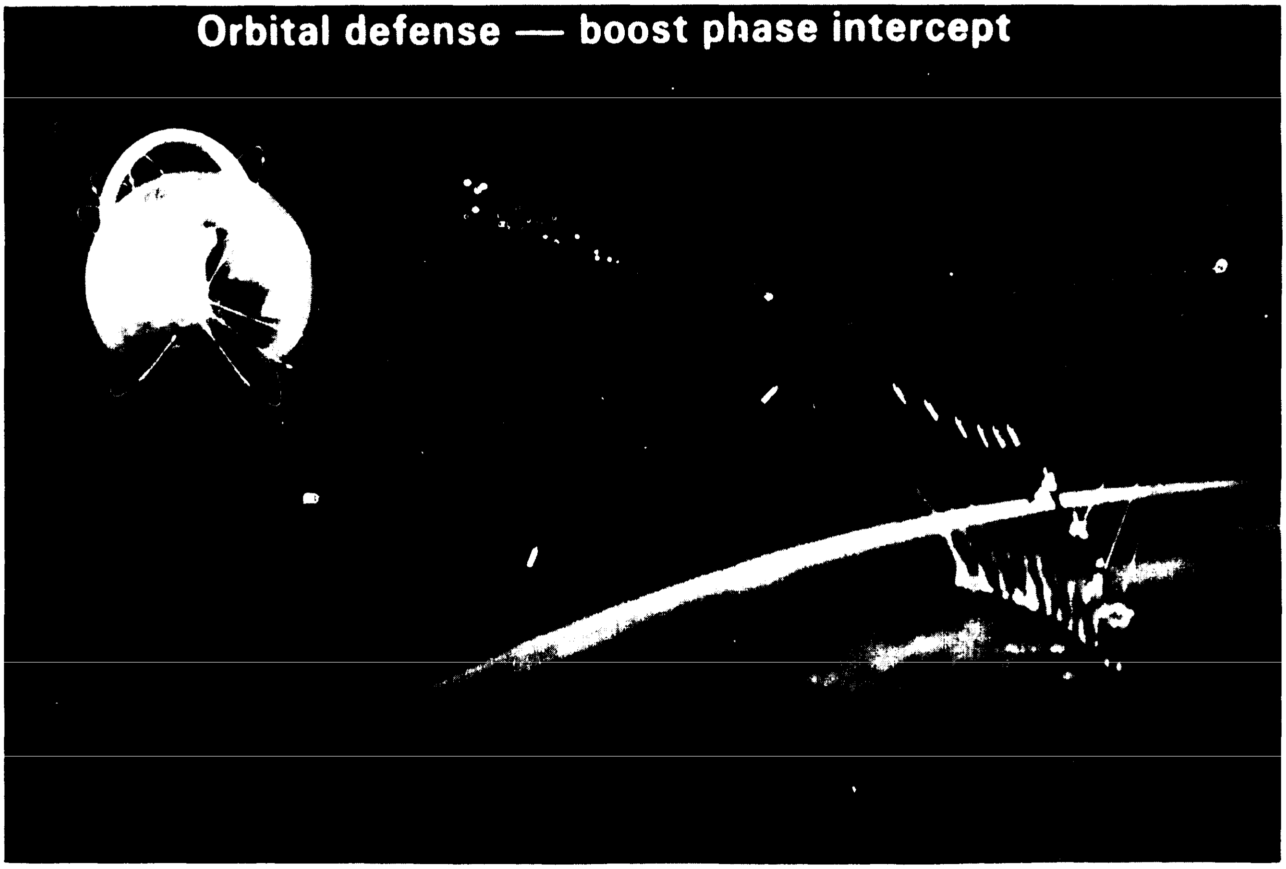
time than the defensive systems they would be designed to counter. Boost-phase defenses need to be effective against both.

- Sensors and computers able to discriminate rapidly between decoys and reentry vehicles in the midcourse phase (as the objects separate from the post-boost vehicles, and before they reenter the atmosphere). Techniques now fairly well understood for making reentry vehicles and decoys "look" like one another to various sensor systems will make target discrimination one of the most challenging tasks for midcourse interception systems.
- Sensors that can function nearly continuously under attack and against a background of nuclear detonations.
- A system of battle management computers and software of very high complexity. A control system will be required to be able to track thousands-possibly hundreds of thousands-of objects simultaneously, assign weapons to attack the correct targets, account for targets destroyed, and assign other weapons to missed targets. This task will require extremely large, complex computer programs of very high reliability.
- Communications links among sensors, battle management centers, and weapons that can function reliably in the face of jamming attempts, attack, and interference from nuclear detonations.
- Space-based power supply systems, each of ten or more megawatts, with high reliability, quick response, and affordable maintainability.
- Means of protecting space-based BMD assets from a wide range of possible means of attack.
- Ground-based exoatmospheric (late midcourse layer) interceptors that are inexpensive because they must be numerous.
- Ground-based interceptors for the final (terminal) layer that are-inexpensive because they must be numerous.

Not only do issues of technological feasibility need to be resolved, but so do issues of operational feasibility. That is, the developed components must be combined into an integrated, reliable system that could operate effectively and maintain that effectiveness over time as new countermeasures appeared. Such a system could never be fully tested operationally-as indeed strategic offensive nuclear systems have never been. But we would want to have high confidence in the effectiveness of a defensive system to consider steep reductions in our offensive retaliatory forces.

Criterion 6: Cost

Another part of the decision about investment in BMD research depends on a weighing of potential benefits and risks against ultimate costs. If some of the research can lead only to the demonstration of the technical feasibility of systems so costly that the nation would never want or be able to pay for them, then the decision on whether to do the research would be different than if the expected costs



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were commensurate with the expected benefits. Everyone can agree that a multi-tiered BMD system with significant space basing would be very expensive, but how expensive depends on many unknowns.

Besides illustrating the need for the kinds of technical developments described under Criterion 5, examination of our hypothetical system also indicates how the presence of so many unknown factors makes realistic cost estimates impossible now. It does not demonstrate that deploying a large-scale BMD system would be either affordable or too costly. However, the burden of proof is on those who maintain that BMD can be affordable and display a favorable cost/exchange ratio with offenses to provide credible estimates of eventual system costs.

Important issues of cost include the following:

- Allocation of Defense Department research funds. The first six years of the Strategic Defense Initiative are scheduled to consume a total of approximately $33 billion in defense research funds. Succeeding years before a development decision may bring yet higher annual costs. These should be weighed against opportunity costs in other areas of defense research.
- Allocation of national technical research re-

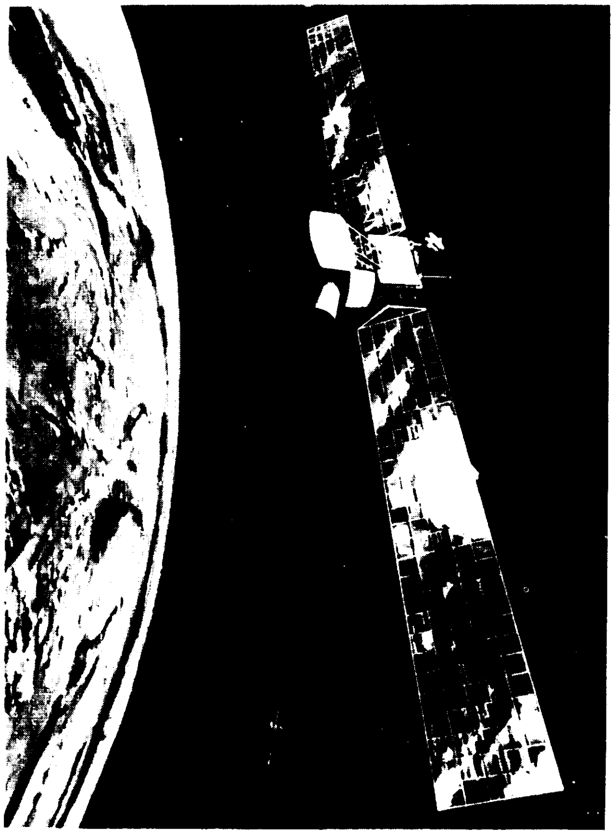

Photo credit: U.S. Department of Defense

Artist's conception of space-based sensors on a surveillance and tracking satellite.

sources. The supply of specialized scientists, engineers, and research facilities is not highly elastic in the short term. BMD research would divert some of these national resources from other important tasks. On the other hand, BMD research might produce substantial "spin-off" results which could lead to advances in technologies applicable to other civilian or military purposes. Over the long term, the research might also stimulate training of additional scientists and engineers.

- Allocation of military procurement funds. BMD procurement could absorb funds needed for other military programs, such as ground, naval, or air forces. On the other hand, under some scenarios, BMD might reduce the need for expenditures on offensive nuclear forces and even on conventional forces.
- Allocation of industrial resources. In the procurement stage, BMD deployment might divert engineering and manufacturing resources from other production. On the other hand, it might contribute to an industrial base for other activities, such as commercial development of space.
- Total costs. The total system costs for BMD will remain difficult to predict for some time. Also difficult to determine are the potential effects of BMD on other U.S. military needs. For example, a BMD deployment which led to negotiation of deep reductions in offensive forces would eventually allow shifting expenditures away from strategic offenses. In the short run, however, until the cost-exchange ratios in the offense-defense competition on both sides became clear, *increased* expenditures might be required to maintain offensive forces on a par with those of the Soviet Union.

Defenses intended to protect substantial parts of the United States' and its allies' populations would also require a highly capable air defense system, since making ballistic missiles obsolete would not in itself suffice to assure population survival. Effective population defense might also be judged to require large civil defense expenditures as a complement to the active missile and air defenses.

A change in U.S. strategy which placed greater emphasis on non-nuclear capabilities for deterring aggression against U.S. allies might require costly enhancements of our air, sea, and land conventional forces and those of our allies. An alternative, however, which could reduce rather than increase the cost of such forces might be substantial conventional arms control, particularly in the NATO-Warsaw Pact arena.

We referred earlier to the concept of the "cost-exchange ratio" between defense and offense. That is, increments of defense should cost less than the corresponding increments of offense that they must neutralize. If so, then the offense would have a strong disincentive to try to keep up with the defense. We also need to estimate at what point the Soviets would decide to concede such a reality and stop trying to maintain offensive capabilities. However, a favorable cost-exchange ratio would not suffice if the defense system as a whole were too expensive to deploy. One goal of research should be to identify a BMD system whose base cost and cost-exchange ratio with offenses was such that the combined cost of overcoming existing Soviet offenses and countering their response to our defenses was affordable. Just what the cost-exchange ratio needs to be would depend on how willing the Soviets might be to try to outspend us to maintain their offensive capabilities.

CONCLUDING REMARKS

Debated Issues

The question of the role of ballistic missile defense in U.S. national security is complex. However, national debate has tended to polarize between support of and opposition to the SDI.

Both proponents and opponents agree on two major points:

- The United States should adopt whatever BMD posture will be most likely to minimize the risk of nuclear war.
- The United States should be carrying out some research on BMD technology.

The strongest disagreements regarding SD I center on two related issues:

- How likely is it that technology will reach a point where it would be desirable to deploy BMD? This disagreement partly reflects differing guesses about the future cost and rate of technological progress. More significantly, however, it reflects differing views about how valuable BMD would be for our national security, and how effective a BMD system must be for the benefits of deployment to outweigh the risks.
- Should the research program be carried out with the vigorous commitment that characterizes the SDI? The central idea of the SDI seems to be an ardent belief that a program of urgent, centrally directed, and generously funded research and development would have a good probability of bringing us within a few years to the point where we would be justified in deciding to deploy a high-technology ballistic missile defense system. The central concern of SD I opponents, apart from skepticism that such a system could be effective and affordable, is that the technology development may be much more likely to destabilize the superpower strategic balance and set off an arms race than to justify a decision to deploy. For this reason they favor a less urgent, less expensive, and less prominent research program, mainly to hedge against unexpected technological breakthroughs and as a means of deterring the Soviets from abandoning the ABM Treaty by providing the United States with an adequate response if they do.

Proponents of SDI are not all of one mind. However, they stress some or all of the following:

1. *The most important national goal we can have is assured survival; that is, President Reagan goal of a world in which "free people could live secure in the knowledge that their security did not depend on the threat of instant retaliation to deter a Soviet attack, that we could intercept and destroy strategic ballistic missiles before they reach our soil or that of our allies.* " This goal may be attainable, particularly if the development of defenses induces the Soviets to agree on reductions of offensive forces, and therefore it is worth pursuing vigorously.
2. *Even if we cannot achieve assured survival, a strategic policy that relies to a significant extent on strategic defenses would be better for the United States*

than our existing policy of deterring aggression only by the threat of retaliation by our offensive nuclear forces.

3. *The strategic balance has gradually been shifting against the United States, and developing and deploying ballistic missile defenses (with or without accompanying arms control measures limiting strategic offensive forces) offers the best opportunity to reverse this trend.*
4. *Many of the new ideas proposed for ballistic missile defense are now ripe for intensive research and development.* If the United States develops these technologies vigorously, we can expect major improvements in potential BMD capabilities. There are grounds for believing that defensive technologies may improve so much faster than offensive technologies that it will become cheaper to deploy defenses than to deploy offensive countermeasures to overcome the defenses. This would give the Soviets a powerful incentive to agree to reduce offensive arms and concentrate on building their own defensive systems. If the Soviets exploited these BMD technologies and we did not, our security might be severely jeopardized.

Opponents of SDI argue some or all of the following:

1. *Assured survival is so extremely improbable in the forseeable future as to be irrelevant as a national goal.* If it could be attained at all, it would require drastic reductions and stringent limitations of all offensive nuclear arms even if very effective defenses could be deployed. But since the vigorous pursuit of defensive capabilities now would make such offensive arms control much less likely to be attained, we should pursue offensive arms control first and defensive deployments afterwards, if at all.
2. *Ballistic missile defenses that are highly effective, but not adequate to provide assured survival, could create dangerous instabilities.* Developing them would set off an offensive/defensive arms race. Furthermore, defensive deployments could provide great incentives to preempt in a crisis by holding out the possibility of "victory" to the side launching a massive first strike and defending against the presumably less effective retaliatory second strike. If deployed BMD systems were themselves vulnerable to attack, the incentive to strike first could be even greater.
3. *The buildup of Soviet strategic forces in recent years, while certainly undesirable, has not reduced the U.S. ability to deter a Soviet attack.* The continuing Soviet buildup does not pose a serious threat to the credibility of our deterrent. A U.S. strategic defense would not improve the strategic balance. Modernization of our strategic forces and vigorous efforts to make the arms control process effective would be far more likely than BMD to improve U.S. security.
4. *While nobody can predict with certainty the results of future research, it is highly unlikely that we could develop BMD systems which could not be overcome by affordable Soviet countermeasures.* Therefore, the SDI is not the most fruitful area in which to concentrate our limited resources for military R & D. While research on BMD is necessary, an overly vigorous U.S. BMD program would be likely to stimulate a buildup of Soviet offensive forces, which would preclude meaningful offensive arms control measures and make it harder to maintain the survivability of our retaliatory forces.

OTA Findings

I.–Both the capability of a BMD system to defend the United States, and the strategic value to the United States of any given BMD capability, depend on the interaction of all the kinds of the defenses actually deployed with all the kinds of offensive threat against which they must actually defend. In the past, the enormous destructive power of nuclear weapons has meant that offensive strategic technologies have had a large and fundamental advantage over defensive technologies. Unless this imbalance between the offense and defense disappears, strategic defenses might be plausible for limited purposes, such as defense of ICBM silos or complication of enemy attack plans, but not for the more ambitious goal of assuring the survival of U.S. society. This imbalance might be changed either by political decisions of both superpowers to reduce the kinds and levels of offensive deployments to capabilities much less than available technology permits, or by development and deployment of defensive systems able to overcome whatever offenses could be developed and deployed in the same period. While it is certainly possible that defensive technological development could outpace the development of offensive weapons and countermeasures to defenses, this does not appear very likely.

2.–Assured survival of the U.S. population appears impossible to achieve if the Soviets are determined to deny it to us. This is because the technical difficulties of protecting cities against an all-out attack can be overcome only if the attack is limited by restraints on the quantity and quality of the attacking forces. The Reagan Administration currently appears to share this assessment.

3.—If the Soviets chose to cooperate in a transition to mutual assured survival, it would probably be necessary to negotiate adequately verifiable arms control agreements on reducing present and restricting future offensive forces and on the manner, effectiveness, and timing of defensive deployments. OTA was unable to find anyone who could propose a plausible agreement for offensive arms reductions and a cooperative transition that could be reached before both the Soviets and the United States learn more about the likely effectiveness and costs of advanced BMD technologies. Indeed, such a transition could hardly be planned until engineering development was well advanced on the actual defensive systems to be deployed. Even then, adequate verification would be difficult. Without such agreement on the nature and timing of a buildup of defensive forces, it would be a radical departure from previous policies for either side to *make* massive reductions in its offensive forces in the face of the risk that the other side's defenses might become highly effective against the reduced offenses before one's own defenses were ready. Such a transition would be more appealing to both sides if BMD technologies could be developed which cost less to deploy than the offensive countermeasures needed to overcome them than it would be if the historic and current advantages of offense over defense persist. In essence, the question is whether a vigorous U.S. program to develop BMD, and the prospect that both sides might deploy effective BMD, will make the Soviets more willing than they have been in the past (or now say they are) to agree to deep reductions of strategic offensive forces on terms acceptable to the United States.

4.—There is great uncertain y about the strategic situation that would arise if BMD deployment took place without agreement between the United States and Soviet Union to reduce offensive forces as defensive forces grew. Until the actual offensive systems (including ICBMs, SLBMs, bombers, and cruise missiles) and defensive systems (including BMD and air defenses) were specified and well understood, no one could know with confidence whether a situation of acute crisis instability (i.e. striking first could appear to lead to "victory") could be avoided. A fear on either side that the other could obtain such a first strike capability could lead both sides to buildup both their offenses and their defenses. Such build-ups would make it even more difficult to negotiate a cooperative transition from offense dominance to defense dominance.

5.–The technology is reasonably well in hand to build a BMD system that could raise significantly the price in nuclear warheads of a Soviet attack on hardened targets in the United States; such a system, if combined with a re-basing of U.S. ICBMs, could protect a substantial fraction of those U.S. land-based missiles against a Soviet first strike. However, it is not clear whether BMD would be the best way to provide missile survivability, nor is it clear whether the combination of a U.S. program protecting ICBMs and the Soviet response--perhaps expansion of their Moscow defense to other Soviet cities—would on balance strengthen or weaken our deterrent.

6.–It is impossible to say at this time how effective an affordable BMD system could be. To answer this question requires extensive research on sensor, command and control, and weapons technologies; and on system architecture (including survivability and computer software); on counter-counter-measures. Credible cost estimates based on this research will also be necessary.

7.–The decision whether to push ahead vigorously with the SDI or to scale back the Administration proposal involves a balancing of opportunities against risks, in the face of considerable uncertainty. The SDI offers an *opportunity* to substantially increase our nation's safety *if we* obtain great technical success and a substantial degree of Soviet cooperation. The argument that sufficiently great U.S. technical success would force the Soviets to cooperate in their own security interests is logically compelling, but there can be no assurance that the Soviets would actually behave as we think they should. The SDI carries a *risk* that a vigorous BMD research program could bring on an offensive and defensive arms race, and a further risk that BMD deployment, if it took place without Soviet cooperation, could create severe instabilities. Whether BMD deployed in the face of intense Soviet efforts to counter it would enhance U.S. security depends on a judgment that decreased Soviet confidence that they could destroy targets in the United States or on allied territory would, in Soviet minds, outweigh their increased confidence that targets in the Soviet Union would survive because of their own BMD.

8.–Whatever type of BMD research program the United States decides to pursue, it would be prudent to carry out that research in such a way as to minimize Soviet incentives to decide to deploy their own BMD beyond the limits set by the ABM Treaty before the United States has completed the research necessary to make our decision. This might be done by unilaterally restraining our BMD research. We would have greater influence over Soviet actions, however, if we reached agreement with the Soviets regarding disputed interpretations of the ABM Treaty-including the boundaries of permitted research-and regarding the conditions under which future BMD deployments would be desirable. Such an agreement would also reduce Soviet incentives to buildup their offensive forces in order to overcome anticipated U.S. defenses. However, it must be recognized that acting to deter a Soviet decision to deploy BMD may require limiting and slowing our own BMD research.